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Environmental management — Examples of environmental performance evaluation (EPE)

Management environnemental — Exemples d'évaluation de la performance environnementale (EPE)

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

In exceptional circumstances, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example), it may decide by a simple majority vote of its participating members to publish a Technical Report. A Technical Report is entirely informative in nature and does not have to be reviewed until the data it provides are considered to be no longer valid or useful.

Attention is drawn to the possibility that some of the elements of this Technical Report may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO/TR 14032 was prepared by Technical Committee ISO/TC 207, *Environmental management*, Subcommittee SC 4, *Environmental performance evaluation*.

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Introduction

This Technical Report is a companion document to ISO 14031:1999 and was developed with the understanding that many organizations would benefit from examples illustrating how environmental performance evaluation (EPE) has been applied by a variety of organizations. Please refer to ISO 14031:1999 for guidance on the process and concepts of EPE.

The purpose of this Technical Report is to provide real-life examples for the consideration of organizations undertaking EPE. The examples aim to encourage and assist organizations, particularly small and medium sized enterprises, by showing how EPE can be conducted by a range of organizations.

The examples provided in this Technical Report were developed and written by organizations or individuals and submitted to ISO/TC 207/SC 4 through appropriate ISO member bodies. These examples have been edited to reflect the process of EPE described in ISO 14031:1999. The reader may not find them to be comprehensive regarding environmental aspects, environmental performance criteria, or number and type of indicators selected, as these are issues determined by each organization according to its particular circumstances.

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Environmental management — Examples of environmental performance evaluation (EPE)

1 Scope

This Technical Report provides examples of EPE that represent a range of applications from simple to elaborate. They also represent a range of organizations (e.g., manufacturing and service companies; non-governmental organizations; government agencies; small, medium and large enterprises; organizations with and without certified environmental management systems) and geographic locations.

IMPORTANT -

The examples in this report are included only because they illustrate the use of EPE.

Value judgements in these examples related to the relative environmental benefits of one material over another, one process over another, or one product over another, reflect decisions made specifically by the management of the organizations in the examples. No endorsement is given by ISO/TC 207/SC 4 to those decisions, to the scientific data used, or to their conformity with other ISO standards.

No endorsement is given by ISO/TC 207/SC 4 to any organization or any organization's products or services.

No organization's particular application of the guidance in ISO 14031 is recommended because the management of each organization has selected the application most suited to its needs. No endorsement is given by ISO/TC 207/SC 4 to the choices made by individual organizations or to the relative merits of these different applications of EPE.

2 Terms and definitions

For the purposes of this Technical Report, the terms and definitions given in ISO 14031 apply.

3 Format for the examples provided in this Technical Report

3.1 General

Examples illustrating EPE and ISO 14031 are provided in Annexes A to Q. The contents of these examples are organized under the headings given in 3.2.

3.2 Headings

3.2.1 Introduction

This section briefly describes the organization and its history. The purpose is to provide:

- a context for understanding how EPE was applied; and
- suitable information for a reader of ISO/TR 14032:1999 to relate his or her own organization to the organization described in the example.

3.2.2 Planning EPE

This section describes how the organization planned its EPE, and can illustrate:

- the identification of environmental aspects;
- the development of environmental performance criteria;
- the consideration of the views of interested parties; and
- other planning activities referenced in ISO 14031:1999.

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3.2.3 Selecting indicators for EPE

This section describes how the organization selected environmental performance indicators (EPIs) related to management efforts (management performance indicators - MPIs) and to the organization's operations (operational performance indicators - OPIs). This section also describes how the organization considered environmental condition indicators (ECIs) in developing its EPE.

3.2.4 Using data and information (if applicable to the example)

This section describes (as appropriate) the following as elements of the EPE process:

- collecting data:
- analyzing and converting data;
- assessing information;
- reporting and communicating.

3.2.5 Reviewing and improving EPE (if applicable to the example)

This section describes how the organization used information to examine the EPE process and to identify opportunities for improvement.

3.2.6 Summary/conclusions

This section includes a summary of any lessons learned by the organization from the application of EPE. It may also include the organization's conclusions on its future application of EPE.

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Annex A

Schreinerei Schmid, Abendsberg, Germany

(A small cabinetry/furniture-making company, with 11 employees, developing environmental performance evaluation to inform critical customers that it is environmentally aware)

Introduction

The Schreinerei Schmid company was established in 1895, and since its establishment has been located in Abendsberg, Germany. There is both housing and other industrial facilities in the vicinity of the workshop. Eleven employees are involved in production and administration, and company has annual sales of approximately one million Deutsche Marks. Since 1995, the company has had an internal environmental information and control system. The company also produced its first environmental report in 1995, with a target audience of the company's environmentally conscious private and corporate customers. In late 1997, the existing environmental management features were broadened to establish an environmental management system for registration under the European Eco-Management and Audit Scheme (EMAS). This effort was supported, in part, by the Bavarian State Government's promotional scheme for small and medium-sized enterprises and handicraft businesses.

Planning EPE

As is traditional in the cabinetry/furniture-making field, environmental and health aspects have been primary concerns in product development for a long time. This is also reflected in the company's environmental policy. In planning for environmental performance, the company intends to satisfy the demands of customers for ecologically sound products. Thus, the business strategy of the company is to expand market position, especially through the production of solid wood furniture, and by using natural oils and waxes for ecologically sound surface treatment. In this way, occupational health aspects for staff were improved (i.e., the use of and need for auxiliary agents in certain processes). Furthermore, reducing the environmental impacts of the company's production benefits the company. By increasing the efficient use of resources and materials, and by decreasing the amount of unnecessary waste, a competitive cost basis for production is realized. The company's environmental performance criteria are based on their environmental objectives and targets.

Selecting indicators for EPE

Table A.1 lists the environmental aspects of Schreinerei Schmid as well as their related environmental performance criteria which were adopted from the company's environmental objectives under the company's internal environmental information and control system, which was later registered under EMAS.

TABLE A.1 - Schreinerei Schmid Environmental Aspects and Performance Criteria

Environmental Aspect	Related Environmental Performance Criterion
Electricity consumption	Reduce electricity consumption
Water consumption	Reduce water consumption
Use of solid wood (instead of composite wood products, such as plywood or particle board, due to concerns about releases of formaldehyde and other substances into ambient air)	Increase the use of solid wood instead of composite wood products
Consumption of paints and primers	Reduce the consumption of paints and primers
Treatment of wood surfaces with natural waxes and oils	Increase the percentage of surfaces treated with natural waxes and oils
Consumption of solvents and paint thinners	Reduce the number of litres of solvents or paint thinner used
Generation of waste for disposal	Reduce the amount of waste for disposal

Table A.2 provides informational statistics on the company, a well as the company's indicators for EPE, which were selected based on the company's business strategy and environmental policy.

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TABLE A.2 - Schreinerei Schmid Statistics and Indicators for EPE

Company Statistics	**1993**	**1994**	**1996**
Annual sales (in Deutsche Marks)	880 000	900 000	940 000
Number of employees	9	10	11
Workshop area in square metres	640	640	780
Indicators for EPE			
Kilowatt hours of electricity used	17 731	17 965	24 797
Cubic metres of water consumed	345	398	201
Percentage of solid wood used	85[a]	70	70
Kilograms of paints and primers used	610	435	426
Percentage of surfaces treated with natural waxes or oils	3	22	30
Litres of solvents or paint thinner used	125	110	60
Kilograms of waste for disposal	1 450	1 320	60

[a] The percentage of solid wood used in 1993 was greater than in 1994 and 1996 due to an exceptionally large order for furniture received in 1993. Therefore, 1993 production was not typical of Schreinerei Schmid's usual annual production.

Using data and information

Collecting data

The company's environmental information system provides the basis for data collection to support the development of indicators for EPE. In the initial years of implementing the company's environmental programs, a considerable amount of data had to be estimated. Over time, the scope of the environmental information system was broadened to be able to support all selected indicators. All indicators were expressed as absolute amounts or as proportions. The use of relative data (i.e., per kilogram or per item of furniture produced) was not considered appropriate because individually designed products have unique sizes and natures that do not support comparisons among products.

Assessing information

The assessment of information is carried out by comparing the company's environmental objectives with the selected indicators for EPE. The sharp rise in consumption of electricity in 1996 resulted from the enlargement and construction of a new workshop. Considerable progress has been made since 1994 in other areas, especially regarding decreased water consumption, decreased consumption of environmentally relevant auxiliary agents, and the increased percentage of the surface areas of products treated with natural waxes and oils. Through new waste management practices, involving extensive internal and external recycling of production wastes, waste for disposal has virtually dropped to zero,

Reporting and communicating

For clients, other interested parties and the general public, the company's progress in improving its environmental performance is documented, with the company's 1994/95 environmental report providing baseline information. This report is updated and published every three years as the public environmental statement required by the company's registration to EMAS. In addition, this information is made accessible over the Internet at http://members.aol.com/schmids40. Internally, the environmental report is used by the company owner as a basis for company meetings and discussions with staff on environmental issues, and to support dialogue between the company and public authorities.

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Reviewing and improving EPE

On the basis of the environmental performance achieved, new environmental objectives and targets were set as the company's environmental performance criteria. These criteria are:

- to increase the use of solid wood in the production of furniture by 10%, making its products more acceptable to its customers;
- to reduce electricity consumption by 10% through optimization of compressed air systems and replacement of heating ovens;
- to reduce the total volume of waste, for both disposal and recycling, by 10%.

One change in the set of indicators for EPE has been necessary as a result of reviewing the EPE process. Since the total volume of waste for disposal has been reduced to almost zero through intensive recycling measures, the strategy of the company owner is now focused on globally reducing all waste streams of the company. Therefore, "total volume of waste for both recycling and disposal" will be integrated as a new indicator replacing the old indicator "kilograms of waste for disposal".

Summary/conclusions

EPE has proven to be environmentally and economically valuable for a small company. Data to support some of the selected indicators for EPE was readily available at the beginning. Data sources and data collection mechanisms to support other indicators for EPE had to be developed or improved during the process.

The most important benefit of conducting EPE for the company owner was that he finally had access to hard figures about the environmental performance of the company. Together with regularly updated environmental objectives and targets, the owner is able to control and improve effectively the company's environmental performance, and to communicate it successfully to the market. Through the information provided in the environmental report, the company could expect a steady increase in its regional customer base and a steady increase in demand for its products.

If you have questions or would like additional information regarding this example, please contact the ISO member body for Germany:

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Annex B

Clemens Härle Brewery, Leutkirch, Germany

[A family-owned and operated brewing company, with 33 employees, implementing environmental performance evaluation starting with a company eco-balance study (an input/output scheme for mass and energy) and management commitment to environmental protection]

Introduction

Clemens Härle is a small brewery run by the Härle family. Despite a trend to the contrary in the brewing industry sector, the brewery is able to maintain its share of the market against competition from larger breweries. The company is located in the town center of Leutkirch in the Allgäu region (State of Baden-Württemberg, Germany). The company produces 28 500 hectolitres of beer and sells 16 000 hectolitres of other beverages annually. Clemens Härle brewery had a turnover of approximately 8,1 million Deutsche Marks in 1997. The majority of the 33 employees are employed in sales and the production process.

The brewing of beer involves producing wort in a mashing and boiling process in the brewing house from the raw materials, which are hops, malt and water. After cooling, the wort is fermented. This fermented immature beer is then stored and filtered. The finished beer is then decanted into bottles or pumped into kegs (pressurized containers). All processes are subject to the strict food standards and purity laws that apply to Bavarian breweries. The supporting infrastructure consists of an energy supply, water supply and treatment plants, wastewater treatment and disposal, as well as facilities for the maintenance of technical equipment and vehicles.

The finished products are stored at the brewery until the company transports them, using its own vehicles, to its customers. All vehicles are fuelled by organic diesel, refined from rapeseed oil. The sale of the finished product is limited to an area with a 50 kilometre radius from the brewery to guarantee premium quality. This also helps to reduce the environmental impacts of distribution activities.

The raw materials (i.e., malt and hops) are only purchased from farms controlled by two independent institutions. No pesticides or artificial fertilizers are normally applied. Where their use is essential, only the application of the minimum quantity that achieves the necessary effect is permissible.

Numerous measures have also been carried out for many years to reduce the consumption of resources, in particular water and energy, and the volume of emissions. A new wort-boiling system in the brewing house reduced the consumption of heating oil by 25%. The use of waste heat was also improved. A heat recovery system achieves annual savings of approximately 45 000 litres of heating oil. Optimizing processes have leveled out peaks in electricity consumption. Water consumption has been reduced by nearly 50% in the last twenty years. Because waste is sorted with care, few recyclable materials are to be found in the non-recyclable waste. Organic waste from production processes is reused in agriculture. Only reusable containers (i.e., bottles and kegs) are used.

Noise pollution problems were addressed with noise abatement measures. These were accompanied by independent surveys to guarantee that the noise levels on neighboring properties are considerably lower than the legal noise emission limits. Thus, adequate margins were always maintained to avoid disturbance to the neighbors.

There were a few difficulties with wastewater acidity (i.e., pH values) at the municipal sewage plant before a neutralization system could be put into operation. Since then, the fluctuations in the pH values have been reduced and the relationship with authorities responsible for water standards has improved.

Environmental activities are used to promote the company to the public, through mechanisms such as press releases and guided tours. The company's profile has been raised by many reports in the media and by winning awards for its environmental activities. Overall, Härle has managed to maintain a long-lasting well-balanced relationship with interested parties (e.g., local residents and authorities).

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Planning EPE

The establishment of an environmental management system certified to either the European Eco-management and Auditing Scheme (EMAS) or ISO 14001 has not been an objective of the company. The owners feel that these systems would be too time-consuming and bureaucratic for a company of this size and that the environmental benefit that normally results from certification could also be achieved by the company's less formal environmental management system. A detailed environmental report and a company eco-balance study (an input/output scheme for mass and energy) were compiled for the first time in 1995.

Company Eco-Balance Studies

A "company eco-balance study" is an internal annual recording of all incoming (input) and all outgoing (output) material and energy streams of the company. Input streams include raw materials, physical plant and equipment, water and energy. Output streams include waster water, air emissions, products and wastes after production. These environmental data are systematically recorded for the entire company year after year and are the basic data supporting indicators for EPE.

Three areas for action were identified:
- conserving electrical and heating energy;
- changing to more environmentally friendly energy sources;
- altering the use of cleansing agents and disinfectants.

Härle intends to produce additional environmental reports in future.

The company's many environmental activities and the 1995 eco-balance study have provided a good basis and information for planning its environmental performance evaluation (EPE). A very good data base existed for the operational area, but the information base on management efforts was rather limited. The following tables illustrate how the important environmental aspects were being managed before the EPE initiative began.

TABLE B.1 - Significant Environmental Aspects

Significant Environmental Aspects	Management Status
Water and energy consumption	Taken into account at Härle (for approximately 20 years), as is usual in breweries. Reason: Water and energy consumption account for a great share of production costs, and are therefore analyzed precisely for economic reasons.
Air emissions, wastewater effluent and solid waste	Accurate data is available from the eco-balance study for the most relevant environmental aspects of wastewater (both volume and quality), solid waste and air emissions.
• Possible leakage of ammonia from the cooling system; • Use of cleaning agents and disinfectants; • Purity/quality of water and raw materials.	• Monitoring of the cooling system (ammonia) and the use of cleaning agents and disinfectants is related to safety. • The health of consumers has to be guaranteed by regular monitoring to ensure that water and raw materials meet food safety regulations.
Local/regional environmental conditions	No direct local/regional environmental objectives

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TABLE B.2 - Environmental Performance Criteria

Environmental Performance Criteria	Management Status - Data Availability
Legal and other requirements	• Legally relevant federal laws on emission protection, technical guidelines on noise, technical guidelines on air and hazardous substances regulation. • Legal requirements are routinely monitored and checked to avoid problems with authorities. • The aim of the company is to achieve a continually improving environmental profile; consumers' environmental concerns are determined by random surveys on individuals.
Past and present performance	Good planning data is available at Härle, since water and energy consumption have been systematically recorded over a long period of time.
Standards and good management practices	Although an environmental management system certified to EMAS or ISO 14001 is not an objective for Härle, internally set standards are documented in the environmental report.
Performance data from industrial associations	Comparisons with other breweries is a traditional "craftsman's tool" in the brewing sector.
Checking/auditing the management	Not considered appropriate at Härle, because it is a small family business.
Scientific research	Research results, as far as they are relevant for small breweries, are used for setting the company's objectives (Example: Brewing Guidelines from the Bavarian Environment Ministry).

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TABLE B.3 - Views of Interested Parties

Interested Party	Comment
Management representatives, employees	• Company strategy is biased towards environmental awareness and protection by the personal commitment of the Executive Director. • As is typical for a small enterprise, informal exchange is favored over formal rules for employee suggestions ("We know each other and talk to each other"). • Special meetings are held on environmentally relevant topics with the master brewer and the head of purchasing.
Customers	Customer interests are identified through focused surveys.
Suppliers	Conducting discussions with suppliers and establishing purchasing guidelines (quality and source of raw materials, packaging to be used).
Banks, insurance companies	Building confidence with the environmental report.
Supervisory bodies, legislator	Regular contact is maintained with authorities.
Local community	Regular personal contact with those responsible.
Media (and Publicity)	• Arousing interest by publicizing environmental activities, interviews; in exchange, reports are made and company data is disclosed. • Active exchange of public opinion in regional newspapers, national news agencies and specialist journals about industry sectors and environmental affairs.
Research institutes	Active participation in research projects.
Environmental groups and other organizations	Contact and information exchange with environmental organizations and the conduct of mutual activities.

Selecting indicators for EPE

The company's environmental report explicitly outlines the environmental performance objectives at Härle. The majority of the environmental objectives focus on technical and organizational measures. If possible, the objectives are expressed quantitatively. For example objectives related to energy are:

- qualitative (organizational/ technical) objective:
  To plan and arrange investment in a combined heating and power plant.

- quantitative (operational process) objective:
  To improve the electrical efficiency in the whole company by at least 1 kW · h per hectolitre of beer produced over the next three years.

Operational performance indicators (OPIs) derived from the control of production (e.g., energy and water consumption) and from the eco-balance study were selected and directly used to check progress towards the objectives set. Absolute values were listed in the eco-balance report on the Härle brewery products for the inputs and outputs indicated in Table B.4.

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TABLE B.4 - Input and Output Categories of the Harle Brewery Eco-Balance Study

Inputs	Outputs
Raw materials Operating and auxiliary materials Packaging Office and advertising material Energy Environmental media (e.g., water, air, soil) Commodities	Main products By-products Waste Solid waste Wastewater Waste (exhaust) gases Energy emitted Commodities

The following OPIs related to significant environmental aspects, expressed as absolute values (for example, in 1994 electricity consumption was 413 000 kW · h and wastewater volume was 6 800 m^3), were to compare environmental performance over the last 10 years:

- electricity used in kilowatt hours per year;
- diesel fuel used in litres per year;
- heating oil consumed in litres per year;
- water consumed in cubic metres per year.

The absolute values were then related to the number of hectolitres of beer produced. This resulted in an additional set of relative OPI's which were also compared over the last 10 years. By doing this, and by using graphical representation, the changes in the absolute values are more readily understood. Some examples of these relative OPI's are:

- litres of heating oil consumed per hectolitre of beer produced;
- kilowatt hours of electricity used per hectolitre of beer produced;
- megajoules of natural gas consumed per hectolitre of beer produced;
- litres of diesel fuel consumed per hectolitre of total beer and other drink products;
- total water consumed in litres per hectolitre of beer produced;
- potable water used for brewing in litres per hectolitre of beer produced;
- non-potable water used for cleaning and other purposes in litres per hectolitre of beer produced;
- hectolitres of beer produced per cubic metre of water (to measure water efficiency).

Using data and information

The collection and analysis of environmentally relevant data at the Härle brewery, although fairly comprehensive, was found to need some improvement for EPE, as described below.

Collecting data

Even in small breweries such as Härle, data on energy and water consumption is collected regularly for each process. This is done using Electronic Data Processing (EDP) and by hand (in the brewing book). Collected data is regularly analyzed by the master brewer.

Data on input materials is well-known (e.g., raw, operating and auxiliary materials purchased). The large amount of work involved in collecting this data is a problem, since the data on quantities needed for the performance evaluation has to be gathered from individual invoices filed in folders. Although software is used for book-keeping and for some sales records, this software does not support identifying and recording material flow quantities.

Before the eco-balance study, data on emissions, waste materials and waste heat was not adequate. There was little qualitative data on the chemical contents and environmental properties of materials used. Missing information was collected from external sources, in particular from suppliers.

An unusual feature of data collection at Härle is that data on volumes of inputs and outputs was not only taken for the complete brewery, but also for each individual process. This means that it is not only possible to identify how much of a particular material was used, but also where exactly these substances were used or produced. Due to the amount of work involved, the brewery will not, in the future, make such detailed

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investigations of the process relevant indicators, which are very interesting for a detailed operational performance evaluation. However, Härle will continue to collect water and energy consumption data for each process.

Theoretically, it would be possible to use the automatically measured and recorded data on the neutralization system to identify the exact volumes of wastewater. However, it requires less work and is more practicable to use a differential calculation (i.e., water used minus brewing water, where sources of error such as rain drainage are taken into account).

The exact identification of environmental data was often problematic because it involved too much work or measuring methods were too complicated or too expensive. The possibilities for time saving are limited, because the company's information systems are not in a network (accounting, sales, recording of operational data in the production process) and data on quantities cannot be obtained in the form needed. This shows how important it is to aim for corporate environmental information systems, particularly for small and medium-sized enterprises. It will be easier to compile OPIs if a company can access and use the necessary data from a normal company Electronic Data Processing (EDP) system.

Analyzing and converting data

The analysis of the data on volumes and quantities showed varying quality in the data because it was collected in different ways. For example:

- Some quantities were actually measured (e.g., measurements from water and electricity metres) or quantities were known exactly (e.g., from invoices and receipts);
- Other volumes and quantities were calculated (e.g., emissions calculated from oil consumption);
- Some volumes and quantities were estimated values based on experience (e.g., from the master brewer) for processes which had not been included in a data collection system (e.g., consumption of glue for labels);

Assessing information

EPE revealed that electricity consumption has constantly increased over the last ten years, and is considerably higher than in comparable companies. This is probably due to the increased use of machinery.

It was determined that by replacing heating oil with natural gas, emissions of carbon dioxide, nitrogen oxide and sulfur dioxide could be reduced considerably.

EPE provided information on and helped to identify processes on which more precise technical examinations should be conducted.

By analyzing the relevant process eco-balance information, it was possible to obtain an overview of the areas in which significant quantities of cleansing agents are used.

Reporting and communicating

The results of the environmental performance evaluation published in the environmental report were systematically used for public relations. For example, a press conference was held which was featured in regional and national newspapers, and in radio news broadcasts.

The environmental report was distributed to targeted customers, visitors, authorities, opinion-formers and interested consumers. The results were also published in consumer and environmental journals.

The environmental profile of the company was strengthened by winning the prize for environmental excellence awarded by the Environment Ministry of Baden-Württemberg. The total response to the environmental report, which included the eco-balance study, is considered to be very good.

Reviewing and improving EPE

Check

How effective is the present environmental performance evaluation process?

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The Executive Director of Härle considers that a significant and general improvement of the company's environmental management system has been achieved by EPE.

Identifying indicators for EPE has given new insights on how to optimize the processes, especially in the areas of water use, energy use, and transport. EPE has also helped to identify several effective measures for improvement (e.g., in waste management).

The material and energy eco-balance studies required approximately 50 man-days, using both an external consultant and internal employees. This first examination took so much time because data on quantities of stock and on the consumption or volume of waste was not readily available for many raw materials, auxiliary materials, or emitted substances.

Internal and external expenditure, including software, totaled approximately 30 000 Deutsche Marks.

Act

How can the environmental performance evaluation process be improved?

For data which has to be recorded annually, it is possible to reduce workload by making the recording time period the same as for the business year. Detailed environmental reports, such as the one from 1995, should be published every three years.

Workload for data recording should be less for the next environmental performance evaluation process because a detailed database now exists. The data recording will also be simplified through the eco-balance studies on commodities and processes.

Data will continue to be recorded and administered with eco-balance software. For future eco-balance studies, the workload for the inputs and outputs will be reduced to approximately 20 man-days and costs are estimated at approximately 10 000 Deutsche Marks.

Large time and cost savings can only be achieved with difficulty if the EDP information systems are not extended and also used to support environmental performance evaluation. This would be too large an exercise for a small company if it wanted to develop a company-specific solution. Therefore, improvements in this area would only be possible if the software companies integrated functions on environmental performance evaluation into their products.

The time taken for recording data can also be reduced by using checklists containing a systematic listing of data sources, including location and storage medium.

The potential cost reductions identified so far have shown that it is possible to link indicators for EPE to costs. This has already happened for the use of water and energy as well as for some of the raw, auxiliary and operating materials. Potentially, this could be expanded into systematic environmental cost management.

Summary/conclusions

Excellent data now exist and participation in the European Union's Eco-Management and Audit Scheme (EMAS) or certification to ISO 14001 would be relatively easy should the Härle brewery decide to do so in the future. Environmental performance evaluation following the guidance in draft versions of ISO 14031 has been successfully completed without an environmental management system that meets all the requirements of EMAS or ISO 14001.

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Annex C

Frederiksborg Linnedservice A/S, Oelsted, Denmark

(An industrial laundry, with approximately 70 employees, serving hospitals and rest homes, using ISO 14031 to review indicators developed to support its ISO 14001 environmental management system)

Introduction

Frederiksborg Linnedservice A/S is an industrial laundry that hires out, washes and maintains linen and clothing for hospitals and rest homes in North Zealand and in the Copenhagen area of Denmark. 40% of the company is owned by the county of Frederiksborg and 60% is owned by Berendsen Textile Service A/S, which is a part of the Sophus Berendsen A/S group. It has approximately 70 employees and an annual turnover of about 30 million DKr.

During 1997 and 1998 Frederiksborg Linnedservice developed an environmental management system which was certified to ISO 14001 in June 1998. The company's environmental policy commits it to "a constant reduction of the environmental impact caused by our production". Health and safety matters within the company are dealt with by the safety committee which co-ordinates its activities with those relating to the environmental management system operations.

The company's activities are covered by the "Regulation of companies other than listed ones", which is legislation that requires the company to give notice to the local authority of any significant changes in its activities. (Note: listed companies are those required to apply for an environmental permit before they can commence or expand production.) The municipality of Frederiksværk issues the company's wastewater discharge permit under Chapter 4 of the Law of Environmental Protection.

Planning EPE

As part of the development of its environmental management system the company identified its significant environmental aspects, set environmental performance criteria (objectives and targets) and identified its interested parties.

The company's significant aspects are:

- the consumption of water, energy and washing chemicals;
- waste water discharge;
- laundry transportation;
- various aspects arising during the upstream and downstream lifecycle phases of the products that the company processes (i.e. linen and clothing).

As part of its environmental management system, Frederiksborg Linnedservice has established environmental targets relating to its environmental performance. Like the other 21 laundries belonging to the Berendsen Textile Service, Frederiksborg Linnedservice is working on benchmarking and optimizing its environmental performance regarding its consumption of water, electricity, chemicals and oil/gas under the so-called Water, Electricity, Chemicals and Oil/Gas (WECO) program. The WECO program involves setting overall targets for the Berendsen Textile Service and individual targets for each of the 21 laundries within the group through an economic evaluation of these four inputs. All Berendsen Textile laundries in Denmark and Sweden will be certified to ISO 14001 within 2 to 3 years. Then each laundry will be able adjust its specific targets within the overall WECO targets as part of its target setting within ISO 14001.

The most important interested parties were also identified during the implementation of ISO 14001 and these are:

- employees;
- neighbors;
- the municipality of Frederiksværk and the County of Frederiksborg;
- customers;
- board of directors/management;
- Berendsen Textile Service A/S;
- Sophus Berendsen Corporate Environment Department.

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Selecting indicators for EPE

In order to monitor and evaluate how its environmental performance compares with the targets that have been established under its EMS, Frederiksborg Linnedservice developed a series of management and operational performance indicators. ISO 14031 was used to evaluate whether these indicators could be usefully supplemented with additional Management Performance Indicators (MPIs) and Operational Performance Indicators (OPIs) and with environmental condition indicators (ECIs).

This evaluation took place at a series of meetings with attendance by environmental and other managers from Frederiksborg Linnedservice, Berendsen Textile Service and Sophus Berendsen A/S. The meetings typically consisted of an introduction to ISO 14031 and to the process of identifying significant aspects and selecting indicators. This was followed by a systematic review of the annex to ISO 14031 and the lists of significant environmental aspects, indicators, objectives and targets from the environmental management system. Finally, a potential list of indicators was prepared and the relevance of each indicator was discussed taking into account the technological and economic circumstances of the company.

The result was a list of 44 indicators grouped as:

- (E) - existing indicators, i.e., those selected in the development of the company's environmental management system;
- (D) - indicators for which the basic data exists and whose applicability will be evaluated as part of the objective and target setting process for 1999;
- (F) - relevant future medium and long term indicators.

The indicators selected, the reasons for their selection and their relation to environmental objectives and targets are presented in Table C.1 and C.2.

Review of the indicators for EPE

The indicators will be evaluated annually unless otherwise stated. If the period is a project period, this is indicated by a (P). Indicators contained in Sophus Berendsen's Environmental Questionnaire are indicated by SBEQ. The Questionnaire is sent out each year by the Sophus Berendsen Corporate Environment Department to collect site specific information on environmental management activities and environmental performance for the corporate database. This is published in Sophus Berendsen's Environmental Profile.

TABLE C.1 - Management Performance Indicators (MPIs)

MPI	Status	Reasons for Choice of Indicator and Relation to Environmental Policy, Environmental Objectives or Targets
Implementation of policies and programs		
Number of questions answered on a questionnaire concerning environmental conditions sent to selected environmentally critical suppliers	E	To give an initial estimate of the environmental performance level of suppliers. Used as a criterion for the selection of suppliers and for development collaborations with suppliers ***Objective***: estimation of suppliers causing significant environmental impacts
Number of meetings having work place assessment on the agenda	E	To estimate if work place assessment (health and safety review) is occurring on an ongoing basis ***Objective***: implementation of action plans concerning work place assessment
Score from a questionnaire concerning the degree of staff satisfaction	E	To estimate the level of staff satisfaction ***Policy***: safe and attractive working conditions

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MPI	Status	Reasons for Choice of Indicator and Relation to Environmental Policy, Environmental Objectives or Targets
Number of days lost per week due to sickness	E	Indicates the health and safety conditions within the company ***Policy*:** safe and attractive working conditions ***Objective*:** improvement of current health and safety conditions
Number of reports of industrial injuries	E	Indicates the health and safety conditions within the company ***Policy*:** safe and attractive working conditions ***Objective*:** improvement of current health and safety conditions
Number of environmental instruction hours per employee (Environmental instruction consists of external courses, internal seminars/course and on-the-job training)	E	To ensure that all employees receive a minimum level of environmental training ***Objective*:** at least one day of environmental instruction for each employee
Number/percentage of environmentally assessed acquisitions and important rebuildings out of the total number of acquisitions and important rebuildings	D	To document whether new acquisitions and important rebuildings are being environmentally assessed ***Objective*:** systematic environmental assessment of new acquisitions and important rebuildings
Number/percentage of products environmentally assessed by the company out of a selected number of existing and newly purchased environmentally critical products	D	To document whether selected products are being environmentally assessed ***Objective*:** environmental assessment of products having significant environmental impacts
Number of hours spent on environmental projects using Life Cycle Assessment	D	***Objective*:** active participation in projects concerning Life Cycle Assessment
Number of implemented environmental objectives and targets and the number being implemented on time	D	To estimate the efficiency of the management system (May be used during the review of the management) ***Policy*:** formulation of realistic and measurable targets
Percentage of staffing hours used for environmental instruction and training	D	To show the prioritization of environmental instruction in relation to other types of training No direct objectives but expressed as the objective of at least one day's environmental instruction for each employee
Number/percentage of environmentally critical products for which the company has specified environmental requirements (e.g. demands substitution of chemical substances or unacceptable environmental performance by supplier)	D	To estimate the environmental performance in relation to products of the supplier ***Objective*:** assessment of suppliers and products having a significant environmental impact

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MPI	Status	Reasons for Choice of Indicator and Relation to Environmental Policy, Environmental Objectives or Targets
Compliance to environmental demands and expectations		
• Number of regulatory non-compliances • Number of injunctions	E SBEQ	To estimate degree of compliance with the regulatory requirements. Indicators used for the management review ***Policy*****:** as a minimum to meet the present regulations
Number of deviations from procedures and instructions per month for functions/units where it is found relevant (BTS level)	D	To identify the weaknesses of the environmental management system in different functions/units (Indicator used for the management review)
Number of corrective actions per function/unit	D	To estimate the efforts to rectify the weaknesses of the system (Indicator used for the management review)
Economic performance		
Value (DKr) of raw material and resources saved compared to consumption in the fourth quarter of 1995 (WECO)	E	To show the operational savings of raw material and resources To promote the WECO objectives concerning reduction of consumption of chemicals
Costs of chemicals consumed (WECO) per kilogram of laundered clothes	E	To compare operational costs with those of other laundries To promote the WECO objectives
• Cost of fuel per vehicle • Costs of maintenance and repairs per vehicle	E	To show the total operational costs related to the company's vehicles (see also the operational performance indicator under supplies and deliveries) ***Objective*****:** reduction of the environmental impact resulting from transport
Annual duty for sewage discharge	D SBEQ	To show the operational costs of important water consumption and the resulting large sewage discharge To promote the WECO objectives
Number of staffing hours spent on environmental projects/action programs per group of staff	F	To estimate the prioritization of the effort made in the environmental field May be applied if for instance the aim is that 5% of a staff group's working time should be spent on environmental work

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MPI	Status	Reasons for Choice of Indicator and Relation to Environmental Policy, Environmental Objectives or Targets
Relations to interested parties		
Number of requests from external interested parties concerning the environmental performance of the company	E	To estimate the interest in the company's environmental activities among the interested parties ***Objective***: to ensure a dialogue with external interested parties regarding company environmental performance
Number of environmentally related complaints from neighbors regarding noise, smell and others issues	E SBEQ	To estimate the company's standing in the local area ***Policy***: consider the environment an important part of the company's relation to society
Number of newspaper clippings referring to the environmental management and/or the environmental performance of the company	F	To estimate whether environmental performance is being communicated widely ***Objective***: to ensure a dialogue on the company's environmental activities with external interested parties
Number of new customers mentioning environment as part of the reason for choosing Frederiksborg Linnedservice	F	To estimate the marketing value of the environmental management activities ***Policy***: consider the environment to be an important part of our trade with customers and suppliers as well as with society

TABLE C.2 - Operational Performance Indicators (OPIs)

OPI	Status	Reasons for Choice of Indicator and Relation to Environmental Policy, Environmental Objectives or Targets
Materials		
Chemicals used per kilogram of laundered textiles (SBEQ: Kilograms of washing chemicals, kilograms of sodium hypochlorite and litres of petrol)	E SBEQ	To estimate the consumption of chemicals for comparison with other laundries ***WECO-target***: reduction of the consumption of chemicals
Quantity of water used per kilogram of laundered textiles (WECO) (SBEQ: Total consumption in cubic metres and cost of water in DKr)	E SBEQ	To estimate the consumption of water for comparison with other laundries ***WECO-target***: reduction of the consumption of water
Number of auxiliary products containing polyvinylchloride (SBEQ: Volume in cubic metres and cost in DKr of polyvinylchloride-containing plastic waste; quantity in kilograms and cost in DKr of polyvinylchloride for wrapping)	E SBEQ	To estimate rate of phase-out of polyvinylchloride-containing products ***Objective***: survey of the use/employment of PVC

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OPI	Status	Reasons for Choice of Indicator and Relation to Environmental Policy, Environmental Objectives or Targets
Chlorofluorocarbon stock in air-conditioning - number of products, equipment, machinery, containing chlorofluorocarbons (SBEQ: Quantity in kilograms of chlorofluorocarbons in air-conditioning and in fire-fighting equipment)	E SBEQ	To estimate the initiative compared to the phase-out of chlorofluorocarbons ***Objective***: survey of the stock of chlorofluorocarbons
Re-washing (a second wash of the textiles as a result of quality control) as a percentage of the total amount of laundry	E	To survey the extent of re-washing in order to find possibilities for reducing the extent of re-washing To promote the WECO-objectives
Percentage reduction in use of chlorine per kilogram of washed clothes compared with previous year's use	D	To estimate the status of the reduction in use of chlorine. ***Objective***: reduction to a technically necessary level
Percentage of re-circulated water used during the textiles washing process (for each principal type of textile, if possible)	F	To estimate performance in relation to water reuse for comparison with other laundries To be used if a water re-circulation target is set for the laundries
	Energy	
Consumption of electricity and oil/gas per kilogram of washed clothes (WECO) (SBEQ: Total consumption in megawatt hours and cost in DKr of energy: consumption of energy by type (electricity, steam, district heating/natural gas and oil) in megawatt hours)	E SBEQ	To estimate the consumption of electricity and oil/gas for comparison with other laundries ***WECO-objective***: reduce the consumption of electricity and oil/gas
Percentage of the energy consumption used as process energy and for space heating	E SBEQ	May be used for estimation of the payment of energy taxes
Estimated steam boiler efficiency as a percentage	E SBEQ	To assess if the steam boiler is operated efficiently ***WECO-objective***: reduction of the consumption of oil/gas.
	Products	
Number of discarded pieces of textile per type of textile	E	To estimate the durability of the various textiles processed ***Objective***: reduction of the environmental impact during the lifetime of the textiles
Percentage of purchased textiles with eco-labels (if applicable)		Used as part of the assessment of goods relating to the environmentally friendly purchase policy ***Objective***: determination of targets for purchase of eco-labeled textiles

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OPI	Status	Reasons for Choice of Indicator and Relation to Environmental Policy, Environmental Objectives or Targets
Supplies and deliveries		
Consumption of fuel per kilometre per vehicle	E	To estimate whether certain vehicles use unexpectedly high amounts of fuel ***Objective*:** reduction of the environmental impact during transport
Waste		
Amount of waste by type in cubic metres (SBEQ) as well as the costs of waste in DKr	E SBEQ	To estimate performance in relation to waste minimization. ***Objective*:** waste minimization
Waste per kilogram of washed clothes	F	To estimate performance in relation to waste minimization, specified by type according to the future waste regulations of the municipality ***Objective*:** waste minimization
Number of (and percentage of) the different types of hazardous waste for which reduction plans have been made	F	To estimate the reduction in the use of products that lead to the generation of hazardous waste ***Objective*:** waste minimization and replacement of hazardous substances
Emissions to soil and water		
Amount of waste water per kilogram of washed clothes	D SBEQ	To be estimated together with the consumption/reuse of water per kilogram of washed clothes in order to control the water balance To be seen as a part of the WECO-objectives
Nitrification inhibition as a percentage (based on self-control measurements)	D	To estimate whether legal requirements (at present only a guideline) are being respected within a good margin (No objective/targets in relation to the waste water load)
Discharged Biological Oxygen Demand and Chemical Oxygen Demand in waste water (based on self-control measurements). To be followed as the annual concentration and absolute amount as well as the amount per kilogram of washed clothes	D	To estimate status/performance in relation to regulatory requirements/guidance (No objective/targets in relation to the waste water load)

Using data and information

Data and information for the monitoring of the selected indicators will be collected as part of the ISO 14001 process supplemented by contacts with key site, subsidiary and corporate representatives.

The information generated by the EPE process will be communicated internally as part of the ISO 14001 communication activities. This will include oral presentations by the site manager and environmental co-ordinator and by other participants in the EPE project at subsidiary and corporate level as well as the dissemination of the present project report.

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Reviewing and improving EPE

The present indicators as well as any new indicators selected in the 1999 ISO 14001 planning process will be reviewed as part of the internal environmental reporting process and the management system review. The site environmental co-ordinator will, in co-operation with the relevant subsidiary and corporate environmental personnel, make suggestions for further use and improvement of EPE as part of the ISO 14001 process, and decisions will be taken as part of the management system review.

Summary/Conclusions

Frederiksborg Linnedservice offers the following observations regarding its implementation of EPE:

- The use of ISO 14031 inspired the company to find new management and operational performance indicators, which may be incorporated into the existing environmental management system. The management performance indicators may be especially useful in relation to the management review, while the operational performance indicators are particularly useful in the daily operation of targets and conditions.

- The company is already working actively with operational performance indicators as a tool for controlling the consumption of water, electricity, chemicals and oil/gas (WECO). Using ISO 14031 stimulated the development of additional ways of controlling these parametres (for instance by focusing on the reuse rate of water and on the economic savings) and the development of the relevant indicators.

- For the time being, environmental condition indicators are not considered applicable but the company may in the future consider how to use environmental conditional indicators in its external communication with interested parties.

- The presence of an environmental management system means that developing new indicators can be done in a straightforward process since procedures for collection and handling of data and data reporting do already exist.

- ISO 14031 can be seen as an alternative to ISO 14001 for companies who do not wish to establish an extensive management system but who would, however, like to work systematically and continuously on improving their environmental performance. For a company with an EMS certified to ISO 14001, EPE can supplement the procedures already developed and especially help focus the process of internal environmental reporting and the management review.

- The implementation of EPE also included MPIs and OPIs relating to health and safety aspects of the activities at the site as part of the ongoing dialogue with the health and safety committee at the site.

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Annex D

Perusahaan Pelindung Getah, Malaysia

(A rubber glove manufacturing company, with approximately 100 employees, getting started on environmental performance evaluation)

Introduction

The Perusahaan Pelindung Getah (M) Sdn. Bhd. (PPGM) is a small private limited company established in 1988 and located in Malaysia. The PPGM factory is located upstream from a public water supply intake which consequently requires the PPGM to comply with stringent effluent standards. The total number of employees at the PPGM is approximately 100. The factory has three production lines which operate 24 hours per day, for 312 days each year. The factory produces approximately 8 million pieces of medical examination gloves per month, most of which are exported to the United States of America.

The PPGM uses a natural rubber latex concentrate with 60% dry rubber content preserved with 0,7% ammonia on latex by weight. A latex compound is prepared by adding chemicals to the latex in a sequence of batch operations. The additives include fatty acid soap (stabilizer), sulfur (cross-linking agent), zinc dibutyldithiocarbamate (accelerator), zinc oxide (activator), alkylated phenols (anti-oxidant) and titanium dioxide (pigment). After mixing with the chemicals, the latex is left to mature for one day before its utilization in glove manufacturing.

The manufacturing process uses the coagulant dipping technique and an automatic chain drive system. The dipping process begins with cleaning of the porcelain formers and finishes with stripping of the gloves from the formers. Although the technology adopted for glove manufacturing is widely used by latex glove manufacturers since it is practical and has low operating costs, environmental considerations had not been fully incorporated in the design resulting in significant environmental concerns.

The occurrence of residual soluble proteins in latex gloves has the potential to cause allergic reactions in sensitized individuals and their release into the wastewater.

The wastewater from the PPGM factory is treated on site in an effluent treatment plant utilizing a chemical flocculation, anaerobic digestion and activated sludge process. Hazardous chemical sludge containing zinc is produced. Legislation require PPGM to collect, transport, treat and finally dispose of the sludge to a central treatment facility. PPGM is also required to treat its effluent to comply with the existing regulatory standards. The effluent standards with which PPGM is expected to comply are that the zinc concentration in the final discharge be less than 1 mg/l and Chemical Oxygen Demand (COD) is to be less than 50 mg/l.

This example concentrates on starting an EPE process. PPGM does not have an environmental policy and no environmental management system is in place, but the management of PPGM has agreed to evaluate its environmental performance following the principles of ISO 14031. In this example, the company is attempting to reflect the relationship between the indicators for EPE and the company's environmental performance criteria.

Planning EPE

The management of PPGM decided to plan their EPE based on the environmental aspects related to the company's activities, the views of selected interested parties and some selected environmental performance criteria.

The important environmental aspects of the company's products and activities were identified as indicated in Table D.1.

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TABLE D.1 - Important Environmental Aspects of PPGM

Product/ Activity	Environmental Aspect	Potential Impact/Effect
Rubber glove	• Disposal of rejected gloves (i.e., those not meeting product specifications)	• Soil and ground water contamination through land application and air pollution through open burning
Latex compounding	• Addition of chemicals (e.g., stabilizers, curatives, protective agents, pigments, defoamers) in latex compounding • Discharge of residual latex containing toxic chemicals • Addition of sulfur powder during latex compounding and emission of sulfur dust • Mixing of ammonia-preserved latex in open tanks and emission of ammonia vapor • Washing of latex mixing and storage tanks and generation of hazardous solid waste (residual latex coagulum containing toxic chemicals) • Generation of hazardous liquid waste containing high concentrations of zinc and COD	• Soil and ground water contamination through land application • Water pollution • Health-related problems for workers
Leaching of gloves with water	• Discharge of effluent from leaching tanks	• Water pollution

After reviewing public statements, minutes of meetings and discussions with interested parties, the important interested parties were identified as indicated in Table D.2.

TABLE D.2 - The Views of Interested Parties

Interested Parties	Expected View
Department of the Environment	• Treated effluent shall comply with regulatory requirements
Export market (e.g., U.S.A. Food and Drug Administration)	• Level of extractable protein in rubber gloves shall be less than or equal to 0,3 mg extractable protein per gram of rubber
Public water treatment plant operator	• Quality of river water at the intake which may be affected by the effluent discharged from the PPGM factory
PPGM top management	• Cost effectiveness of environmental control measures
Local community	• PPGM's operations shall not cause any nuisance

In the plan for development of the EPE process, the following environmental performance criteria were selected :

- total compliance with regulations;
- zero public complaint on its operations;
- minimal adverse environmental effect (e.g., meet ambient air quality standards);

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- maintaining the number of pieces of gloves rejected to be less than 5% of the total pieces of gloves produced, in accordance with product specification.
- maintaining the level of extractable protein in gloves at less than or equal to 0,3 mg extractable protein per gram of rubber.

The PPGM management plans to implement the following environmental management programs to address its environmental performance :
- reduction of extractable protein level in gloves;
- improvements in effluent treatment plant efficiency;
- waste minimization through process modification;
- monitoring of surface water quality upstream and downstream of the PPGM factory.

Selecting indicators for EPE

PPGM selected indicators for EPE to provide information on management efforts, performance of its operations and the condition of the environment as a direct consequence of the implementation of environmental management programs. The management of PPGM has also established the objectives and targets to be achieved within a specified time-frame for each of the programs. The indicators selected are more meaningful with the establishment of these objectives. The PPGM has also set up a project plan for each program. The project plan lists the activities to be carried out, the time frame, the resources, and the responsibilities associated with each activity.

The indicators selected in relation to environmental performance criteria are presented in Table D.3.

TABLE D.3 - Selected Indicators for EPE

Indicators for EPE	Basis for Selection of the Indicator
Management Performance Indicators (MPIs)	
• Annual total cost of implementing environmental programs.	• For the evaluation of management commitment (i.e., useful public relations material).
• Number of environmentally-related complaints received by PPGM per year.	• For evaluation against the environmental performance criterion on zero public complaint.
• Number of effluent samples analyzed monthly not complying with regulatory standards.	• For evaluation against the environmental performance criterion on total compliance with regulations.
Operational Performance Indicators (OPIs)	
• Number of pieces of gloves rejected in relation to the total number of pieces of gloves produced per month.	• For evaluation against the environmental performance criterion on controlling rejects in order to reduce wastes.
• Extractable protein level of glove measured in milligrams of extractable protein per gram of rubber.	• For evaluation against the environmental performance criterion on eliminating the potential cause of protein allergy (This information is useful to the U.S. FDA).
• Quantity of zinc in kilograms discharged to the receiving watercourse per month.	• For evaluation against the environmental performance criterion on minimizing wastes.
• COD load in kilograms discharged to the receiving watercourse per month.	• For evaluation against the environmental performance criterion on minimizing wastes.
• Quantity of dried sludge in kilograms produced per month.	• For evaluation against the environmental performance criterion on minimizing wastes.

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Indicators for EPE	Basis for Selection of the Indicator
Environmental condition indicators (ECIs)	
• Incidence of protein allergy associated with the use of rubber gloves by sensitized individuals (i.e., number of official reports per year).	• For evaluation against the environmental performance criterion on eliminating the potential cause of protein allergy.
• Changes in the quality of surface water upstream and downstream of the factory's effluent discharge point. This indicator is based on the test for inhibition of oxygen consumption by activated sludge as carried out in accordance with the ISO 8192 procedure. The specific indicator is the percentage of change in EC 50 value where EC 50 is defined as the concentration which inhibits the oxygen consumption by 50%.	• For evaluation against the environmental performance criterion on ensuring the environment is not adversely affected by PPGM's operations (This information will be useful to the water treatment plant operator).

Using data and information (Collecting, analyzing, and converting data)

Some of the indicators require raw data collection on a regular basis, analysis of the collected data and conversion of the data into indicators. For example, the indicator on the quantity of zinc discharged to a watercourse per month requires regular measurements of effluent flow rates and zinc concentrations in the effluent. The PPGM management uses a commercial software to enable the collected data to be stored and managed. The computer software has the capability to display the analyzed data in a graphical form and to show the trend of the various indicators with time. The information can be incorporated in a report, prepared using a word processor, for communication to interested parties on a regular basis.

Reviewing and improving EPE

PPGM may consider adding more indicators, for example, on the consumption of toxic chemicals, energy and water. The company's management will also consider implementing an environmental management system to improve the use of EPE in the company.

Summary/conclusions

PPGM recognizes the need for EPE and in general the need for the company to embark on an EMS following the ISO 14001 system to maintain competitiveness in its industry.

If you have questions or require additional information regarding this example, please contact the ISO member body for Malaysia:

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Annex E

Katayama Shokuhin Company, Shiunji Plant, Japan

(A food processing company, with approximately 200 employees, getting started on environmental performance evaluation)

Introduction

Katayama Shokuhin is a food processing company that produces various types of pickles. The company's headquarters are in the Niigata Prefecture, Japan. This case study focuses on its main plant at Shiunji, constructed in 1986 in the industrial park in the town. It is a medium-sized plant, with a total floor space of 8 017 m^2 and 202 employees. The raw materials are farm products, and total annual production is approximately 4 700 tonnes.

The industrial park in which the plant is situated is near the coast, away from residential areas. The waste water discharged from the industrial park flows into the sea via the Ochibori River, which runs nearby. The Niigata Prefecture monitors the water quality in the Ochibori River, to confirm the required environmental standards are properly achieved.

The plant has been developing an environmental management program, which included the establishment of an environmental conservation organization. The company is committed to working on local environmental issues and takes a leading role in the region's anti-pollution liaison conference. (Katayama Shokuhin's chairman has been the chairman of the conference since 1992, and the company's president has been a director of the conference since 1996). Although the company is interested in ISO 14001, it has no definite plans to develop its environmental management system for the purposes of certification to the standard.

Planning EPE

Katayama Shokuhin, as part of its active environmental commitment, conducted an internal review of the environmental impact of its operations and established an environmental action plan based on the Environmental Activities Evaluation Program in 1997. Following those measures, the company started an environmental performance evaluation, and is now developing it further using the guidance in ISO 14031.

> **Environmental Activities Evaluation Program:**
> This is a program that the Environmental Agency of Japan has been working on since 1996 in a effort to help various businesses, such as small and medium sized enterprises, understand and implement environmental conservation. Simple techniques for environmental conservation, including internal reviews of the environmental impacts and commitment and preparation of action plans, are provided in this program.

Summarizing environmental aspects

In implementing its environmental performance evaluation, Katayama Shokuhin have identified their environmental aspects by summarizing the relationship between each manufacturing process and its environmental impact. Table E.1 shows the stages from the arrival of raw materials and conveyance of products to product disposal.

TABLE E.1 - Process Stages and Related Environmental Aspects

Process Stage	Environmental Aspect
Business office activities	Wastes (e.g., paper)
Arrival of raw materials • Conveyance of raw materials • Box opening process	 • Automobile exhaust gasses • Wastes from packaging materials (e.g. boxes)

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Process Stage	Environmental Aspect
Segregating and washing process Desalinization process Seasoning and compression processes Maturation process Measuring and packaging process Production inspection process Packaging and shipping	Use of water resources, waste water discharged from washing, segregating garbage Use of water resources, waste water discharged from Desalinization Wastewater from seasoning Use of packaging materials Use of packaging materials
Wastewater treatment	Sludge from waste water treatment
Incineration of wastes	Exhaust gases
Boiler and private power generation	Exhaust gases
Purchasing of power	Exhaust gases (induced)
Conveyance of products (out-sourced)	Automobile exhaust gases
Consumption of products	(Consumer) Wastes from packaging materials

Identifying the views of interested parties

Katayama Shokuhin have tried to understand and reflect interested parties' opinions through consultation with the Niigata Environmental Association (an organization of business entities in the prefecture) and the Environmental Management Division of Niigata Prefecture, as well as through discussions in meetings on environmental conservation policies within the industrial park (town officials in charge also participated).

Environmental objectives and priorities

When planning for the environmental performance evaluation, the company established its broad environmental objectives. Priority was given to action, and environmental performance criteria later established, in such areas as:

- resource saving (efficient and reduced use of resources);
- reduction of environmental loads (emission reduction, better waste disposal, and reduction of carbon dioxide emissions);
- pollution prevention (of water);
- environmental education.

Selecting indicators for EPE

Basis for selecting indicators

Katayama Shokuhin established a set of indicators, as shown in Table E2, which the company considered would help its understanding (and management) of the identified environmental aspects. The results for 1997 and 1998 have been understood in principle and have sharpened the company's focus on the relationship between its environmental aspects, the related production processes and the use of its products. The basis for the selection of indicators was as follows:

Discharges to water

Recognizing that waste water discharge is an important environmental aspect for food manufacturing, Katayama Shokuhin have selected the total Biological Oxygen Demand (BOD) as the Operational Performance Indicator (OPI) to evaluate organic pollution of the receiving waters (the Ochibori River) by their discharges. They have also adopted, as a more strict control, a related Management Performance Indicator (MPI) which compares the BOD of their discharges against a criterion of 60 milligrams of oxygen per litre of waste water discharged the company has voluntarily set itself. (The discharge of hazardous materials is not problematic because of the characteristics of this type of industry.)

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Exhaust gases

The total output of carbon dioxide has been selected as a basic OPI, because it is easy to calculate and helps to identify the trends in emissions, and environmental impacts, of other pollutants arising from combustion. The company has also estimated, for reference purposes, the output of carbon dioxide in the conveyance of products by sub-contractors to determine the indirect environmental impact as much as possible.

Solid wastes

The quantity of solid waste produced by type was selected as a basic OPI. The company has also adopted the quantity of waste consigned for treatment and disposal by contractors as an OPI to assist in promoting on-site disposal. The quantity of packaging materials on the company's products (which is disposed of as waste by the consumer) was also selected as an OPI, to improve understanding of the indirect environmental impact.

Utilizing resources

The volume of water, and the mass of paper and plastics used for packing were all selected as OPI's to track and understand the use of resources other than energy in the plant.

Employee education

The number of employees who have received education on environmental conservation was selected as an MPI to stress the significance of education to employees.

Water quality

The prefecture measures the environmental quality standard (EQS) of the rivers into which the waste water from the industrial park is discharged. The company does not gather specific EQS data but is informed by the prefecture that the desired EQS has been continually achieved in recent years. This information in effect provides a qualitative Environmental Condition Indicator (ECI).

Targets as environmental performance criteria

The company has set targets linked to appropriate indicators, as its environmental performance criteria. The targets relate to environmental aspects such as discharges to water, exhaust gas and wastes. Each target is expressed as a value to be attained in the year 2002 (five years after the base year of 1997).

TABLE E.2 - Indicators of EPE and Environmental Performance Targets

Indicator	Type	Result (1997)	Target (2002)
Discharges to water			
Total BOD of discharges	OPI	4 881 tonnes oxygen	
Percentage of monthly samples meeting voluntary discharge criterion[a]	MPI	92%	100%
Exhaust gases			
Output of carbon dioxide (within the plant)[b]	OPI	1 806 tonnes	95% (of the 1997 result)
(Reference) Output of carbon dioxide in conveyance of products	OPI	280 309 tonnes	

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Solid wastes			
Total output of wastes (within the plant)	OPI	1 125 tonnes	95% (of the 1997 result)
Combustibles (office)	OPI	6,5 tonnes	
Combustibles (production)	OPI	704 tonnes	
Garbage	OPI	12 tonnes	
Sludge of waste water treatment	OPI	402 tonnes	
Total consigned for treatment by contractors (Reference)	OPI	1 101 tonnes	10% (of the 1997 result)
Packaging wastes after consumption of products	OPI	1 320 tonnes	
Utilizing resources			
Usage of water resources	OPI	188 842 m^3	90% (of the 1997 result)
Usage of paper for packaging materials	OPI	1 192 tonnes	90% (of the 1997 result)
Usage of plastics for packaging materials	OPI	128 tonnes	90% (of the 1997 result)
Education of employees			
Number of employees who received environmental education[c]	MPI	27	All employees

[a] Voluntary discharge criterion is BOD 60 mg of oxygen per litre of waste water discharged.

[b] Including carbon dioxide induced by purchasing of power (calculated using a coefficient).

[c] Number of employees who received external and internal training by experts.

Using data and information (Reporting and communicating)

Katayama Shokuhin is trying to make all employees aware of the results of its environmental performance evaluation to promote employee involvement. The company has also submitted an environmental action plan based on the Environmental Action Evaluation program as well as publishing the results of its actions.

Reviewing and improving EPE

Emphasis was initially been placed on the development of OPIs. The company has progressed beyond evaluating only the plant to assess the emission of exhaust gases during the transportation of its products, and the generation of waste that results when the consumers of its products dispose of the packaging.

Katayama Shokuhin's environmental performance evaluation is still in its early stages. It intends to review the evaluation to confirm the appropriateness of the selected EPIs and the effectiveness of the targets for further improvement.

Summary/conclusions

In spite of being a medium-sized company, Katayama Shokuhin's management is clearly committed to protection of the environment, and has carried out an environmental performance evaluation at its Shiunji Plant. It has focused on all production processes and to some extent on the use of its products. Detailed data have been collected for EPE purposes and an improved understanding of the plant's environmental aspects has resulted which should greatly assist the company to improve its performance.

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Annex F

Envases Alvher, Mataderos Plant, Buenos Aires Province, Argentina
(A site of the company manufacturing flexible laminated packaging, with 210 employees, using environmental performance evaluation to evaluate its solvents recycling program)

Introduction

Envases Alvher, an industrial division of "Dinan S.A.", is a leader in Argentina in the market of flexible laminated packaging, with 50 years of activity in the packaging business. The market in Argentina has a volume of approximately 15 600 tonnes per year. Envases Alvher has a market share of approximately 46%.

The company employs 350 people distributed among 3 plants which have a total covered area of 17 000 square metres. The plants use equipment for polyethylene extrusion, extrusion-coating, and for different types of coatings and metallic films. In addition, rotogravure printing machines, laminators, some which use solvents and some which do not, cutters and embossing machines are used in the production process.

Combinations of simple and compound films are produced for use in the food, cosmetic, personal care, cleaning, beverage and pharmaceutical industries. Examples of these products are:
- special foils (e.g., tetra-laminated) for packaging machines, especially high speed machines;
- multi-layered foils for tubes to be used for toothpaste, cosmetics and foods;
- metallic substrata to be used in different laminations and foils for special packaging processes.

Planning EPE

In 1994 the company started to implement an environmental management system. As a first step, an environmental policy common to all three plants was written, and a plan was developed for the activities needed to support the policy. The planning included:
- characterization of waste streams;
- identification of possibilities for minimization of and recycling of waste;
- determining the level of compliance with regulatory requirements;
- determining the costs that would be involved (as the final stage of planning).

The characterization and analysis of waste streams helped to identify opportunities for improvement. As a result of this analysis, the company decided to recycle the solvents that are used to clean the printing machines and their accessories. Envases Alvher initiated a program to recycle the large volume of dirty solvents generated by its processes.

This example describes the development of three indicators for EPE for the process of recycling the cleaning solvents in the production site identified as Mataderos Plant, one of the three plants of Envases Alvher.

Recycling cleaning solvents

The printing machines contain between 7 and 9 sections, and in each section a particular color is printed on the film. When a printing job, which can last from a few hours to several days, is finished the various parts of the machine (e.g., printing cylinders, ink pots, pans, pumps, hoses) are cleaned. Solvents are used to remove the inks, and after use these solvents are contaminated by the inks. All the solvent used for cleaning, approximately 19 000 litres per month, is collected after use.

The solvent recycling program has four stages:
- development of suppliers;
- design of the operation of the plant;
- implementation of the recycling plan;
- development of records and indicators for EPE.

The maximum quantity of solvents that can be recovered and re-used, through a distillation process, is 70% of the inked (i.e., contaminated) solvent.

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Selecting indicators for EPE

To evaluate the environmental performance of the solvents recycling operation, three indicators were selected:

a) Operational performance indicator (OPI):
Ratio of the amount of recycled solvent consumed to the total amount of inked solvent generated.

The purpose of this indicator is to evaluate the utilization of the recycled solvents in the plant. The value of 0,7 for the indicator is the target, because this means that the maximum volume of recycled solvents that it is possible to obtain in the plant is being consumed

b) Management performance indicator (MPI):
Annual cost savings achieved by recycling solvents.

The purpose of the MPI is to evaluate the savings achieved through the solvent recycling operation. The annual cost of the cleaning operation using only pure (i.e., non-recycled) solvent and disposing of the generated inked solvent by incineration, is compared with the cost of the operation using recycled inked solvent. The table that follows shows the saving achieved in the year 1997 and how the MPI is derived.

TABLE F.1 - Annual Cost Savings Achieved by Recycling Solvents

		Without Recycling		**With Recycling**		**MPI (Annual Savings)** (U.S. dollars)
	Unit Cost (U.S. dollars per litre)	**Quantity** (Litres per year)	**Cost** (U.S. dollars per year)	**Quantity** (Litres per year)	**Cost** (U.S. dollars per year)	
Pure Solvent	0,85	196 000	166 600	40 000	34 000	
Distillation	0,35	- - -	- - -	156 000	54 600	
Incineration	0,65	228 000	148 200	72 000	46 800	
Total			314 800		135 400	**179 400**

c) Environmental Condition Indicator (ECI):
Quality of air in the incineration plant's surroundings measured through the concentration in the air of particulate matter (PM in $\mu g/m^3$), and volatile organic compounds (VOC in ppm).

The purpose of this indicator is to provide a measure of the contribution the recycling of solvents makes to the improvement of the external environment by means of the reduction of emissions of the incineration plant. This fact can also be illustrated using the data of the volumes of inked solvent incinerated as it is calculated in the paragraph corresponding to "Using data and information" (see below).

Interrelationship of indicators

The three indicators are related one to another, and they represent three ways of presenting the results of the recycling operation. A different parametre for evaluating the success of the program is addressed in each case.

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The OPI demonstrates the performance of the organization in the improvement of the use of resources (i.e, the recycled solvent). The MPI demonstrates the financial aspect of the operation, and is strongly influenced by variations in the cost of non-recycled solvent, which changes due to factors external to the organization. The financial aspect of the operation is also influenced by the efficiency of the recycling operation. As the proportion of inked solvent that is recycled increases, the financial yield also improves.

The ECI is related to the impact of the cleaning operation on the environment, which is directly related to the OPI. As the ratio of recycled to non-recycled solvent increases, the environmental impact caused by the incineration of inked solvent reduces. It is also directly linked to the MPI as illustrated by the method that is used to calculate the ECI.

Using data and information

The OPI above mentioned, ratio of the amount of recycled solvent consumed to the total amount of inked solvent generated, is calculated monthly. One method for obtaining the data required for the OPI was to measure the consumption of solvent and the generation of inked solvent waste by the cleaning process. This required a system for the manual collection of daily records. The alternative, which proved to be much simpler to implement and which was finally applied, was to collect the data from the documentation (e.g., the remittance and dispatch notes) related to the delivery and disposal of solvents from the factory. The quantities of solvent were then calculated as follows:

(1) Quantity of recycled solvent consumed: the sum of the volumes stated on delivery (i.e., remittance) notes for the recycled solvent received from the recycling operator during the month plus the difference between the stock at the beginning and end of the month.

(2) Quantity of inked solvent generated: the sum of the volumes stated on dispatch notes for the inked solvent sent to the operator during the month plus the difference between the stock at the beginning and end of the month. The sum of the shipments sent coincides with the solvent generated because all the inked solvent is sent to be distilled.

The reduction of emissions, an OPI of the incineration plant, is calculated annually, and this is related with the improvement in quality of air (ECI). The gaseous emissions produced by the incineration of inked solvents not recycled and distillation waste of the recovery operation are compared to the emissions that would have been produced if there was no recycling program and if all the inked solvents were incinerated. For illustrative purposes, the reduction of gaseous emissions achieved during 1997 is demonstrated using the data on volumes of inked solvent incinerated (Table F.1).

Reduction of emissions in 1997:

$$\frac{(228\,000 - 72\,000) \times 100}{228\,000}$$

$$= 68{,}4\%$$

Summary/conclusions

The implementation of an environmental management system and the characterization of waste streams helped to identify actions that would not only benefit the environment, but also reduce costs and improve profits.

Generally, when a waste minimization or waste recycling program is implemented, it is associated with an appreciable cost saving which helps to get important support for the program at all levels.

The use of indicators for EPE helped Envases Alvher to verify the level to which the program had advanced, and to take the corrective measures necessary to achieve its objectives. The indicators for EPE made it easier for management to monitor the recycling program. The presentation of the indicators for EPE to all personnel in the company also allowed management to show satisfactory progress of their plans to implement an environmental management system and obtain support for the extension of the programs involved.

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Annex G

Petroquimica Cuyo S.A.I.C., Western Argentina

(A chemical processing company, with approximately 230 employees, implementing environmental performance evaluation integrated with its ISO 14001 certified environmental management system)

Introduction

Petroquimica Cuyo S.A.I.C. is a private company located in the western region of Argentina, near the Los Andes mountain range. The total number of employees at Petroquimica Cuyo is approximately 230 people.

Shareholders of Petroquimica Cuyo are Perez Companc S.A., who is responsible for the company management, Panam S.A., and Laboratorios Phoenix S.A.I.C.F.

The plant produces about 90 000 metric tonnes (MT) of polypropylene (PP) homopolymers, copolymers and compounds each year. The process includes six main areas:

- propylene purification;
- gas phase polymerization;
- extrusion and pelletizing;
- deodorization, drying and bagging;
- palletizing and storage;
- utilities (steam, hydrogen, nitrogen, cooling water, compressed air and wastewater treatment).

The production plant is located in a sensitive area where a wide variety of activities co-exist, such as oil and gas production and refining, vineyards, fruit and vegetable farming, and mountain tourism. The region is very dry, almost a desert, with a rich valley served by a river and artificial irrigation. This is the main reason why local environmental legislation is very stringent and is considered to be among the more advanced in the country. The Petroquimica Cuyo plant is supplied by underground water and all water coming from the wastewater treatment is used for internal irrigation of a tree plantation.

The company has been certified as meeting the requirements of ISO 9001 and ISO 14001, and the management systems are integrated. Petroquimica Cuyo is currently in the process of implementing an Occupational Health & Safety Management System.

Planning EPE

During EMS implementation, Petroquimica Cuyo management decided to start planning Environmental Performance Evaluation (EPE) based on the company’s most significant environmental aspects and the views of the interested parties (such as provincial authorities, the local community, and employees). Environmental performance criteria consistent with the concept of eco-efficiency was set by the top management of the company.

Selecting indicators for EPE

The different indicators for EPE selected and described below were useful to:

- monitor the improvements that were being achieved through the implementation and certification of the company’s EMS (ISO 14001);
- quantify environmental improvements in terms of money and the associated cost/benefits;
- take corrective actions as a result of the trends shown by the indicators for EPE.

The company needed to collect data on a regular basis to provide input for the calculated indicators. Existing data, such as production or accounting records, were used. In other cases, the company had to introduce new measurements as well as new procedures and forms to ensure that the required data were available.

Following the ISO 14031 process, it was necessary to analyze the collected data and convert them into useful information (indicators) describing the environmental performance of the organization. The data analysis and selected indicators are closely related to the subsequent assessment resulting from the eco-efficiency activities of the company. The selected indicators were also very useful for both internal and external communication.

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Some examples of the more outstanding indicators used by this organization are presented in Tables G.1, G.2 and G.3 below.

TABLE G.1 - Management Performance Indicators (MPIs)

MPIs	Unit of Measurement	Approach, Interest Focus, or Rationale for Selection of the MPI	Comments or Evolution Over the Past 3 to 4 Years
Investments for ISO 14001 certification	U.S. dollars per year	Cost of implementing an ISO 14001 EMS certified by a third party.	Includes not only environmental investments.
Savings achieved through EMS implementation	U.S. dollars per year	Costs and financial benefits.	More benefits than expected.
Resolved and unresolved corrective actions	Number	Follow up of the certification process and periodic reviews and audits.	No significant changes.
Environmental complaints	Number	Assessment of the community and authority concerns about Petroquimica Cuyo.	No significant complaints.
Environmental training of internal personnel and contractors	Hours per year	Measurement of management efforts and training needs.	Less than expected.

TABLE G.2 - Operational Performance Indicators (OPIs)

OPIs	Unit of Measurement	Approach, Interest Focus, or Rationale for Selection of the OPI	Comments or Evolution Over the Past 3 to 4 Years
Consumption of diesel oil	Litres per tonne of polypropylene	Cost reduction by resource management.	A new loading area, with a more rational use of it and vehicles, produced an important decrease of the diesel-oil consumption (50% in 3 years)
Annual consumption of chlorofluorocarbon R 22	Tonnes per year	Management of hazardous substances which can affect the condition of the environment.	Control and a program for detection of leakage resulted in a decrease in R 22 consumption (50% in the last 4 years).

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OPIs	Unit of Measurement	Approach, Interest Focus, or Rationale for Selection of the OPI	Comments or Evolution Over the Past 3 to 4 Years
Cumulative inventory of hazardous wastes	Cubic metres	Source data for operational control and evaluation of environmental impact through wastes management.	A lack of disposal sites at the beginning of the plant operation resulted in an increased inventory. During the last two years the adoption of new technologies (reverse osmosis) and the safe disposal of oils allowed a reduction in the cumulative inventory of hazardous wastes
Generation of hazardous wastes	Cubic metres per year	Item inventory	Important reduction during last two years.
Consumption of underground water	Tonnes per tonne of polypropylene	Resource management, especially considering the arid characteristics of the region where little water is available.	The operational changes began in 1995 (dry cleaning, decrease in the number of water purges in extrusion and in condensate lines, improvement of filter system, etc.) produced a sensible decrease in underground water consumption.
Recycled pallets	Number of pallets per year	Evaluation of efficiency and savings.	In order to obtain savings by recycling pallets, it is necessary to have good logistical co-ordination between the polypropylene producer and the customer.
Consumption of steam	Tonnes per tonne of polypropylene	• Energy Efficiency. • Cost of Resources. • Resource management.	The insulation of pipes and the improvement of existing insulation produced a decrease in steam consumption, thus achieving the environmental target.
Consumption of electrical energy	Kilowatt hours per tonne of polypropylene	• Energy Efficiency. • Cost Reduction by Resource Management.	Reduction of 6,5% during the last three years.
Consumption of natural gas	Cubic metres per tonne of polypropylene	• Energy Efficiency. • Cost of Resources. • Resource management.	Linked with the decrease in steam consumption.
Consumption of propylene	Tonnes per tonne of polypropylene	• Cost reduction. • Resource Management.	No significant changes.

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OPIs	Unit of Measurement	Approach, Interest Focus, or Rationale for Selection of the OPI	Comments or Evolution Over the Past 3 to 4 Years
Wastewater discharged from the Petroquimica Cuyo site	Cubic metres	Evaluate the impact of the plant activities in the surrounding environment.	In 1995 the wastewater treatment unit was improved. Since then no liquid effluents have been discharged out of the plant. They are all used to irrigate the tree plantation.
Consumption of chemical products	Kilograms per tonne of polypropylene	Evaluate the decrease in environmental impacts and cost savings.	The incorporation of new and up-dated technology, such as reverse osmosis, produced a strong decrease in the sodium hydroxide and hydrochloric acid consumption (50% in one year).

TABLE G.3 - Environmental Condition Indictors (ECIs)

ECIs	Unit	Approach, Interest Focus, or Rationale for Selection of the ECI	Comments or Evolution Over the Past 3 to 4 Years
Tree plantation area irrigated with wastewater	Hectare	Evaluate the relationship between the management of the organization and the condition of the environment.	There was no irrigated area in 1994. At present the area involves more than 9 hectares.
Soil conductivity	Deci-siemen per metre	Evaluate the environmental condition of the irrigated area (wastewater).	No significant changes.
Water table depth	Metres	Evaluate the availability of underground water.	No significant changes.
Groundwater quality	Parts per million	Evaluate relationship between operations and specific contaminants in groundwater.	No significant changes.

Reviewing and improving EPE

After reviewing its EPE, the management of the company considered the selected indicators valuable because they provided useful information for management's review related to:

- conditions in particular areas and localization of problems;
- the points of view of interested parties;
- the necessity of internal and external communication;
- costs and financial benefits.

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Summary/conclusions

The experience of conducting EPE integrated with the company's EMS was very successful because of the high standard of control achieved by assessing the company's environmental performance against set criteria.

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Annex H

Immenstadt Clinic, Allgau Region, Southern Germany

[A 180 bed hospital, with approximately 260 employees, implementing environmental performance evaluation in a service organization using a company eco-balance (an input/output scheme for mass and energy) approach]

Introduction

Immenstadt Clinic, in the Allgäu region of southern Germany, is one of four hospitals that form the non-profit organization Oberallgäu Clinics, Ltd. The clinic has a capacity of 180 patients with surgical, internal organ specialist, and anaesthesia departments. There are also several in-patient departments such as ear, nose and throat, ophthalmology, gynaecology and maternity. The clinic has 260 employees and manages an annual budget of $14 million (U.S. dollars) for approximately 52 000 nursing days. Environmental protection initiatives were carried out occasionally until 1996. There was no overall organization of such initiatives, nor were they part of the regular management of the hospital, and no environmental management system complying with either the European Eco-Management and Audit Scheme (EMAS) or ISO 14001 had been introduced.

The Immenstadt Clinic is located in a region in which the natural environment is important for tourism, and some areas are categorized as "climatic health resorts".

Planning EPE

The pilot project titled "Environment-Oriented and Cost Saving Clinic Management" was started in mid-1996. The aims of the project were to determine the environmental status, to set up an environmental management system, and to identify and take advantage of potential opportunities to conserve resources and reduce costs. The annual amounts of inputs and outputs of material and energy formed the basis for planning EPE.

The significant environmental aspects, identified in 1996 as part of an initial environmental review, were as follows:

- A considerable amount of energy is consumed for heating (primarily use of heating oil, with some heating also provided by a district biomass heating power station) and for electricity required for the operation of medical equipment and systems.
- A considerable amount of recyclable material was found in the non-recyclable waste. Large amounts of infectious waste have to be disinfected, through treatment in a steam sterilization process, before disposal.
- The clinic's annual water consumption is considerably higher than that of an average German industrial company with a comparable number of employees. Wastewater with some infectious content, is sterilized in practice by the use of disinfectants at all stages in the medical service process.
- The use of materials with some eco-toxic content (e.g., medical auxiliary and operating materials such as medication, disinfectants, and various other hazardous substances) is normally high in a hospital.

Important interested parties were informed of the environmental project and also included in the identification of environmental aspects as part of a patient and employee survey. In addition, the following responsible authorities were also included in the project:

- the head of the Oberallgäu district administrative office who commissioned the pilot project;
- the district assembly with its elected members (e.g., a hospital committee including the mayor and a few councilors from Immenstadt).

Selecting indicators for EPE

The environmental performance evaluation at the clinic was based on the significant environmental aspects identified in the initial environmental review (i.e., consumption of energy and water, use of medical auxiliary and operating materials, volume of waste).

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Operational performance indicators (OPIs)

The data to support EPE was obtained through a company eco-balance (an input/output scheme for mass and energy) study of the Immenstadt Clinic. This eco-balance study provided data to establish the environmental base-line for the clinic on the amounts of inputs and outputs of energy and material, as a basis for statistical comparisons with later years, and also for evaluation of the clinic's "continual improvement process".

Company Eco-Balance Studies

A "company eco-balance study" is an internal annual recording of all incoming (input) and all outgoing (output) material and energy streams of the company. Input streams include raw materials, physical plant and equipment, water and energy. Output streams include waster water, air emissions, products and wastes after production. These environmental data are systematically recorded for the entire company year after year and are the basic data supporting indicators for EPE.

Table H.1 indicates the inputs and outputs chosen for the Immenstadt Clinic's eco-balance study; the specific quantity and the related costs allocated to each input or output were also recorded.

TABLE H.1 - Inputs and Outputs Chosen for the Eco-Balance Study

Inputs	Outputs
Amount of medical auxiliary materials used	Nursing days provided
Amount of operating materials used	Amount of waste generated
Amount of energy used	Amount of energy emitted
Amount of water used	Amount of wastewater discharged
Amount of compressed air or oxygen used	Amount of waste air or oxygen emitted

In addition, the 20 largest blocks of flows and costs from the eco-balance study were ranked in descending order. This supported the identification of items for which the development of saving measures would appear to be particularly effective.

OPIs based on parametres compared to turnover or production take fluctuations in the turnover or production quantities of a company into account when evaluating performance. The medical service sector has introduced "nursing days" or the "planned number of beds" as a measurement of turnover, and this measure is used in the Immenstadt Clinic. Based on the significant environmental aspects identified, the following OPIs comparing various parametres with turnover were selected:

- energy efficiency indicator - consumption of heating energy and electricity per planned bed or nursing day;
- water efficiency indicator - water consumption per planned bed or nursing day;
- waste indicators:
  - volume of waste per bed or waste quota per nursing day;
  - recycling quota (volume of recyclable materials in relation to total waste volume).

The environmental performance criteria of the organization (Immenstadt Clinic) is annual improvement in the value of the selected OPIs. The Clinic also plans to compare the following OPIs with other hospitals of a similar size:

- amount of medical oxygen used per nursing day or per planned bed;
- amount of gas emissions (e.g., carbon dioxide, sulfur dioxide, nitrogen oxide) per nursing day or per planned bed;
- amount of energy consumed per nursing day or per planned bed. In the future, the average temperature of each calendar day in the region would be considered in relation to this indicator. This would allow for consideration of the influence of extremely cold or extremely mild winters on energy consumption.

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Management performance indicators (MPIs)

The following MPIs were selected:
- number of measures implemented from the agreed 2-year resource and cost savings program;
- cost savings realized by the reduced use of resources, recycling of waste and the prevention of environmental pollution;
- extent of compliance with applicable regulations.

Two management objectives, the achievement of which would also be indicative of management performance, were also set.
- creation of an environmental management system complying with EMAS with successful certification;
- publication of an environmental statement.

Environmental condition indicators (ECIs)

The following ECIs were selected in co-operation with the regional authorities, taking into account in the environmental management of the Immenstadt Clinic:
- the change in the temperature of ground water caused by heat emitted;
- concentration of gas emissions (e.g., carbon dioxide, sulfur dioxide, nitrogen oxide) in the air in the vicinity of the Immenstadt Clinic. This aspect is particularly significant in the area; some locations are categorized as "climatic health resorts" and tourism is important in the region.

Using data and information

First, data was collected for the year 1995 through the eco-balance study. The most important data sources were the financial records with the 1995 annual balance, bills from suppliers, and receipts for waste disposal from the purchasing department.

The data analysis showed that the quantities of materials and energy were recorded in different physical units (e.g., for energy consumption, use of heating oil was measured in litres, use of electricity was measured in kilowatt hours). This led to converting the amounts into uniform physical units (e.g., converting litres of heating oil into kilowatt hours of energy) and assigning them to the appropriate life cycle assessment input (e.g., total energy consumed). To guarantee comparability of data for the following years, procedural guidelines for the collection, conversion and accounting of data were documented.

The eco-balance study established the following picture of the environmental base line for the Immenstadt Clinic in 1995:
- total energy consumption - approximately 5 million kW · h;
- total water consumption - 28 600 m^3;
- total volume of non-recyclable waste - 458 m^3;
- medical auxiliary materials and operating materials - After analyzing the data, potential opportunities for saving resources of specific and particularly cost-intensive auxiliary materials were identified and realized (e.g., medical oxygen).

In addition, a benchmarking exercise with a hospital of similar size was conducted using the available indicators related to turnover. Results showed that Immenstadt Clinic uses water and energy resources more efficiently than other hospitals of similar size.

Reporting and communicating

The results of the environmental performance evaluation were communicated internally to the hospital management and to the environmental work groups. Medical and administrative staff were particularly impressed by the indicators that showed potential opportunities for resource and cost savings. As a result, 4 work groups developed 260 environmental measures to be implemented as part of a 2-year program.

To communicate the environmental performance evaluation process of the Immenstadt Clinic to external interested parties, detailed reports were made available to the responsible authorities and articles were published in the local daily newspaper. An environmental statement and report is planned after successful certification to ISO 14001 or EMAS.

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Reviewing and improving EPE

The collection of data involved a considerable amount of work; however, the method used and the guidelines for collecting data should make future data collection easier.

The employees involved have initiated measures using the identified indicators which have led to resource savings and the reduction of wastes. As a result, an annual savings of $25 000 (U.S. dollars) has been realized.

Summary/conclusions

EPE (especially in combination with the initial environmental review) provided the Immenstadt Clinic with an effective and efficient introduction to environmental management. At the same time the foundation was laid for the creation of an environmental management system according to ISO 14001 and/or EMAS.

EPE has proven to be a successful tool for environmental management in hospitals.

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Annex I

YPF Luján De Cuyo Refinery, Central Western Argentina

(A multinational oil company's refinery, employing approximately 570 people, implementing environmental performance evaluation integrated with its ISO 14001 certified environmental management system)

Introduction

YPF Luján de Cuyo Refinery is a business unit of a multinational oil company based in Argentina, with several operations and sites in Los Andes county of Argentina, the United States of America, and elsewhere. It was established in 1940 in the central western area of Argentina, near the Los Andes mountains, an inland semi-deserted area. It is a private company with 20% of the shares owned by the government. It is a typical oil refinery complex, processing 20 000 cubic metres of crude oil each day, producing liquefied petroleum gas, gasoline, turbine fuel (JP1), gas oil, kerosene, fuel oil, lubricant base oil, coke, carbon dioxide (food grade), and propylene and virgin naphtha for petrochemical use. The total number of employees at this location is 568.

The Refinery uses water from a nearby river for its processes and returns some of this water to the river downstream, after a treatment process that includes pools constructed to American Petroleum Institute (API) standards, biological treatment and aerated lagoons.

The Refinery Unit implemented an environmental management system conforming to ISO 14001 during 1997. Throughout the process, the top management perceived the need to further improve the environmental management system by developing a set of indicators to evaluate the results of technological changes, initiatives, legal compliance and overall environmental performance.

The scope of the environmental performance evaluation (EPE) was the entire Refinery operation; the focus was on developing a managerial decision-making tool and a reliable source of environmental data to incorporate into internal and external voluntary environmental performance evaluation reports.

Planning EPE

The significant environmental aspects of refinery operation include as a minimum: resources (e.g., crude oil utilization, cooling water consumption), emissions to air (e.g., sulfur compounds, carbon dioxide, nitrogen oxides, volatile organic compounds, and various leaks), emissions of substances in wastewater (e.g., oil, phenols, chemical oxygen demand, nitrogen and phosphorus compounds, and acidity) and liquid and solid toxic wastes. These aspects were identified during the process of implementing an EMS according to ISO 14001.

Concerning this particular case, it is important to mention that the Refinery was built at the base of the mountains, close to a river which supplies water to the main cities and agricultural crops (e.g., grapes, olives and other fruits) in the river valley. The areas not served by artificial irrigation are desert. It is a typical mountain dry inland oasis. The principal source of water is the river. Groundwater is a secondary source, but wells have to be drilled very deep and are expensive. This is why some of the relevant environmental condition indicators that are show in tables below are related with this issue.

Another important issue in the planning of the EPE was that, compared to the rest of the country, the province has well developed environmental legislation. Interested parties are sensitive to air pollution and water contamination. Upstream oil activities are perceived by the community and the media as the cause of surface degradation, poor groundwater quality and desertification.

The above mentioned critical problems plus the proactive role that YPF plays in the local community justifies the technical and social indicators mentioned in Table I.3.

The environmental criteria of the YPF Luján de Cuyo Refinery are expressed in the organization's Environmental Policy. Examples of the criteria particularly linked to the use of indicators include commitments to:

- continuous improvement of the environmental performance.
- allocate with priority financial resources in order to ensure the preservation of the environment.
- minimize waste generation and environmental impacts resulting from oil refining.

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This production site usually employs indicators to measure operational performance, and economic and financial results. Therefore, the development and use of EPE was a natural extension of common practice in other areas of the company. The potential use of environmental benchmarking was also appreciated. ISO 14031 was chosen as the guiding document.

Soon after the company obtained its ISO 14001 certification, the management supported the implementation of EPE fully integrated into the EMS. A group of 10 people, experienced in the ISO 14001 implementation process, formed the EPE task force, which was co-ordinated by the Management Representative, with the assistance of an external consultant. Two officials from the company's accounting department also joined the team.

As all environmental aspects and impacts had been identified and evaluated according to ISO 14001, a plant wide data base was generated with over 2 500 inputs. Approximately 200 were noted as potential operational performance indicators (OPIs) or management performance indicators (MPIs), 85 of which are used. Only some examples of these indicators are shown in the tables below.

Selecting indicators for EPE

A set of indicators directly linked to environmental costs was developed based on Guidelines provided by the Austrian Federal Ministry for the Environment, Youth and the Family (Bundesministerium für Umwelt, Jugend und Familie - BMUJF) in the manual titled *Development of a Methodical Approach for Deriving Environmental Costs from the Enterprise Accounting System (Entwicklung Eines Methodischen Ansatzes Zur Ableitung von Umweltkosten Aus Dem Betrieblichen Rechnungswesen)*, developed by the Institut für Ökologische Wirtschaftsforschung (IÖW), Arge Müllvermeidung Graz and the Institut für Verfahrenstechnik Graz; published in June 1997 by the BMUJF, Vienna, Austria.

Consideration of these guidelines and documents helped in some cases to integrate several aspects and impacts into a comprehensive, more meaningful indicator. In addition, this process also resulted in some very interesting management performance indicators (MPIs).

Evaluation and selection environmental conditions indicators (ECIs) was a difficult task, and the following were useful for the selection of ECIs:

- previous knowledge on the area;
- relationships and consultation with academic units, research institutes and governmental agencies
- the Organization for Economic Co-operation and Development publication on environmental performance reviews *A Practical Introduction,* published as OCDE/GD(97)35;
- the United Nations Commission on Sustainable Development publication *Indicators of Sustainable Development - Framework and Methodologies* (Published August 1998).

In general, the criteria for selection of indicators were established according to the guidelines in ISO 14031 and documented in a procedure in the company's environmental management system manual.

TABLE I.1 - Examples of Management Performance Indicators (MPIs) (Incomplete List)

MPI	Comments
Man-hours for environmental training as a percentage of the total training man-hours	Environmental commitment
Annual budget for environmental care as a percentage of the total annual budget	Environmental commitment
Number of environmental initiatives for the local community per year	Understanding the views of interested parties
Man-hours per year for emergency simulations	Emergency response preparedness
Total annual man-hours in environmental training of contractors and suppliers	Environmental commitment
Annual expenses in environmental remediation	This is related to reduction / prevention of pollution
Annual expenses in tank maintenance / repair	This is related to reduction / prevention of soil contamination and underground water quality

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MPI	Comments
Cost (in U.S. dollars) for chemical products for wastewater treatment per cubic metre of wastewater	Expenses for chemical products for wastewater treatment
Number of environmental incidents per year with cost over 5,000 U.S. dollars	Indirect measurement of the environmental prevention policy
Annual expenses for water use	Conservation of natural resources

TABLE I.2 - Examples of Operational Performance Indicators (OPIs) (Incomplete List)

OPI	Comments
Kilowatt hours per 1 000 cubic metres of oil processed	Benchmark indicator - Electrical efficiency - Global greenhouse effect prevention
Water intake in cubic metres per cubic metre of oil processed	Intake water efficiency (not valid as an stand-alone indicator)
Equivalent low pressure steam in metric tones per cubic metre of oil processed	Benchmark indicator - Steam and energy consumption - Global greenhouse effect prevention
The relation between the mass of crude oil and the sum of masses of products with commercial value produced during the same period of time	Conversion efficiency
Cubic metres of effluent water per cubic metre of oil processed	A measure of the re-use of water
Waste generation (by type) per month	Waste minimization
Annual consumption of potentially hazardous products	Environmental risk potential
Total stock of chlorofluorocarbons at the site	Ozone depletion substances. This is related to reduction / prevention of pollution
Operational availability index	Indicates quality of preventive maintenance and status of facilities / equipment

TABLE I.3 - Examples of Environmental Condition Indicators (Incomplete List)

ECIs	Comments
Hydrocarbon content in groundwater	Measured at selected sites in the region - related to reduction / prevention of soil contamination and underground water quality
Sulfur dioxide in air (ppm at 6 locations in the plant)	Benchmark indicator related to the sulfur content in crude oil - Global acidification effect prevention
Forested/park area as a percentage of the total site area	Understanding the views of interested parties
Productivity by hectare	Agricultural activities - River valley
Head count index on poverty	Regional
Unemployment rate	Regional
Population attending school (three levels)	Regional
Primary school enrollment ratio	Regional
Access to safe drinking water	Regional
Access to natural gas / electrical service	Number of homes served - Regional
Access to adequate sewage disposal facilities	Homes served - Regional
Salinity in surface water	Regional - River valley
Salinity in groundwater	Selected sites - Regional

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Analyzing and converting data

The areas responsible for collecting the data are required to calculate those indicators that result from multiple inputs of data or that involve rather complex calculation. In each case where there is potentially conflicting or unclear conclusions resulting from a specific indicator, the indicator is so noted, and any measurement uncertainties, and the frequency of data collection and reporting are also noted.

Summary/conclusions

YPF Lujan de Cuyo Refinery considers that indicators are a valuable tool in decision taking. However they rarely have significance by themselves and a great care should be taken to define their significance and limitations. Appropriate explanatory text should be provided when evaluating and reporting on indicators. Comparability between units is an important issue when corporation-wide benchmarking is intended.

YPF Lujan de Cuyo Refinery's experience showed that the selection of indicators by a multidisciplinary team is a very productive approach. In addition, the inclusion of environmental cost factors when selecting indicators was very helpful for the organization.

The fact that this refinery was working on the implementation of an environmental management system based on ISO 14001 was very useful and simplified many tasks.

Finally, the organization believes that certain tools, and previous experience on other internationally agreed procedures for environmental performance for the regional or national level can be used with care, together with the guidance in ISO 14031, when selecting indicators for EPE.

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Annex J

Hipp Company, Pfaffenhofen/Ilm, Southern Germany

(A food processing company, with approximately 750 employees, and with an environmental management system certified to ISO 14001 and EMAS, getting started on environmental performance evaluation)

Introduction

Hipp, a medium-sized family business situated in Pfaffenhofen/Ilm, Southern Germany, was founded in 1932. The company has subsidiaries in Austria (Gmunden), Switzerland (Sachseln) and Hungary (Janossomorja). Approximately 750 employees are currently employed at the Pfaffenhofen site. In 1997 the company had a turnover of approximately 330 million Deutsche Marks.

The most important areas of business in Pfaffenhofen are the production and sales of baby food. A total of 166 different articles are manufactured, the most important being baby food in jars, milk semi-solid food, fruit juices and powdered milk. The customer structure is made up of retail grocers, drugstore markets, pharmacies and drugstores. In addition to Germany, Austria and Switzerland, the products are sold in France, England, Belgium, the Netherlands, Luxembourg, Hungary, Poland, Czech Republic, Slovakia, CIS (Russia).

The company's success is founded on the philosophy of constantly producing top quality in harmony with nature. Top priority is given to the health of children and the confidence of mothers in the products. Approximately ten per cent of the employees work in the area of quality control. Hipp currently buys a large amount of its raw materials from well known associations and amalgamations of organic farmers, and receives supplies from approximately 1 000 organic farmers.

In co-operation with Dr. Hans Müller (1891 to 1988), the founder of organic biological farming, fruit, grain and vegetables were farmed organically and processed in Switzerland as early as 1956. Hipp uses approximately 300 different raw materials, which are examined, washed, chopped if necessary, cooked and mixed during preparation. After bottling, the products are sterilized, labeled, packed and distributed.

Hipp has had an environmental management system conforming to the European Union's Eco-Management and Audit Scheme (EMAS) since 1995. Certification to ISO 14001 followed in 1997. The company has written and published environmental statements and reports since 1995.

Hipp operates four wells at the Pfaffenhofen site, drawing water from a depth of 21 to 70 metres. The water quality is far above that required by the drinking water regulations. The most productive well is officially recognized as mineral water.

Hipp's main energy source is natural gas, used together with heating oil in both boiler houses to generate processing steam. In 1999 Hipp plans to connect to a biomass heating power station. The main share of energy used will then be generated from sustainable raw materials (wood chippings).

The most important source of emissions of harmful substances into the air is the combustion of natural gas and heating oil in the boiler houses. The amount of carbon dioxide and sulfur dioxide emitted has been reduced during the last few years by substituting heating oil with natural gas.

Most of the wastewater flows into the purification plant. Prior to this, organic particles larger than 2 mm are separated by mechanical pre-treatment of the wastewater. Clean cooling water and rainwater from the roof run-off are discharged into the River Ilm.

97% of the waste materials are recycled. The majority of waste consists of plant material, which is used to feed cattle or as agricultural fertilizer. Waste meat is used as feed in a special fattening company.

Recyclable materials such as glass, paper, plastics, metals and wood are returned directly to the recycling cycle.

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Planning EPE

Hipp has set itself ambitious environmental objectives based on the company's environmental guidelines. The organic share of products, for example, should be constantly raised and the share of resources which can be regenerated should be extended. The purchase of natural organic products, almost free of harmful substances, does not take place directly under consideration of environmental condition indicators. However, an indirect selection of farming areas according to their environmental condition takes place in that the biological raw materials must fulfil not only the guidelines of the Bioland Association, but also those of Hipp, which supplement the Bioland guidelines. The Hipp organic farming begins with an examination of the fields to be farmed to detect harmful substances in the soil. The results of the examinations have to meet Hipp's strict standards, before a contract is signed for the use of the field for Hipp organic farming. The quality of the environmental condition of the farming land is also guaranteed by, for example, setting minimum distances to roads with heavy traffic volumes and other sources of hazardous substances.

Extensive controls of incoming raw materials prevent their use when, despite the use of organic farming methods, an environmental condition in a farming area leads to unacceptable levels of harmful substances in the produce.

Selecting indicators for EPE

The most important environmental aspects are recorded within a company eco-balance (input/output scheme for mass and energy) study. Thus, indicators can be used to record and monitor the development of the most important environmental aspects over the last few years. At the same time, indicator values are pinpointed as concrete environmental targets for the coming year. This requires extensive in-company discussions with those involved (e.g., production, representatives, purchasing).

Company Eco-Balance Studies

A "company eco-balance study" is an internal annual recording of all incoming (input) and all outgoing (output) material and energy streams of the company. Input streams include raw materials, physical plant and equipment, water and energy. Output streams include waster water, air emissions, products and wastes after production. These environmental data are systematically recorded for the entire company year after year and are the basic data supporting indicators for EPE.

The Hipp Company's environmental aspects, environmental performance criteria and management performance indicators (MPIs) are provided in Table J.1. Hipp's indicators for EPE and their related environmental targets are presented in Table J.2. In addition to the environmental aspects shown in Table J.1, the OPIs in Table J.2 are linked to the use of water and energy, emissions resulting from energy produced on-site, and the generation of waste.

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TABLE J.1 - Hipp Environmental Aspects, Environmental Performance Criteria, and Management Performance Indicators (MPIs)

Environmental Aspect	Environmental Performance Criterion/Criteria	MPI(s)
Use of resources (Use of water is an important environmental aspect for Hipp)	• Conserve and reduce the use of resources; • Reduce costs	• Amount of operating material in kilograms; • Cost of operating material per tonne of production; • Amount of packaging in kilograms; • Cost of packaging per tonne of production; • Use of water in cubic metres; • Cost of water usage per tonne of production
Organic biological farming	• Produce top quality products in harmony with nature; • Increase the organic share of the total production; • Improved quality of water used	• Percentage of total production using organically farmed raw materials; • Percentage of mineral water in the total amount of drinking water used

TABLE J.2 - Hipp Operational Performance Indicators (OPIs)

OPI	1995	1996	1997	Targets for 1998
Percentage of organic share	69,1	68,2	73,3	75
Operating materials in kilograms per tonne of product	4,7	4,3	4,5	4,3
Cleaning agents in kilograms per tonne of product	2,5	2	1,95	1,9
Water in cubic metres per tonne of product	13,3	12,1	10,6	10
Packaging in kilograms per tonne of product	615,4	570,1	564,2	560
Energy in kilowatt hours per tonne of product	1 151	1 137	1 085	1 060
Carbon dioxide in kilograms per tonne of product	241	235	205	200
Sulfur dioxide in grams per tonne of product	162	173	132	120
Nitrogen oxides in grams per tonne of product	349	234	222	215
Wastewater in cubic metres per tonne of product	11,3	10,5	8,9	8,5
Total waste in kilograms per tonne of product	251,4	212,9	250,5	230
Volume of non-recyclable waste in kilograms per tonne of product	5,9	5,1	5,3	5
Organic waste in kilograms per tonne of product	203,2	174,6	211	190

Water consumption is an important environmental aspect for Hipp. The Hipp Company uses raw water supplied via a separate circulation system for the company's cooling system, and it uses drinking water (i.e., quality mineral water or tap water) for food production.

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Processing agricultural raw materials requires a large amount of water, in particular for washing fresh vegetables and sterilizing the products. High quality drinking water is mostly used for this purpose. This drinking water is separated from the surface water by various layers of soil, so that human influences such as the application of fertilizers to farmland, are not detectable. This makes this drinking water a valuable resource, which should be used very sparingly to preserve the reserves for many years to come. Hipp's water consumption decreased in the last six years from 835 100 cubic metres to 462 860 m^3, i.e. by 45%. The water consumption per tonne of product decreased from 17,6 m^3 to 10,6 m^3. Water savings of 100 000 m^3 have been made by optimizing circulation of the cooling water for sterilization.

In addition, the vegetable preparation process has been rearranged. Flooding systems have been replaced by other transport methods. The water used for washing carrots is reused several times. The use of water intensive pre-cookers is being increasingly replaced by the use of the steam thawing machinery. Floors are being cleaned by high pressure cleaners, which achieve a better cleaning effect while simultaneously saving water.

Water-saving measures have also been implemented in areas outside the production process. For example water taps have been equipped with devices for mixing water with air to reduce the amount of water used. An annual saving of 1 500 m^3 has been achieved by reducing the amount of water in toilet cisterns. These measures are documented in the annual environmental program with responsibilities and deadlines, so they can be continually checked and updated.

The company's efforts to reduce water consumption are reflected in the wastewater situation. The amount of wastewater produced five years ago was 774 000 m^3; this has decreased by approximately 50% to 387 500 m^3 last year. At the same time discharges to the municipal sewer works decreased from 511 000 m^3 to 244 000 m^3. Hipp`s water pollution was also reduced from 48 000 corespondent values per inhabitant to 20 000 correspondent values per inhabitant, a reduction of over 50%. (A correspondent value per inhabitant is equivalent to the daily amount of wastewater produced by the average person). This has relieved the strain on the purification plant and reduced the extent of planned expansion on the plant.

Due to the organic waste in the water and the relatively high temperature (25 ^{o}C) Hipp's wastewater is suited to the cleaning performance of the purification plant, in particular for the biological purifying phase. This becomes evident during lengthy breaks in production, e.g. during construction work, in which the cleaning performance of the purification plant decreases. An earlier problem with the purification plant's handling of larger particles in Hipp's wastewater has been solved by introducing mechanical pre-treatment at the site.

Using data and information

Data is collected annually for the company eco-balance study. Water consumption can be measured precisely with water metres on wells and municipal water connections. Water consumption and wastewater amounts are additionally measured for the main production processes (e.g., the cleaning of the cooking equipment, floors and machines, the cooling, the washing of raw goods, the sterilization and the bottling). The main deficits can thus be identified and improved by environmental measures.

Hipp conducts active environmental cost-management, limited to the most relevant cost blocks. An input/output-process-balance documents consumption. After analyzing and evaluating the values, objectives and measures are formulated, which lead to the reduction of environmental impacts and also to cost savings. Compared to 1992, annual savings of approximately 300 000 Deutsche Marks have been achieved by reducing water consumption and the volume of wastewater. Thus in the last few years the environmental costs fell from 82 Deutsche Marks per tonne of product to 69,50 Deutsche Marks per tonne of product.

Reporting and communicating

The annual environmental report contains not only the absolute values of the environmental aspects in the life cycle assessment, but also the indicators regarding the production unit. In addition, the planned values of the environmental indicators are stated for the coming year. The environmental report is distributed to employees, consumers, large customers, suppliers, universities, authorities, hospitals and others. An answer-coupon is included in the environmental report to obtain as much external feedback as possible. Approximately 50 to 60 replies are received annually, consisting of very positive feedback, and sometimes interesting suggestions, which are then evaluated internally. Three thousand copies of the environmental report are published annually, and publication via the Internet is currently being prepared.

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Reviewing and improving EPE

Indicators for EPE are an important instrument for Hipp for assessing the environmental impacts of the last few years. The prerequisite for the continual improvement of the environmental situation at Hipp is the nomination of objectives and measures with the help of the indicators, after intensive internal discussions with the persons involved. In this manner it is possible to check if measures implemented have actually achieved the planned savings. An internal report to the management (Management Review) informs management on the development of indicators and the extent to which objectives have been achieved. Together with management, causes are then analyzed and possible solutions are planned. The indicator system is improved and extended when potentials for improvements are identified.

Environmental Guidelines of the Hipp Company

We feel responsible for protecting the environment. Our corporate environmental protection goes beyond legal requirements to do justice to this responsibility. The environmental guidelines are the basis for the continual improvement of Hipp's corporate environmental protection and are part of the company's corporate policy. The implementation of these guidelines is a obligatory part of the management's responsibility and is guaranteed by a practicable environmental management system. To us, this is now and in the future an essential prerequisite for the production of healthy foodstuff.

1. The use of environmentally-friendly technologies enables us to minimize harmful effects on the environment as far as is possible.
2. The interaction between the Hipp Company and the environment is constantly monitored, documented and analyzed. Possible improvements are to be realized with the most appropriate technologies, taking, however, economic aspects also into consideration.
3. The negative effects on the environment caused by new activities, products and processes should be kept to a minimum, and are therefore always assessed in advance.
4. We aim to save resources. Recyclable resources are to be used in favor of limited resources.
5. As the world's largest processor of organic raw materials, we are particularly committed to constantly raising the organic share of our products.
6. Packaging planning is subject to a minimization principle. The quantity of packaging materials used should be kept to a minimum. This is achieved by using a maximum amount of secondary raw materials and recyclable packaging. We support packaging alternatives, such as recycling systems.
7. We believe that effective corporate environmental protection can only be achieved with the active participation of all employees. We aim to encourage their environmental awareness by providing them with information and instructions, and offering them training programs.
8. We offer our customers constant advice on the possibilities of the environmentally-friendly use of our products.
9. Our suppliers are all expected to fulfil environmental standards comparable to the ones of our company.
10. We cultivate an open dialogue with the public by regularly informing them on our environmental protection activities. We endeavor to integrate their suggestions and comments into these activities.
11. The intensive contact to authorities helps us to avoid and/or minimize negative effects on the environment.
12. A comprehensive accident management system has been developed to minimize the risk of accidents, as well as harmful effects on human beings and the environment.
13. Control systems guarantee the fulfillment of our environmental objectives. These systems are subject to constant examinations according to the latest state of knowledge, and they can be modified if necessary.

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Annex K

United Chemical And Metallurgical Works (Spolek), Ústí Nad Labem, Czech Republic

(A chemical company, with approximately 2 000 employees, using environmental performance evaluation as a tool for environmental management system implementation)

Introduction

This example illustrates the use of the guidelines on environmental performance evaluation (EPE) in ISO 14031 to assist the establishment of an environmental management system (EMS) that complies with ISO 14001. The case study was developed by the employees of Spolek's environmental department in co-operation with the consultant (Management Systems Team, Prague) who assisted the company in implementing its EMS. At the time of writing, the EMS was implemented and certified. EPE was an important tool during planning and development of the EMS.

United Chemical and Metallurgical Works (Spolek pro chemickou a hutní výrobu, a.s.) is a company established in 1856 near the center of the city of Ústí nad Labem (population of 100 000) in the north of the Czech Republic. The company operates in one of the valleys in a heavily polluted area near the Polish and German borders known as the "Black Triangle". Frequent smog alerts and "dead forest" areas are caused by heavy chemical and petrochemical industry operations, brown coal mining and power station operations in all three countries.

The company is owned by several minor and two major (54% and 12%) private shareholders. Spolek employs over 2 000 people and the annual sales of its products amount to over 100 million U.S. Dollars. 40% of sales are exported (to Germany, Austria, Poland, Italy, and Slovakia). The local business environment and management practices are influenced by the process of transformation from a centrally planned to a market economy.

Spolek makes about 1 000 products, the majority of which are elementary inorganic and organic compounds, synthetic resins, organic dyestuffs and special chemicals. The most significant environmental aspects are waste waters released into a local river and the management of toxic wastes (e.g., mercury).

The main production plant in Ústí, where the EMS was implemented, is organized into three divisions.

Planning EPE

The company was complying with the regulations in force when it was planning for its EMS but the limits were to become more stringent in the near future which would make compliance very difficult. Setting priorities was therefore a key consideration in the planning stage. The company management decided to use the ISO 14031 approach to determine priorities and improve the planning process.

In planning its EPE and preparing for implementation of its EMS, Spolek assessed its status against the 16 principles of International Chamber of Commerce (ICC) Business Charter for Sustainable Development. This process yielded a set of priority areas for improvement in general management practices which included:

- clear allocation and documentation of responsibilities;
- a motivation program;
- the integration of environmental aspects into marketing strategies;
- research and development;
- improved feedback, collection and utilisation of data.

In a management session, a set of performance criteria was developed for the EMS related to customer interests, health and safety and legislative requirements, product environmental quality, risk minimization, company image, etc.

A decision was also made to improve the management of the Ústí plant's operational systems. The first tool that was developed to assist this process was a complete Legislative Register which included other requirements and voluntary commitments. A limited form of register which had previously been used by the company was updated and improved for this purpose.

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As the next step, it was decided to produce a Register of Environmental Aspects (REA) for all operations at the Ústí plant. This was a very complex task and therefore the Environment Protection Department developed a methodology based on the guidance in ISO 14031 which was particularly helpful for identifying the environmental aspects. This methodology was used by all units of the company to identify and evaluate their specific environmental aspects and record them in the REA, and it now provides a tool for checking and updating the REA.

Selecting indicators for EPE

Selecting management performance indicators (MPI's)

Targets were set in those areas of management that received the highest priority according to the agreed management (performance) criteria. Projects were developed and MPI's were selected to monitor and evaluate progress in the priority areas at given intervals.

TABLE K.1 - Examples of Management Performance Indicators (MPIs)

Project	Management Performance Indicators (MPIs)
Product research and development	• Number of new products developed using an LCA approach. • Number of improved environmental aspects in products. • Number of products and the amount of toxic content in the products replaced by non-toxic content.
Environmental training and motivation	• Percentage of cost spent on employee training. • Number of incidents per year caused by human error. • Number of feedback ideas received per year from employees via an environmental suggestion box.
Public relations (Company image)	• Number of activities (open doors) per year developed and organized for the city community. • Number of complaints per year from the community.

Selecting environment condition indicators (ECIs) and operational performance indicators (OPIs)

First, a list of global and regional environmental impacts was developed including items such as global warming, depletion of the ozone layer, damage to forests, pollution of groundwater, etc. which led to identification of the company's environmental aspects relating to these impacts. Next, ECIs and OPIs related to the identified aspects were prioritized using a set of 5 criteria:

- economic criteria (e.g., costs of materials, energy, fees, cleaning);
- social criteria (e.g., public and employee complaints, views of interested parties);
- legislative (e.g., limits, regulations, voluntary agreements);
- technological (e.g., new materials and technologies);
- ethical (Elbe River Program and other voluntary commitments).

Environmental aspects were listed for all activities performed at each operational unit and then prioritized for significance using the above set of criteria specifically adapted to the conditions of the unit. The resulting significant aspects fall into two groups:

1. aspects to be controlled and monitored (so that current limits and values are not exceeded);
2. aspects to be improved (environmental improvement programs are designed to implement measures to reach target values of selected OPI's).

A set of priority ECIs and OPIs (called "characteristic indicators" in the company) emerged as applicable to all the production units in the plant. These were expressed in measurable units, e.g. chlorinated hydrocarbon (CHC) volume per cubic metre of waste water, mercury content per cubic metre of air, CHC volume per hour per cubic metre of air. These indicators are constantly monitored for the entire plant and used for external communication (e.g., environmental report, negotiations with the local administration and other interest groups).

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TABLE K.2 - Examples of Spolek Company "Characteristic" Indicators

Global/Regional Impact	Priority Environmental Aspect	OPI/ECI (Spolek Characteristic indicator)	Target
Forest depletion - acid rain	Sulfur oxides (emissions to air)	Sulfur oxides in tonnes per year	In 1997: 52% of 1993 emissions
Water pollution	Chlorinated hydrocarbon content in plant effluents	Chlorinated hydrocarbon in tonnes per year in waste water[a]	In 2000: 22 tonnes per year
Heavy metals in the environment	Mercury emissions to air	Tonnes of mercury per year	In 1997: 77% of 1993 emissions
Ozone layer depletion	Freon emissions to air	Tonnes of freon per year emitted to air	In 1997: 3% of 1993 emissions
[a] The company can only monitor the total volume at its output point and then control its contribution to water pollution.			

The "characteristic" OPI's and ECI's are used internally by all production units of the company as the main reference in the process of prioritizing their own particular environmental aspects.

Measurable OPI's are then selected for each significant aspect of each production unit (e.g., Chlorinated hydrocarbon per cubic metre of waste water, hours of emergency training per employee per year). These indicators are monitored and evaluated and the results are reported to management, the environment protection department and others in the company.

TABLE K.3 - Examples of a Production Unit's Aspects to be Improved

Production Unit - Environmental aspect	Characteristic Indicator	OPI	Target
Sulfuric acid production - Sulfur trioxide emissions after absorption	Sulfur trioxide emissions to air	Sulfur trioxide emissions in kilograms per tonne of produced acid	2,2 kg per tonne in 1999
Organic dyes production - dust emissions after dryer	Dust emissions to air	Dust in milligrams per cubic metre of air	5 mg per cubic metre of air in August 1998
Chlorine production - Electrolysis - Mercury emissions to air	Mercury emissions to air	Mercury emissions to air in grams per tonne of product	5 grams per tonne of chlorine in March 1998

TABLE K.4 - Example of a Production Unit's Aspect to be Monitored

Production Unit - Environmental aspect	Characteristic Indicator	OPI	Target
Hydrofluoric acid production - Vapor after absorption	Hydrofluoric acid emissions	Hydrofluoric acid in milligrams per cubic metre of air	Target in September 1998: 8,7 mg hydrofluoric acid per cubic metre of air (Limit: 10 mg hydrofluoric acid per cubic metre of air)

Reviewing and improving EPE

The indicators for EPE are periodically reviewed as part of the audit and EMS review process.

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Summary/conclusions

Spolek found that putting EPE in place as a management tool when developing its EMS helped to focus the company's efforts on the areas most requiring attention. An important benefit of this approach is the training and increased motivation of the employees that results from their participation in setting environmental priorities and designing the process for monitoring and control. Increased environmental awareness and employee motivation also provides more commitment to the implementation of EMS programs.

The guidance in ISO 14031 was found to be particularly helpful when identifying the environmental aspects of the organization.

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Annex L

Danish National Railway Agency, Denmark

(A company managing Denmark's railway infrastructure, with approximately 3 400 employees, using ISO 14031 as an instrument for improving the structure and quality of its indicators for environmental performance evaluation)

Introduction

The Danish National Railway Agency (DNRA) was formed January 1, 1997 as a result of the reengineering of the Danish State Railways (DSB) into an operating company (DSB) and an infrastructure company (DNRA). DNRA is part of the Ministry of Transport, and has approximately 3 400 employees. The activities of DNRA can be divided into four main areas:

- operating and maintaining the rail infrastructure, e.g., reconditioning of tracks (replacing rails, sleepers, ballast), controlling weeds (weeds might reduce track drainage, affecting track stability), and grinding track (for operational purposes and for limitation of noise);
- extending the rail infrastructure;
- planning and managing traffic;
- allocating rail infrastructure capacity to various rail operators (including the supply and distribution of energy to electric trains. In this respect, DNRA wants to increase its use of renewable energy).

The DNRA also owns and operates property used by operational, traffic and administrative personnel, among others.

The environmental aspects relate to consumption of energy and raw materials and emissions from works and vehicles. Running the properties involves purchasing office goods, various types of equipment, and the consumption of electricity, water and heat. Track reconditioning generates substantial quantities of waste in the form of used ballast. Weed control involves the use of pesticides which may be considered harmful to the environment. Railways are a source of both noise pollution and vibration. DNRA seeks to reduce these nuisances through track maintenance and the erection of noise barriers. Oil spillage may cause harm, especially to groundwater, and some locations have been subject to oil pollution. DNRA's duties therefore involve both preventing further pollution and cleaning up after previous spills.

Extending the rail infrastructure will have a major impact on the environment. The location of new track can, for example, seriously affect flora and fauna, the natural and cultural landscape, neighbors, large and small towns, and businesses. The environmental aspects related to railway operation include emissions, aesthetic problems, noise pollution, vibration, reduced amenity value and restricted area access. During the construction phase, the environment will be affected by contracting work that entails, for example, noise pollution, energy consumption, emissions, access roads, and disruptions to daily life.

The travel patterns of trains (e.g., speed, number of stops, acceleration) affect the consumption of energy and the related emissions. Travel patterns are a result of planning, traffic management and the operational habits of train drivers. DNRA can influence the rail sector's largest environmental impacts, the energy consumption and emissions of trains, through careful planning and management of traffic.

DNRA supplies and distributes energy to electric trains. Using electricity as a source of energy enables the use of renewable energy. DNRA is therefore presently investigating the potential of using windpowered electricity and does at the same seek to extend the share of the railway infrastructure that is electrically driven

Planning EPE

DNRA has formulated its environmental policy on the basis of the environmental aspects mentioned above.

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DNRA's environmental policy

DNRA will work to ensure that the railway is used properly and efficiently with a view to minimizing environmental impacts and the consumption of resources. In this way the railway can make a considerable contribution to solving one of the transport sector's biggest problems - ever increasing environmental impact.

Together with other players in the transport sector and society in general, DNRA will look for new ways of achieving sustainable mobility.

DNRA will work to ensure that the railways retain and exploit their position as the most environmentally friendly form of transport. DNRA wishes to be viewed as an organization which leads the field in environmental matters, because the challenge facing railways in the future is to be able to provide a form of transport which is both competitive and environmentally sound.

DNRA sees it as its duty to encourage Denmark's rail operators to incorporate environmental awareness into their operations. The organization itself will provide routes which are operated and extended with nature and the environment in mind.

DNRA will evaluate the environmental consequences of all the services which it provides or receives, integrating environmental aspects into its operations as a whole. This is why DNRA is involving its customers, the authorities and the general public in an active dialogue on environmental aspects.

DNRA volunteered as a pilot company in a test of ISO 14031. The rationale for participating was partly to contribute to the experience amassed in connection with the standard and partly to supplement the internal work of DNRA on environmental management. The anticipated benefits were:

- a tool enabling DNRA to assess the extent to which it is meeting its environmental objectives at all times;
- improved measurement of managerial performance;
- the measurability of environmental targets;
- a review of its existing indicators for EPE;
- the evaluation of its existing environmental objectives using a different system;
- the use of some of the resulting indicators in the 1997 environmental report which is named Environmental Report and Green Accounts (hereafter green accounts) and all others in the future.

DNRA has worked with indicators for EPE for some time, producing its first green accounts for the 1996 financial year in conjunction with DSB. These accounts provided a status report in terms of the environmental targets that had been set for both DSB and DNRA. Following the division of DSB and DNRA, DNRA adopted a strategy and objectives for its own environmental work. DNRA published its first independent environmental accounts, the Environmental Report and Green Accounts for 1997, in May 1998. ISO 14031 was tested both during and after the preparation of the Environmental Report and Green Accounts for 1997, and helped to broaden the company's perspective and structure its work in this area.

DNRA is in the process of developing an environmental management system in line with the guidelines set out in the European Union's Eco Management and Audit Scheme (EMAS). As this process was already under way, it was not appropriate for DNRA to use the "Plan-Do-Check-Act" model when testing ISO 14031, even though it is seeking to report its environmental performance in line with this. Instead, the focus was solely on the development of indicators for EPE and the future use of indicators for EPE at DNRA. Therefore, the project focused on structuring and raising the quality of indicators for EPE ("Plan").

Selecting indicators for EPE

Following a review and discussion of the standard, a brainstorming session was held in which ideas for new indicators based on DNRA's environmental strategy were suggested and discussed. Indicators were then produced on the basis of DNRA's environmental strategy, environmental objectives and most significant environmental aspects. The indicators were then divided into three categories consistent with ISO 14031 (i.e., environmental condition indicators, operational performance indicators and management performance indicators).

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The brainstorming session resulted in a list of proposed indicators which was subsequently reduced or reworked by means of a critical review. In this review, priority was given to those indicators which DNRA could realistically use over the next two years. Although this approach to the standard was slightly awkward, since DNRA had not produced quantifiable targets and the indicators were chosen before the underlying documentation (evaluation of environmental objectives relative to the interested parties and reasoning for choice of key environmental aspects) had been produced, it was chosen because DNRA wished to use as many indicators as possible in the Environmental Report and Green Accounts for 1997. Examples of these indicators are provided in Table L.1.

TABLE L.1 - Examples of DNRA Indicators for EPE

Environmental Objective	Provisional Environmental Target	MPIs	OPIs	ECIs
Extending the Rail Infrastructure				
DNRA will make environmental demands in all relevant invitations to tender and contracts	Environmental demands to be made in all invitations to tender and contracts To be used in 1998	Percentage of invitations to tender and contracts in which the procedure for environmental evaluation is used		
DNRA will ensure that the railways take due account of nature and the surrounding landscape	Aesthetics policy to be formulated	Progress made in the project for the formulation of an aesthetics policy in connection with time-tabling (1998)		To what extent are the aesthetic objectives met (1998)
Operating and Maintaining the Rail Infrastructure				
DNRA will take environmental aspects into consideration when making purchasing decisions	All product groups to be subjected to environmental evaluation	Percentage of product groups which are prioritized on the basis of environmental evaluation (1998)		
DNRA will prevent noise pollution and vibration and help remedy the nuisance caused to those living near the railway who are most affected by noise pollution	All priority residential areas to be offered noise reduction solutions	Number of residential areas offered noise reduction measures relative to the overall levels of noise pollution (number of priority residential areas)	Kilometres of sound barriers erected (1996, 1997)	
Planning and Managing Traffic on the Rail Network				
DNRA will start to change over to greater use of non-fossil fuels and renewable energy sources	Dialogue to be entered into with all energy suppliers	Percentage of energy suppliers with whom a dialogue has been entered into on non-fossil fuels and renewable energy (1997)	Percentage of non-fossil fuel and renewable energy used in comparison with total energy used (1998)	Railway sector's contribution to climate change, acidification, eutrophication, smog and depletion of natural resources (1998)

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DNRA was already aware of its most significant environmental aspects before the project began. The new element introduced by the project was that the justification of DNRA's choice of key environmental aspects was documented for the first time.

While evaluating the indicators, DNRA also looked at its environmental objectives relative to its interested parties with a view to analyzing which environmental objectives were of interest to which parties. The analysis of interested parties was produced on the basis of discussions within DNRA and between DNRA and external consultants (Deloitte & Touche). The analysis also drew on DNRA's experience from previous experiences with various interested parties and general investigations into and theories about such parties' interest in environmental matters. No concrete investigation was carried out and there was no direct dialogue with interested parties. The result of the analysis is a document illustrating which interested parties are interested in which of DNRA's environmental objectives. This type of analysis will be part of DNRA's ongoing work to develop its environmental reporting and indicators for EPE. Table L.2 shows an example of the results of the analysis of interested parties.

TABLE L.2 - Examples of the Results of the Analysis of Interested Parties

Interested Party	Extending the rail infrastructure	DNRA will make environmental demands in all relevant invitations to tender and contracts	DNRA will ensure that the railways take due account of nature and the surrounding landscape.	DNRA will start to change over to non-fossil fuels and renewable energy
Suppliers		**X**		**X**
Employees				
Rail network managers in other countries				**X**
Competitors and other sectors				**X**
Ministry of Transport		**X**	**X**	**X**
Environmental organizations		**X**	**X**	**X**
National environmental authorities		**X**	**X**	**X**
Local environmental authorities			**X**	
People living near railway lines			**X**	
Politicians		**X**	**X**	**X**
Rail operators		**X**		**X**
End-users				
Media				
Internal management report		**X**	**X**	**X**
NOTE **X** means that the party has an interest in the relevant objective.				

Using data and information

The central Environmental Affairs Office in the Administration Department had primary responsibility for gathering data in connection with the preparation of the Green Accounts for 1996 and the Environmental Report and Green Accounts for 1997. There is an identified need for better interface between the units that generate data and the Environmental Affairs Office which processes and analyses data. DNRA is currently

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working to ensure that the individual units are themselves responsible for gathering data and subsequently submitting reports to the Environmental Affairs Office for use in the evaluation of indicators for EPE which are reported internally or externally.

The list of indicators (examples given in Table L.1) indicates which of the indicators were used for the Green Accounts for 1996, which were used in the Environmental Report and Green Accounts for 1997, and which are likely to be used in future environmental reports (1998). This last category covers both internal and external reporting, although many of the indicators will probably be used exclusively for internal reporting since some of them relate almost entirely to internal processes which are not of direct interest to the general public.

Reviewing and improving EPE

In connection with the development of an environmental management system at DNRA, an environmental strategy has been adopted which comprises an environmental policy and environmental objectives. Measurable environmental targets for each of the departments and divisions have yet to be finalized. The indicators for EPE resulting from this project will be linked to the environmental targets and have already been used when formulating environmental targets. They will continue to be used for this purpose in the future.

The standard's approach to defining environmental targets and associated indicators will help in critical reviews and the further development of DNRA's environmental strategy and environmental targets. This will ensure that environmental performance can be assessed for both the individual units and for DNRA as a whole. Such tools obviously play a vital role in the development of an effective environmental management system.

The indicators for EPE and the way they are classified as management performance indicators, operational performance indicators and environmental condition indicators will become an integral part of future internal reporting at DNRA and, where applicable, environmental reports and green accounts. Presented appropriately, the indicators can give a good idea of developments in the organization, providing a basis for any corrective action in areas which may not have made sufficient progress.

The analysis of interested parties revealed that the Ministry of Transport, environmental organizations, government environmental authorities and politicians are the parties most interested in DNRA's environmental objectives, while employees, foreign rail network managers, competitors, other sectors and end-users (e.g. train passengers) are interested in very few of the environmental objectives. Future work will look into the information requirements of such parties in connection with DNRA's environmental reporting in the future.

The intention when the project started was to develop various indicators relatively rapidly so that they could be used in the Environmental Report and Green Accounts for 1997. This did not ultimately happen and so there are no major differences between the indicators used in the Green Accounts for 1996 and those used in the Environmental Report and Green Accounts for 1997. The indicators which have not been used in DNRA's environmental reporting to date will therefore be used as input for future environmental reporting.

Summary/conclusions

On the basis of its experience with ISO 14031, DNRA would like to pass on the following observations based on its experience to other organizations wishing to use ISO 14031:

- the standard's three categories (management performance indicators, operational performance indicators and environmental condition indicators) are a useful tool when developing in-house indicators;
- the work on the analysis of interested parties and significant environmental aspects forms a sound basis for analyzing and developing indicators;
- it pays to take the time to work systematically with ISO 14031;
- draw inspiration from and involve others when producing indicators;
- although the annex to ISO 14031 is a useful source of inspiration, don't feel constrained when developing indicators;
- it is important to integrate work on indicators with other environmental work in the organization, for both environmental reporting and environmental management;

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- remember that there should be a clear link between significant environmental aspects, policy, strategy, objectives, targets and indicators;
- while the text in the standard may seem complex, the approach is not; it is just good old common sense.

If you have questions or require additional information regarding this example, please contact the ISO member body for Denmark:

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Annex M

Elkem Fiskaa Silicon, Kristiansand, Norway

(A silicon metal production plant, part of a multinational company with approximately 5 300 employees, focusing on the views of interested parties in its implementation of environmental performance evaluation)

Introduction

Elkem ASA is among the world's leading suppliers of ferroalloys and silicon metal. Elkem is also engaged in aluminium production as well as the manufacture of a number of special products related to its core production. Elkem has approximately 5 300 employees and 25 production plants in Europe, North and South America.

Elkem Fiskaa, situated in the town of Kristiansand in the southern part of Norway, is Elkem largest industrial facility. The site consists of the company's research center and the Elkem Fiskaa Silicon plant, which manufactures carbon materials and silicon metal.

The main product, silicon metal, is the main raw material for production of silicones and silanes, and is used as alloying element in aluminium production. The by-product, Microsilica ®, is used as an additive in concrete.

Elkem Fiskaa Silicon has for several years been reporting environmental data to state and local authorities. This reporting is related to the plant's discharge permit. The primary environmental data have also been presented in an annual health, safety and environmental report to external interested parties, as well as in the Elkem Group environmental report.

This example focuses on Elkem Fiskaa's effort to assess and understand the views of interested parties, because the company feels that the environmental information it issues should focus on those areas or issues about which its interested parties want information. Elkem Fiskaa has had some experience with the communication of environmental issues to interested parties, especially neighbors, customers and local and national authorities, but the company had not, to date, conducted a thorough or comprehensive assessment of the information needs of its interested parties.

Planning EPE

The main objective of EPE at Elkem Fiskaa Silicon was to develop a set of indicators based on the company's significant environmental impacts and the needs and requirements of its interested parties.

During 1994, a Cleaner Production Project was carried out at Elkem Fiskaa Silicon, and as a result, very good knowledge of the input and output data of the production process was established.

Elkem Fiskaa Silicon had also been working with Life Cycle Assessment (LCA), and was assessing the life cycle properties of silicon metal when EPE was initiated. It was decided to plan EPE using existing knowledge of the significant environmental aspects of the production plant, and to revise the indicators after the results from the LCA study were presented.

EPE at Elkem Fiskaa Silicon was organized into five steps:

- environmental status evaluation;
- assessment of interested parties;
- first selection of indicators for EPE;
- Testing and evaluation;
- final selection of indicators for EPE;

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Selecting indicators for EPE

Environmental status evaluation

The intent of the environmental status evaluation step was to identify the significant aspects and environmental issues on which to focus the EPE process. All relevant reports and documents were gathered and reviewed to assess the most significant aspects of Elkem Fiskaa Silicon at that time.

Table M.1 lists those aspects that Elkem Fiskaa Silicon had identified as the significant aspects from earlier environmental studies. The potential environmental impacts related to these aspects are also listed.

TABLE M.1 - Significant Environmental Aspects and Related Environmental Impacts at Elkem Fiskaa Silicon

Environmental Aspects	Related Environmental impacts
Emissions of sulfur dioxide	Acidification and local health impacts
Emissions of nitrogen oxide	Acidification and local health impacts, eutrophication
Emissions of carbon dioxide	Global climate change
Emissions of dust	Local health impacts
Emissions of noise	Local health impacts

Assessment of interested parties

The next step was to conduct an assessment of the company's interested parties. The working group at Elkem concluded that the following were the company's interested parties:

- customers;
- suppliers;
- bank/Assurance;
- political parties;
- neighbors of the plant;
- non-governmental organizations (NGO's);
- employees;
- local authorities;
- owners/shareholders;
- concern managers;
- national authorities.

To achieve the most reliable input and understanding of the views of these interested parties, a questionnaire was developed and circulated. The questionnaire listed 10 questions and some of the questions may vary from one group of interested parties to another. A letter describing the objectives of the company's effort was also circulated. Elkem Fiskaa Silicon circulated approximately 65 questionnaires, and approximately 70% of them were returned. For specific interested parties (e.g., bank/assurance, owners/shareholders and corporate managers) input was primarily collected through interviews. Considering the number of questionnaires circulated and returned, the input was not considered statistically representative, but it did provide a general impression of which environmental aspects were of greatest concern to the company's interested parties.

A general impression from this investigation was that environmental knowledge varies from one interested party group to another, and can vary among the members of an interested party group. This indicated that when producing an external environmental report, it is necessary to explain the different environmental and human impacts related to the different types of discharge from Elkem Fiskaa Silicon.

In their responses to the questionnaires, interested parties indicated that they would like more information about the following issues:

- emissions of sulfur dioxide;
- emissions of carbon dioxide;
- emissions of nitrogen oxide
- emissions of noise;
- emissions of dust;

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- polycyclic aromatic hydrocarbons;
- waste and waste treatment;
- acute discharges (i.e., those exceeding either internal company limits or regulatory limits);
- energy conservation;
- health effects;
- environmental objectives;
- general impacts on the local vicinity;
- environmental plans and actions;
- costs for environmental actions;
- global impacts;
- the company's environmental policy.

In the questionnaire, Elkem Fiskaa Silicon invited interested parties to participate in a meeting at Elkem Fiskaa Silicon to discuss environmental issues and the development of a first set of indicators for EPE for the production plant. 45 interested parties (76%) accepted the invitation for the meeting, which was arranged by Elkem Fiskaa Silicon, and at which approximately 15 interested parties participated.

First selection of indicators for EPE

Based on the results of the environmental status evaluation, the identified significant environmental aspects, and the results of the assessment of interested parties' needs, a set of indicators were selected. The data was related to the production of one tonne of silicon metal, and data for the previous three years were presented, in order to show the changes in performance, independent from variations in annual production. This set of indicators is presented in Table M.2.

TABLE M.2 - First Set of Indicators for EPE

Indicator	1993	1994	1995
Metric tonnes of silicon produced	48	48,5	49
Kilograms of sulfur dioxide emitted per tonne of silicon produced	16	17	16
Tonnes of carbon dioxide emitted per tonne of silicon produced	4	3	3
Kilograms of nitrogen oxide emitted per tonne of silicon produced	21	21	21
Kilograms of dust emitted per tonne of silicon produced	2	3	2
Kilograms of waste produced per tonne of silicon produced	41	44	22
Kilowatt hours of energy consumed per tonne of silicon produced	12	12	12
Level of noise in decibels emitted during the production of silicon	56	-	51

Testing and evaluation

The meeting with interested parties at Elkem Fiskaa Silicon was planned as an initial test of the first set of indicators. For most of the interested parties, Elkem Fiskaa is seen as one large industrial facility. In general, the interested parties focused on comparing the emissions of Elkem Fiskaa Silicon against others, including both local and long distance-transported contamination. Several neighbors wanted to know how dangerous it is to live near the plant and if the water quality of a nearby fjord was dangerous. They also wanted to know Elkem Fiskaa Silicon's plans for action, especially in the area of reducing contamination.

The indicators showing specific emissions were of only minor interest for the interested parties at that meeting. The interested parties were interested in indicators showing trends and development over time, but it was the level of contamination and the related concentrations of different contaminants in the air that was considered important.

Final selection of indicators for EPE

An initial conclusion was that the first set of indicators presented at the meeting are useful for internal use by the company, but they may also be useful for benchmarking purposes with other companies with similar production processes or products.

To fulfil the needs of its interested parties, it was considered necessary to establish another set of indicators with explanatory descriptions of the variety of the company's environmental impacts.

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Elkem Fiskaa Silicon has decided to implement an environmental management system based on ISO 14001 in 1999, and its environmental report will present a set of indicators that fulfils all of the needs and requirements of the company's interested parties. Therefore, Elkem Fiskaa Silicon has selected a new set of indicators as presented in Table M.3. Table M.4 shows which interested parties are interested in which indicators. However, most of the final set of indicators and supporting data are available for all interested parties.

TABLE M.3 - New Selected Indicators for EPE

MPIs	OPIs	ECIs
Deviation from discharge permission	Tonnes of sulfur dioxide emitted per year	Noise emitted in decibels
Deviation from internal performance goals	Tonnes of carbon dioxide emitted per year	Grams of dust per cubic metre of ambient air
Plans and actions	Tonnes of nitrogen oxide emitted per year	Grams of sulfur dioxide per cubic metre of ambient air
Improvements	Tonnes of dust emitted per year	Grams of nitrogen oxide per cubic metre of ambient air
Energy consumption (total/specific)	Energy consumption (total/specific)	
	Acute discharge	
	Hazardous waste	

TABLE M.4 - Some New Selected Indicators for EPE in Relation to Elkem Fiskaa's Interested Parties

Top Management (Annual Report)	Divisional Management	Government Authorities	Neighbors	Own Organization
Tonnes of sulfur dioxide emitted per year	Energy consumption (total/specific)	Tonnes of sulfur dioxide emitted per year	Plans and action	All data, both total and specific
Tonnes of carbon dioxide emitted per year	Deviation from discharge permission	Tonnes of carbon dioxide emitted per year	Improvements	
Tonnes of nitrogen oxide emitted per year	Deviation from internal performance goals	Tonnes of nitrogen oxide emitted per year	Health effects	
Tonnes of dust emitted per year	Acute discharge	Tonnes of dust emitted per year	Acute discharge	
Energy Consumption	Energy consumption (total/specific)	Noise	Deviation from discharge permission	
Deviation from discharge permission		Hazardous waste	Noise	
Acute discharge				

Reviewing and improving EPE

At this time, there is no intention to develop more aggregated indicators for external use. Experience from the meeting with interested parties and other efforts indicates that even specific data is hard to explain. For internal use within the company, the situation may be different, and Elkem Fiskaa Silicon will continuously improve its reporting efforts. If more aggregated indicators seem to be successful internally, their external use will be considered.

At the outset of this EPE process, it was decided only to include the environmental impacts related to the silicon metal production plant in Kristiansand. However, the management of the company recognizes the fact that significant environmental impacts may also be related to the mining and transportation of coal and

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quartz, as well as the production of other raw materials. Silicon metal is a raw material for the production of hundreds of different products from silicones and silanes, and it is used as an alloying element in aluminium production. In this implementation of an EPE process, the environmental impacts caused by such products were not considered.

In future work with indicators for EPE at Elkem Fiskaa Silicon it will be necessary to consider the results from the company's ongoing LCA study project and the results of LCA studies carried out by product manufacturers using silicon metal as one of their raw materials

Elkem Fiskaa will work towards certification of its environmental management system to ISO 14001 in 1999, and the company foresees a certain development of their MPIs during this process. This should also include development of a plan for periodical communication with and feedback from their external interested parties.

Summary/conclusions

For some time, Elkem Fiskaa Silicon has been deliberately using their knowledge about environmental issues in their production planning and internal and external reporting. In some ways this can be seen as a practical use of an environmental management system based on health, safety and environmental principles. With the addition of a few more statements, procedures and environmental objectives, the requirements in existing environmental management systems standards will be fulfilled.

Implementing the EPE process was considered a positive experience because it established a productive dialogue for the company with a large number of its interested parties. Most of the interested parties who participated by answering the questionnaire were very pleased to be asked for their input. This was also expressed at the meeting with interested parties.

The results of the EPE process will be used by the company in the following two ways:

1. to measure internal continuous environmental improvements, by monitoring the specific amounts of emissions or energy consumption per ton of product;
2. to use the indicators in external environmental reporting, combined with more detailed explanatory descriptions of environmental and health impacts.

Supplemented by the results of the ongoing LCA study, the indicators for EPE could form a basis for further environmental improvements at Elkem Fiskaa Silicon.

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Annex N

Electrolux AB, Sweden
(A large multi-national company manufacturing household and commercial appliances, with approximately 112 300 employees, using the environmental aspects of its products to select indicators for environmental performance evaluation)

Introduction

Electrolux AB produces household and commercial appliances, such as white goods and industrial laundry equipment, as well as outdoor products such as forestry and garden equipment. In 1996 it had operations in more than 60 countries and 112 300 employees. Each production facility is obliged to fulfil national and local regulations and reporting procedures. Its work on indicators for EPE is carried out on a corporate level.

Electrolux has formulated its "Vision of the Environment", and part of this vision reads as follows:

> "Growth in consumption of non-renewable raw material and natural resources cannot continue indefinitely. Our operations and our products must be integrated in a cycle, so that we can satisfy the needs of our customers without jeopardizing the prospects for future generations. The keywords for our operations are therefore resource-efficiency and recycling. We are going to meet our customers' expectations for safe, environmentally sound products, and we will actively distribute information aimed at stimulating demand for these products."

The environmental policy of Electrolux stresses the responsibility to contribute to sustainable development by continuously improving products and production processes from an environmental perspective. The principles of precaution and total approach are guidelines for all activities carried out.

The environmental strategy of Electrolux states that the company should:
- be a leader and driver in environmentally sound technology, products and processes;
- actively develop demand through the use of environmentally sound products.

In 1995, Electrolux decided to institute ISO 14001 as the environmental management system for all facilities before the year 2000. If a local market wants to recognize another system (e.g., the European Union's Eco-Management and Audit Scheme - EMAS), this can be adapted.

The standardized reporting in Electrolux includes all production sites and warehouses with more than 1 000 m^2 of heated area. In 1995 the reported figures on energy consumption, water consumption and carbon dioxide emission included approximately 97% of the total building surface. These measurements have existed for more than 10 years and are regarded as very accurate. The other reporting parametres in 1995 included approximately 90% of the total factory surface area and are based on estimated values. These parametres are expected to reach a high level of reliability within a few years.

The development and use of indicators for EPE in Electrolux is seen as an implementation of their environmental strategy. The set of indicators is seen as one indicator among several indicators measuring the total business performance. Electrolux applies the Total Quality Model (TQM) for integration of all management functions.

Planning EPE

The main objective for Electrolux's development of indicators for EPE was to:
- check that the environmental development of their processes and products are fulfilling their environmental strategy;
- link the environmental strategy to financial figures and shareholder values;
- make it possible to identify environmental targets at all levels in the organization, both at the different production sites, and within functions, such as logistics, marketing and product development;
- serve as elements in reporting to interested parties.

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The factors regarded as important by Electrolux for the successful implementation of indicators for EPE into the organization are reported to be that:

- the use of indicators for EPE must lead to reduced environmental impacts;
- the indicators for EPE are integrated with business strategy, and give added shareholder value;
- the indicators for EPE are relevant and communicable to interested parties;
- the indicators for EPE are linked to business and employee performance.

Electrolux chose to include impacts on “work environment” for their customers, such as noise, heat and odor from the user phase of their products, as this was seen as a customer demand. The internal work-environment in Electrolux was not included, as this is addressed by other means.

The shareholders are seen as the main interested party at Electrolux. In order to fulfil the shareholders needs and expectations for shareholder value, other interested parties’ needs regarding environmental issues will have to be met.

The development and implementation of indicators for EPE at Electrolux is carried out by the Group Staff for Environmental Affairs at the corporate office in Stockholm, in close co-operation with the Environmental Co-ordinators for the product lines.

Selecting indicators for EPE

Environmental impact assessment

The identification of significant environmental aspects from products and production sites is based on:

- life cycle assessments (LCAs) of most of the product types;
- site specific assessment of each production plant.

Based on the identified significant environmental aspects for each product group, the areas for environmental target setting, as well as internal criteria for compliance, were identified. Life Cycle Assessments were used to identify the main potential environmental impacts from products on a global and regional level. Typical results from LCAs of electric appliances show that most environmental impacts result from the use of the products. The production process (including raw material acquisition and manufacture of components) has a relatively small contribution compared to the impacts resulting from the user phase. In general, 80 to 90% of the environmental impacts from household appliances occur when the customers use these products.

Use of a washing machine has the following potential impacts on environment:

- global warming from incineration of fossil fuel (production of electricity for households);
- use of resources (water);
- water pollution (from detergents).

Thus, reduction of energy and water consumption in the user phase will reduce the environmental impacts significantly from this type of product. Likewise, an example of product specific impacts from refrigeration equipment is the high potential for global warming and ozone-depletion from the use of cooling agents and insulation gases.

Recycling of products will reduce waste loads and impacts from raw materials and production, and recycling was thus identified as one of the main areas on which to focus.

Based on the impact assessment, the most significant environmental aspects were identified for each product group in each of the three business areas. As an example, the significant environmental aspects for commercial refrigeration equipment are:

- cooling gases and insulation gases;
- energy;
- recycling;
- noise;
- work environment.

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Site specific assessments of each production unit were based on balances of material flow (consumption, manufacturing and residual of materials). Consumption of energy and water have been monitored and reported internally for several years, and during the last few years the reporting of material balances, wastes, and use of environmentally hazardous substances has been introduced.

Assessing the views of interested parties

Interested party needs were mainly assessed internally through market surveys and dialogue with these parties. The following interested parties are considered in the development of indicators for EPE:

- authorities - demand fulfillment of legislation, directives and treaties on a national, regional or global level.
- consumers - increasing demand for environmental performance.
- non-governmental environmental organizations - raise the awareness of environmental expectancy in society.

In addition, test institutions such as Consumer Union and Konsumentverket provide test procedures and ratings on environmental matters, and these must also be fulfilled.

To identify the views of interested parties in the financial arena, Electrolux, in 1996, carried out interviews with different financial analysts in Stockholm, London, Frankfurt and New York. Most of these financial analysts saw only a weak correlation between environmental and financial performance. One of the analysts stated that “beyond compliance spending would be seen as a drain on cash flow”. The financial analysts expressed a demand for environmental indicators, but could not specify the kind of information these indicators should include.

Interviews carried out among owners/shareholders gave few specific answers regarding specific needs for environmental information.

From these inquiries it appears that it is up to the company to show a positive link between environmental and financial performance.

The selected indicators for EPE

The selected indicators for EPE are chosen to fulfil internal monitoring of product and production performance. To do so, four group measures for environmental performance were developed:

- Site measures - for the monitoring of production performance at each production site;
- Product groups (Fleet average) - for the monitoring of product improvement in average over time;
- Green range - for the monitoring of product leadership and profitability in this segment;
- Recycling index - for the monitoring of the value of worn-out products.

Site measures - OPIs

Each Electrolux production site or facility monitors and reports internal parametres such as energy cost and consumption, carbon dioxide emissions, water consumption, and material efficiency. In addition, each site may carry out monitoring and reporting of additional parametres to fulfil local internal or external demands.

To facilitate local or corporate monitoring of development from one year to another, most of the key figures are normalized to added value of the products (i.e., added cost: the difference between total manufacturing costs and direct material costs). Such figures include parametres such as energy cost, energy consumption, carbon dioxide emission and water consumption. In addition, energy consumption per cubic metre of heated area and direct material efficiency are requested.

The site measurements are demanded by the customers and the local communities, as well as for internal goal setting and follow up activities.

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Product groups (Fleet average) - MPIs

The fleet average includes all Electrolux products, and calculates the average value for some of the most important environmental factors for each product group. The aim is to monitor the overall rate of improvement. The indicator is used internally for control measures, but may also be used for external communication in annual reports.

As an example, the criteria for fleet average for refrigerators includes parametres such as average energy consumption, percentage of products with hydrocarbons as cooling medium, and average emission of noise.

"Green range" - MPIs

The "Green Range" is used to identify environmentally leading products in each product group and calculate their profitability. For each product group, specific criteria must be met for the products to considered a "Green Range" product. The criteria will change over time, and are based on:

- environmental impacts;
- consumer environmental concerns;
- competitiveness;
- official demands (e.g., criteria shall meet or exceed labeling schemes, legislation and test institutions);
- functional demands.

As an example, the "Green Range" criteria for refrigerators are:

- low energy consumption (energy class A or B);
- hydrocarbons as cooling agent;
- noise emission lower than 38 decibels.

Thus, Electrolux can monitor

- how many of their refrigerator products are meeting the "Green Range" criteria;
- the volume of sales of "Green Range" refrigerators;
- the gross profit of "Green Range" refrigerators.

The criteria for "Green Range" products are important parametres and considerations for research and development (R&D) when developing new products.

Recycling index - MPIs

The recycling index is an indicator for EPE used for product development. The purpose of this indicator is to increase the value of the waste, thus facilitating the recycling processes. The recycling index is the normalized value for worn-out products, based on the value the recycling firm will be prepared to pay (or have to be paid), divided by the value of the raw material.

Recycling Index (RI) = Recycling Value/Raw Material Value

If the recycling index is higher than 0, the cost for the recovery of the materials is less than their value, and there is a potential profit from recycling of the product. If the value is negative, the recycling firm will have to be paid to receive the scrap, and recycling will thus not increase profitability. If the value is above 1, the product or parts of it can be reused, and some of the value added in manufacturing processes can be recovered.

The challenge with this indicator is to predict the recycling value for a product that will end up as scrap in 10 or 15 years. Today, Electrolux uses a recycling value for materials based on the price obtained in today's market.

Summary/Conclusions

Some of the indicators for EPE are already implemented in the organization, whereas others are in the initial stages of the implementation process. The "Green Range" is implemented at White Goods Europe, and Site Measures are implemented for all business sectors.

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Three out of four indicators are directed towards the functionality of the products. Thus, the different functions in the organization, such as marketing, sales, and product development can use them to measure progress related to their specific needs.

Electrolux has established an electronic network for internal communication and reporting of environmental information. This simplifies the data flow and enables the different functions in the organization to use the indicators in decision-making processes, without any delay for information gathering.

The financial community is already starting to recognize the link between Electrolux' performance in environment and business as expressed in the "Green Range" indicator. Future plans include expanding the "Green Range" to cover all product lines and to communicate it even more effectively to the financial community. Future plans also include implementing and using Fleet Average and Recycling Index more widely in the organization.

When implementing the four indicators in the organization, challenges such as the following have to be met:

- system boundaries for the organizational system covered by the indicators;
- how to link the environmental and financial systems internally;
- how to fight for priorities with other strategies.

However, the importance of the four indicators is widely recognized and accepted internally at Electrolux because of the close link to economic value.

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Annex O

ICI, United Kingdom

(A large multi-national chemical company, with 67 500 employees and complex environmental aspects, developing operational performance indicators to reflect the environmental burdens of its activities)

Introduction

ICI is one of the world's largest chemical companies with international businesses, supported by a powerful technology base, in the areas of paints, materials, explosives and industrial chemicals, with strong regional businesses in Pakistan, Argentina and India.

In 1997, ICI had 67 500 employees world-wide, and manufactured more than 8 000 products at over 200 locations in more than 30 countries. The company has implemented a Safety, Health and Environmental (SHE) management system. All businesses, sites, locations and works are required:

- to have established their own local procedures which incorporate good practice as specified in over 100 Group guidelines; and
- to comply with ICI's published SHE policy which includes a commitment to "ensure that (in) all its activities world-wide . . . environmental performance will meet contemporary requirements and that its operations are run in a manner acceptable to local communities."

In 1990, ICI was one of the first chemical companies to define targets for environmental improvement, and since 1992 the company has published an annual Group environmental report describing progress towards these targets.

Eleven ICI sites have been certified to the European Eco-Management and Audit Scheme (EMAS) and to ISO 14001.

Planning EPE

Initially, ICI reported wastes released to the environment in terms of the weight in tonnes emitted to air, water and land, and they were categorized as hazardous or non-hazardous. Reports focused on individual substances identified in United Kingdom, United States of America and European environmental regulations, together with other substances which ICI believes make a significant contribution to the potential environmental impact of its operations.

Simply measuring different waste substances by weight alone gives no indication of the types of different environmental effects they may cause, nor the potency of the substances to exert those effects. For example, the potential environmental impact of a tonne of sulfuric acid on aquatic plant and animal life when released into water is greater than that of a tonne of gypsum.

Recognizing the limitations of reporting by weights alone, over a period of 18 months starting in 1995, ICI developed a new way to assess the potential environmental impact of its emissions which ICI called the "Environmental Burden" approach. ICI's objective was an informative and scientifically sound way to quantify the environmental performance of a company which operates world-wide, and hence to set and monitor targets for improvement. It draws on developments in environmental science to estimate potential environmental impacts, rather than merely stating quantities of wastes and emissions.

ICI established a team to review the implementation of the Environmental Burden (EB) approach and consider how it might be refined in the future. This scientific review panel consisted of three eminent international and independent environmental practitioners who met with the company's experts. ICI considers the development of the EB approach to be an innovative and valuable contribution to environmental performance evaluation, environmental management and reporting. It also enables all interested parties to determine which wastes and emissions are the most significant in terms of their potential environmental impact.

ICI's EB method has been set up so that it can be adapted readily as better scientific data become available, for example, on human and ecotoxic effects of emissions. At present, this method guides operations within the Company and supports decisions on acquisitions and divestments. Future developments could include

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extending it to describe the product supply chain "upstream" and "downstream" of the Company itself. ICI has already made a step in this direction by including the effects of external energy generation.

Selecting indicators for EPE

ICI selected indicators for EPE to reflect the nature and scale of its operations and to enable the Company and its interested parties to monitor progress towards environmental objectives which are called the "SHE Challenge 2000 goals". The baseline is the value of each indicator in 1995; the goals are set for the year 2000. Twenty indicators have been selected relating to:

- compliance (4 indicators);
- public topics (2 indicators);
- resource conservation (2 indicators);
- wastes (5 indicators); and
- environmental burdens (7 indicators).

7 of the 20 indicators are relevant to management efforts to improve environmental performance; the remainder address the environmental performance of ICI's operations.

The environmental aspects of ICI are complex, and a combination of indicators related to them has been selected to provide a comprehensive evaluation of environmental performance.

Management performance indicators (MPIs)

The MPIs selected are chosen to provide information on ICI's performance in implementing its published policy, and assist in the evaluation of management efforts to improve performance. The goals and related indicators are as follows.

ICI Policy:
To ensure that the ICI Group's operations are run in a manner acceptable to local communities

Related MPI:
Total number of complaints received in a defined reporting period

NOTE The following MPIs also relate to the above ICI Policy.

Goal:
Total compliance with local regulations wherever ICI operates

Related MPIs:

- percentage of tests versus the number of consents to emit to water that are totally in compliance;
- percentage of tests versus the number of consents to emit to air that are totally in compliance;
- number of prosecutions and the cost of penalties.

It is mandatory for each ICI operating site to comply with local and national legislation and regulations relevant to its location for the release of wastes and emissions to the environment. Each site reports its percentage of compliance with permitted emission levels and an aggregated figure is then reported in the Group environment report.

Goal:
To comply with ICI's world-wide standard for the construction of new plants

Related MPI:
List of plants completed and under construction in a defined reporting period

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NOTE ICI requires that a new plant shall be built to standards that will meet regulations it can reasonably anticipate in the most environmentally demanding country in which it has a plant that operates the same process as the new plant.

Goal:
To avoid any loss of containment and prevent any spills

Related MPI:
Number and geographic location of spills which could have or did cause public concern or damage to the environment

Additional MPI with no related goal:
Estimated annual environmental expenditure

NOTE This MPI is an estimate because it is difficult to accurately identify that part of expenditure, or revenue, which is purely for environmental purposes.

Operational performance indicators (OPIs)

ICI has selected 5 OPIs related to specific goals for the year 2000 under the "SHE Challenge 2000" program, and 8 which show trends but have a generalized non-specific objective such as waste minimization. 7 of the 13 selected OPIs are derived using the EB approach.

ICI's wastes and emissions are from manufacturing equipment over which the company has direct or indirect control. For example, reported carbon dioxide emissions will be generated by power stations owned by ICI and by power stations from which ICI imports electricity.

Objective:
To minimize waste

Related OPIs:
- total waste, in millions of tonnes, emitted to air, sent to landfill, or discharged to water per year;
- mass of hazardous waste, in thousands of tonnes, sent to landfill per year;
- mass of non-hazardous waste, in thousands of tonnes, sent to landfill per year;
- mass of particulate, in thousands of tonnes, emitted to air per year;
- mass of non-process waste (e.g., building rubble), in thousands of tonnes, sent to landfill per year.

NOTE Wastes sent to landfill are contained and cannot be assessed by the EB approach which deals specifically with unconfined releases into the environment. Because it assesses potential harm, EB cannot be used to establish the impact of wastes sent to landfill. This is because nothing should be sent to landfill unless it is safe to do so. ICI will therefore continue to report wastes sent to landfill, categorized as those considered hazardous and those considered non-hazardous.

The release of wastes and emissions to the environment are reported after treatment where ICI has contractual arrangements in place for the treatment of the waste streams. For example, at the ICI Tioxide Huelva (Spain) facility an acidic solid waste, classified as hazardous when it leaves the site, is neutralized into an inert waste at a nearby municipal treatment plant. This waste is reported as non-hazardous because this is the state in which it is finally released for disposal.

Goal:
To improve energy efficiency per tonne of production by 10% of the 1995 level by the end of the year 2000

Related OPI:
Energy used per tonne of production as a percentage of 1995 usage per tonne of production

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OPIs based on the Environmental Burden (EB) approach

ICI and its panel of international experts reviewed the company's activities and identified a set of internationally recognized types of environmental impacts where the company's various emissions to air and water may exert an effect.

For gaseous emissions, the experts determined that relevant releases are those which have the potential to cause:

- atmospheric acidification;
- global climate change;
- human health effects;
- ozone depletion; and
- the creation of photochemical ozone (i.e., smog).

Under "human health", only carcinogenic effects, which are seen as important by local communities, were specifically considered as opposed to other potential health effects that could also be analyzed.

For discharges to water, ICI identified materials which have the potential to cause:

- acidification;
- aquatic oxygen demand; and
- ecotoxicity to aquatic life (i.e., either metals and their compounds or other substances discharged to water).

ICI has selected aquatic acidification and aquatic oxygen demand because these are important to the company's operations and are issues of concern at the local and regional levels for some of their businesses. Technical details of the selected environmental impact types, the substances ICI includes in each type, and their potency factors are described in the annex to this example.

Technical details of the selected environmental impact types, the substances ICI includes in each environmental impact type, and their potency factors are described in the report "Environmental Burden: The ICI Approach" which is available on the ICI web site at www.ici.com.

EB goals under the "SHE Challenge 2000" program:
To reduce by 50% the company's EB by the end of the year 2000 in the following four environmental impact types:

- ecotoxicity;
- aquatic oxygen demand;
- atmospheric and aquatic acidification; and
- potentially hazardous (i.e., carcinogenic) emissions to air.

OPIs (EB):

- **EB (ecotoxicity)** measured in tonnes per year of copper/formaldehyde equivalent emitted;
- **EB (aquatic oxygen demand)** measured in tonnes per year of oxygen emitted;
- **EB (acidification)** measured in tonnes per year of hydrogen ions emitted;
- **EB (carcinogens)** measured in tonnes per year of benzene equivalent emitted.

ICI has chosen to concentrate on these specific environmental impact types because they are important to regulators and to the local communities in the vicinity of ICI manufacturing operations.

ICI also monitors and reports on EB against the other three listed environmental impacts (i.e., global warming, ozone depletion and creation of photochemical smog) because the company believes they are important to the nature of its operations. However, ICI is a relatively small contributor, in both national and global terms, to these environmental impacts. The EB information will be published in the annual ICI Group SHE performance report.

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Additional OPIs(EB):

- **EB (global climate change)** measured in tonnes per year of carbon dioxide equivalent emitted;
- **EB (ozone depletion)** measured in tonnes per year of CFC-11 equivalent emitted;
- **EB (photochemical ozone)** measured in tonnes per year of ethylene equivalent emitted.

Using data and information

Analyzing and converting data for OPIs(EB)

Developing each EB/OPI involved two additional steps following the identification of the set of 8 recognized environmental impact types upon which ICI's various emissions to air and to water could have an effect.

First, a factor was assigned to each individual substance emitted which reflects the potency of its possible impact.

Potency Factors

A Potency Factor (PF) reflects the potential of an individual emission to contribute to a particular type of environmental impact. Data generated by independent scientists, generally published in peer- reviewed documents, has been used to determine the most appropriate PF for each individual emission for each environmental impact. Where there are no published numbers, ICI have taken advice from Brixham Environmental Laboratory, Zeneca plc, to provide factors by analogy with information in the public domain.

One substance is designated as the baseline or standard for each type of environmental impact and is given a PF of ONE. In the case of atmospheric acidification, the baseline substance is sulfur dioxide (see the annex to this example). The PFs for the other substances involved are determined by comparing their potency with the baseline substance. So, for atmospheric acidification, one tonne of ammonia has a greater potential to create atmospheric acidification than one tonne of sulfur dioxide and has a PF of 1,88. By contrast, the same mass of nitrogen dioxide has a lower potential to cause atmospheric acidification than sulfur dioxide and ammonia, and therefore, nitrogen dioxide has a lower PF of 0,7.

Each substance emission has the potential to affect one or more type of environmental impact. For example, a substance may cause photochemical smog and also have the ability to deplete ozone. The substance's potency, hence its PF, may vary according to the particular environmental impact under consideration.

The calculation and application of the potency factors are described in the annex to this example.

And finally, a formula based on the mass of each substance emitted multiplied by its potency factor, is applied to calculate the EB of ICI's emissions against each type of environmental impact.

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The Formula

EB analysis enables ICI to evaluate the relative potential environmental impact of their diverse emissions. It reflects both the mass and the potency of each substance emission to exert its possible impact. The EB related to each type of environmental impact is calculated using the formula:

$$EB = (m_a \cdot PF_a) + (m_b \cdot PF_b) + (m_c \cdot PF_c) \ldots$$

where

m is the mass in tonnes of each substance emission;

a, b, or c . . . indicates a specific substance emission;

PF is the potency factor for the specific substance in relation to the specific type of environmental impact under consideration.

The EB approach presumes compliance and provides a measurement system for moving beyond compliance. Other key points about the EB approach are:

- individual chemicals can be assigned to more than one type of environmental impact (e.g., ammonia has an effect on both aquatic ecotoxicity and atmospheric acidity);
- each chemical has a specific potency factor for each type of environmental impact and these factors can differ (e.g., benzene has a potency factor of 0,1 for aquatic ecotoxicity and a potency factor of 0,33 for creation of photochemical smog);
- each type of environmental impact has its own characteristics and units of measurements.
- burdens for each type of environmental impact cannot be added together to give a total EB; it is not appropriate since they are as different as “chalk and cheese”.
- EB does not address local issues such as noise and odor.

EB can be used:

- to compare environmental performance with that of previous years;
- to compare emissions with other aggregated sources that have the potential to cause environmental effects, such as other sectors or natural sources; and
- to set targets for improvement.

The model has been conceived so that ICI can prioritize and focus its efforts on those areas of activity which need most attention. ICI is also mindful that this is a dynamic area in which there are many developments, and is committed to ensuring that the system is flexible and can accommodate new developments where they are appropriate.

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Example of EB calculation

The following is an example regarding a hypothetical contribution to atmospheric acidification.

First, the mass (m) of each single substance emission which has the potential to impact on atmospheric acidification is recorded. In this example, the total mass is 32 tonnes.

Second, a potency factor (PF) for each substance emission is determined (see Table O.1).

TABLE O.1 - Mass and Potency Factors of Substance Emissions in a Hypothetical Example on Atmospheric Acidification

Substance Emission	Mass (m) in Tonnes	Potency Factor (PF) For Atmospheric Acidification
Ammonia (NH_3)	20	1,88
Hydrogen chloride (HCl)	3	0,88
Nitrogen dioxide (NO_2)	4	0,70
Sulfur dioxide (SO_2)	5	1,00

For atmospheric acidification, sulfur dioxide is the reference substance; the units of the calculated burden are tonnes of sulfur dioxide equivalent.

Third, the formula [EB = ($m_a \cdot PF_a$) + ($m_b \cdot PF_b$) + ($m_c \cdot PF_c$) . . .] is applied using each substance to obtain the EB for atmospheric acidification:

$$EB = NH_3\,(20 \times 1{,}88) + HCl\,(3 \times 0{,}88) + NO_2\,(4 \times 0{,}70) + SO_2\,(5 \times 1{,}00) = 48{,}04$$

i.e., the EB(atmospheric acidification) is 48,04 tonnes of sulfur dioxide equivalent.

The EB changes if the group of substance emissions changes, even though the overall tonnage remains the same. For example, if the emissions of ammonia and nitrogen dioxide are transposed (i.e., 4 tonnes of ammonia and 20 tonnes of nitrogen dioxide), the total tonnage is still 32 tonnes. However, the EB will be = NH_3 (4 × 1,88) + HCl (3 × 0,88) + NO_2 (20 × 0,70) + SO_2 (5 × 1,00) = 29,16 instead of 48,04, reflecting a lower potential effect on atmospheric acidification by this group of emissions.

Aggregated EB for an organization - a subjective calculation

It is inappropriate to add together the EB for each type of environmental impact [e.g., EB (global climate change) + EB (ozone depletion)] to attempt to determine a total EB for the company. This is because the scientific evaluation adopted to determine the EB for each of the environmental impacts is different and each EB is measured in different units. Although the natural sciences cannot provide a way to aggregate different environmental impacts, it is possible that future developments in the social sciences could yield weighting factors to enable aggregation. However, there is no generally accepted way to do this at present.

EB versus environmental Impact

The EB is a quantitative indicator of the extent to which emissions may exert an environmental effect. It is quite distinct from environmental impact which is a change to the environment resulting from an organization’s activities, products or services.

Some emissions may be destroyed immediately upon release and therefore never have an environmental impact. Other substances may not persist long enough in their active state to cause the adverse effect. For

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example, an effluent to water which has the potential to be toxic to fish may be dispersed and diluted very quickly with the result that there is no impact on fish.

The EB approach enables ICI to look at the full potential of its emissions to cause environmental damage. ICI and its panel of experts believe this approach to be conservative because it considers the total contribution of the emissions and does not consider subsequent degradation or attenuating factors that might occur after substance release.

Reporting and communicating

The results of EPE are widely reported both internally and externally in ICI's annual Safety, Health and Environmental Performance report. In addition to a targeted distribution of the report to opinion makers and interested parties, the report is posted on the Internet at http://www.ici.com where a publication describing ICI's Environmental Burden approach is also available.

Reviewing and improving EPE

Adjusting EB to accommodate divestment and acquisitions

The continuing change to ICI's business profile can distort emissions data when measurements are being compared to a past reference point. ICI's emissions in 1995 will be the baseline for EB analysis. This baseline will be adjusted following an acquisition or divestment.

> If a new business is acquired, the emissions from that business in 1995 will be added to the 1995 EB figures, thereby adjusting the EB baselines. In subsequent years, the emissions from the new business will be treated in the same way as those derived from ICI's other businesses and the new business' emissions figures in a particular year will be included in the overall EB analysis for that year. If a business or part of a business is sold, the emissions relevant to that business will be removed from the 1995 baselines and will not be reflected in subsequent years.
>
> The EB of plants which are closed will not be removed from the original baseline since such closures are generally part of a rationalization program designed to improve ICI's business and environmental performance.

EB analysis - Future considerations

Raw materials

A future refinement of EB analysis could be to extend the approach to the use of raw materials. This would enable ICI to assess the best raw material options in terms of their potential EB.

ICI intends to begin to address the issue of resource use by measuring improvement in process efficiency under its "SHE Challenge 2000" program.

Bulk hydrocarbons and resource depletion

ICI uses some hydrocarbons as fuel. These are evaluated in the EB analysis under the global climate change impact type as carbon dioxide emissions. However, there are considerable quantities of hydrocarbons that are used as feedstocks which cannot be related to one of the selected types of environmental impact. Therefore, ICI is developing appropriate measures based on process conversion efficiencies (i.e., raw materials converted into products). This may lead to an index linking the tonnes of oil, natural gas or coal used per tonne of end product manufactured.

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Eutrophication

This is an environmental impact often used in Life Cycle Assessment studies to measure the potential effect of a product or a process on an aquatic environment through the release of nutrients such as nitrogen and phosphorus. ICI does not believe that its process emissions make a significant contribution to this type of environmental impact, but ICI will carry out further investigations and review this assumption.

Particulate emissions

Particles referred to as “PM10” particles (i.e., particulate matter that is less than 10 μm in diametre) are attracting growing attention within the environmental community. Currently, ICI has little data on these emissions and is unable to assess their potential impact. ICI will continue to keep this under review. In the meantime, ICI will continue to report the weight of emission of particulates to air, primarily from its combustion plants.

System boundaries

The present scope of the EB project is defined primarily to include wastes and emissions that result from the ICI Group activities. It is possible that these could be extended to include:

- provision of raw materials;
- disposal at waste treatment facilities; and
- use of products.

Individual businesses are already addressing boundaries both up and down the production chain using Life Cycle Assessment techniques.

Airborne toxics

ICI’s current approach is to concentrate on the important issue of airborne carcinogens. ICI recognizes that there are other health issues associated with air quality standards and are monitoring developments closely.

Similar approaches by other organizations

ICI is aware of a similar approach to Environmental Burden being undertaken by other companies, including Dow Chemical Company in Europe, and in the USA. ICI intends to continue comparing its EB approach to other EB methodologies to ensure that ICI continues to apply contemporary best practice in assessing and reducing the potential environmental impact of its wastes and emissions.

Summary/conclusions

The environmental aspects of ICI are complex, therefore, it has selected a combination of 20 indicators for EPE to provide a comprehensive evaluation of environmental performance relative to such aspects. ICI has been developing its EPE process since 1990, when it first set targets for environmental improvement. The selected indicators reflect the nature and scale of ICI’s operations to enable the company and its interested parties to monitor progress towards environmental objectives. 7 of the 13 selected OPI’s are derived using the Environmental Burden approach.

ICI and its scientific review panel believe that the Environmental Burden approach is an informative and scientifically sound way to quantify the environmental performance of a company which operates world-wide, and hence to set and monitor targets for improvement. It draws on developments in environmental science to estimate potential environmental impacts, rather than merely stating quantities of wastes and emissions. The indicators are selected to focus on the environmental aspects of the company’s activities that are the most significant and capable of improvement.

The Environmental Burden approach is consistent with the guidance in ISO 14031. ICI and its scientific review panel believe it may assist other companies in the process industries or companies in other sectors as a valuable tool to develop environmental performance evaluation both for internal environmental management and for external reporting. It provides a vehicle for training within a company, and for ensuring consistency of reporting.

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More details on the Environmental Burden Approach are contained in the report “Environmental Burden: The IC Approach”, and in ICI’s Safety, Health and Environment reports which are available on the ICI web site at www.ici.com.

If you have questions or require additional information regarding this example, please contact the ISO member body for the United Kingdom:

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Annex P

City Of Seattle, Washington, USA

(A large city with over 530 000 residents and approximately 10 000 city employees, illustrating the implementation of EPE and the use of indicators for EPE by a local government)

Introduction

The city of Seattle, Washington is at the center of the largest metropolitan area in the Pacific Northwest region of the United States of America. The City has over 530 000 residents and the surrounding suburban areas bring the total population in the greater Seattle area to over 3 million residents. Of particular concern in the Seattle area is maintenance of the historically high quality of the region's air and water, currently under pressure from tremendous population growth in the area. Related to these concerns is the protection of the unique wildlife in the region such as the bald eagle population and spawning migration routes of salmon.

To serve the needs of the local residents, the City engages in diverse business operations which employ approximately 10 000 people in 21 departments. In the normal course of operations, City employees are engaged in a wide variety of activities that have the potential to impact the environment. For example, City's operations include:

- utility service operation (e.g., electricity, water supply, wastewater treatment);
- park maintenance and operation;
- construction activities;
- transportation services;
- office building and entertainment facility operation and maintenance;
- general administrative activities.

The leaders of the City government and City management wish to build on this tradition by implementing a program which demonstrates continual improvement in the environmental performance area. The City has chosen to use the ISO 14000 series of standards as a guide for this effort. However, the City has in place an environmental management system based on ISO 14001, but is not seeking certification at this time.

Planning EPE

The City of Seattle is currently undertaking a multi-year, city-wide, environmental management initiative. The objective of the initiative is to improve the environmental performance of the City's operations by developing and implementing appropriate environmental management programs. In addition to using the ISO series of standards as a guideline, the City also plans to incorporate other beneficial concepts into environmental program development (e.g., guidance from Natural Step, the World Resources Institute [WRI], and the Global Environmental Management Initiative [GEMI]). In order to create both a mechanism for measuring environmental program performance and a tool for to support continual improvement, the City has chosen to implement environmental performance evaluation (EPE), using ISO 14031, as well as WRI and GEMI concepts, as a guide.

Selecting indicators for EPE

The focus of the current initiative is on City operations, in other words, the environmental aspects associated with the actual operation of the City as would be indicated by measurement of management performance indicators (MPIs) and operational performance indicators (OPIs). However, as a city, Seattle does have some influence over the environmental performance of its citizens and, thus, they must also consider environmental condition indicators (ECIs) as defined in ISO 14031. While the focus of the current initiative is on City operations, another existing City initiative has developed a set of ECIs, which are measured periodically and reported to the public. Therefore, it was important to develop the performance metrics (MPIs and OPIs) for the current initiative within the context of the existing City-wide ECIs and to delineate a clear linkage between the two types of metrics. Figure P.1 illustrates the linkages using the actual indicators developed as examples.

The indicators for EPE development process started with a discussion by an in-house team of environmental professionals familiar with the environmental aspects and impacts of City operations. This group was supported throughout the process by an outside consultant. The work of the in-house team was reviewed by a local "Oversight Group," which was organized to provide guidance and insight to city environmental

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activities. This group was composed of local environmental specialists representing various interested parties and perspectives. Representatives in the Oversight Group included individuals from seven major City departments, a regulatory agency, environmental activist groups, a large company located in the area, the University of Washington, and other local interested parties.

In selecting indicators, the in-house team first identified the criteria that would guide indicator selection. The criteria for the initial selection of indicators for EPE were that they should be:

- relevant to environmental concerns of greatest importance, such as global climate change, loss of forests, local air or water quality;
- of interest and relevance to key interested parties of the City of Seattle (e.g., employees, citizens, City Council);
- relatively easy to measure and collect;
- easy to understand;
- have the potential to generate cost savings to the City;
- broadly applicable across City departments.

The in-house team underwent a brainstorming process to identify indicators that met the criteria identified. The initial set of indicators to be utilized is indicated in Table P.2. To begin, they determined that the City should focus on operational performance indicators (OPIs). This was considered by the City to be the most important type of indicator because this type of metric tracks actual environmental results, the amount of the environmental load placed by City operations on the environment. Management performance indicators (MPIs), which measure programs that are expected to improve performance on the identified OPIs, will be added following adoption and implementation of the OPIs. Ultimately, the need to improve performance on the OPIs will drive the management programs, which should be implemented at the departmental level.

Having identified an initial set of indicators, an Issue Paper was then developed which described the EPE process in general, indicator development, and the initially-selected indicators. The paper was circulated to key interested parties for comment and critical input was incorporated into the final draft. For example, based upon input from key interested parties, it was decided to initially set only a couple of explicit targets for improvement on OPIs. The Oversight Group felt that initially the City should focus on gathering the data and establishing performance trends. Additional “hard” goals will follow.

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Environmental Performance Indicators

MPIs

City of Seattle operations — **Examples**
- Training;
- Audits;
- Facility investments.

Seattle as a whole — **Examples**
- Recycling programs;
- Providing bike paths;
- Energy conservation programs;
- Water conservation programs.

OPIs

Materials use

City of Seattle operations:
- Paper purchases;
- Chemical use;
- Use of environmentall y preferable products.

Seattle as a whole:
- Recycling volume.

Energy/Water consumption

City of Seattle operations:
- Energy use;
- Water use;
- Fuel use.

Seattle as a whole:
- Energy use per capita;
- Water use per capita;
- Commute trips per capita;
- Transit ridership.

Waste Stream

City of Seattle operations:
- Solid waste generated;
- Hazardous waste generated;
- Green waste generated.

Other Measures

City of Seattle operations:
- Regulatory violations/fines;
- Facility site visits;
- Compliance assessments.

Habitat protection (& impact offsets)

Seattle as a whole:
- Trees planted

ECIs

Seattle and regional environment — **Examples**
- Water quality;
- Air quality;
- Tree coverage;
- Salmon return to streams.

City of Seattle operations | **Seattle as a whole** | **City of Seattle operations** | **Seattle as a whole** | **Seattle and regional environment**

FIGURE P.1 - City of Seattle Indicators for EPE

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TABLE P.2 - Proposed Set of Indicators for EPE for the City of Seattle

Environmental Objectives	Environmental Performance Indicators	Target	Financial Benefits	Environmental & Human Health Benefits	Responsibility for Data Collection
CONTINUALLY IMPROVE ENVIRONMENTAL PERFORMANCE					
Comply with Regulations	✓ Regulatory Violations • Number of violations; • Number of fines; • Cost of fines; • Number of releases.	• Zero violations and fines. • Zero uncontrolled releases.	Reduction in fines	Various	Central office compiles data; No change in legal reporting structure
	✓ Facility Site Visits • Percentage of facilities; • Receiving site visit.	Facility Site Visits: • 50% in 1999; • 50% in 2000.			
	✓ Compliance Assessments • Corrective actions completed	100% corrective actions completed on schedule			
Reduce Pollution at the Source	Chemical Use (to be added in 2000) • Quantity of hazardous materials purchased; • Number of products phased out; • Quantity of pesticide applied.	Trend: down for purchases and applications; up for products phased out	Reduction in: • Hazardous materials purchase costs; • Disposal costs; • Storage costs; • Risk costs; • Record keeping costs.	Reduction in: • Landfill or other disposal; • Employee/ public exposure; • Accidental releases; • Non-point source releases. Improvement in: • Air quality; • Water quality.	Baseline data to be gathered in 1999; All departments will gather data; Central office will compile & analyze
	Hazardous Waste Generated • Quantity of waste disposed; • Cost of waste disposed.	Trend: down	Reduction in: • Waste disposal and compliance costs; • Hazardous materials purchased.	Reduction in: • Land converted to landfills; • Energy to transport waste.	Central office compiles data
Reduce Pollution at the Source	Solid Waste Generated • Tonnes generated.	Trend: down	Reduction in: • Waste disposal costs.	Reduction in: • land converted to landfills; • Methane gas emissions; • Energy to transport waste.	SPU

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Environmental Objectives	Environmental Performance Indicators	Target	Financial Benefits	Environmental & Human Health Benefits	Responsibility for Data Collection
CONTINUALLY IMPROVE ENVIRONMENTAL PERFORMANCE					
	Green Waste (to be added in 2000) • Quantity of green waste commercially recycled or disposed	Trend: down	Reduction in: • Disposal costs; • Purchase of commercial mulches; • Water use (irrigation).	Reduction in: • Energy to transport material to disposal sites; • Odor at off-site composting facilities.	Central office compiles data.
Reduce Consumption of Resources	Paper Purchases • Quantity purchased	Trend: down			ESD - Purchasing
	Use of Environmentally Preferable Products (e.g., recycled oil) • Quantity of oil used; • Percentage of oil used that is recycled product.	Trend: up (80% recycled is current goal)	Encourages market in recycled goods	Reduction in: • Natural resource extraction impacts	ESD - Fleets/ Purchasing
	Energy Used in City Facilities • Facility energy use; • Total cost of energy.	Trend: down	Reduction in energy costs	• Avoided cost of building new supply (electricity); • Air quality improvements (fossil fuel reductions).	• Departments collect and report on building/facility energy use; • Limit analysis to representative buildings/ facilities.
Reduce Consumption of Resources	✓ Energy Used by the City Fleet • Distance traveled by vehicle (non public safety); • Distance traveled in alternative fuelled vehicles; • Quantity of gasoline and diesel fuel used; • Average vehicle fuel efficiency.	• Distance traveled to be reduced by X % by 2002; • Distance traveled in alternative fuelled vehicles to be increased by X % by 2002 (non public safety); • Gasoline use to decrease by X % by 2002.	Reduction in energy costs	Reduction in: • Air emissions that contribute to global warming and pollution; • Use of non-renewable natural resources. Improvement in: • Air quality.	• ESD collects data; • Central office compiles and analyses data.

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Environmental Objectives	Environmental Performance Indicators	Target	Financial Benefits	Environmental & Human Health Benefits	Responsibility for Data Collection
CONTINUALLY IMPROVE ENVIRONMENTAL PERFORMANCE					
	Water Used in City Facilities • Quantity of water used	Trend: down	Reduction in water and sewer costs	• Reduction in waste water to be treated; • Increased water in stream; • Improved water quality.	• Departments collect and report on building/facility water use; • Central office compiles and analyses data; • Limit analysis to represent-ative buildings/ facilities.

Future implementation steps and activities

Step 1

The first implementation step will be the establishment of tracking mechanisms by all City departments to determine their performance on the initial indicator set identified under the indicator column in Table P2.

Step 2

The second implementation step, beginning in 1999 will include:

1. setting additional explicit goals for improved performance on OPIs;
2. consideration of management performance indicators (MPIs) which might drive the OPIs and consideration of additional OPIs as noted in Table P.1 "to be considered later."
3. reporting of environmental results to employees and citizens on a biennial basis through a Corporate Environmental Report (CER).

Step 3

The third step will involve consideration of new ECIs for the City as a whole. These would be developed jointly with the Strategic Planning Office and other interested departments, and would expand the set of ECIs already identified in "Seattle's Comprehensive Plan (OMP, 1996)" within the context of the performance targets set for City operations.

Summary/conclusions

EPE provides a useful tool for the City of Seattle to encourage continual environmental performance improvement across a diverse group of City departments and operations. Furthermore, it provides the basis for the communication of the City's environmental performance to key interested parties through the development of periodic environmental reports.

If you have questions or require additional information regarding this example, please contact the ISO member body for the USA:

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Annex Q

Silicon Valley Environmental Partnership, California, USA

(A non-profit, non-governmental organization using environmental condition indicators to track regional environmental conditions)

Introduction

The Silicon Valley Environmental Partnership (SVEP), a non-profit organization based in the Silicon Valley region of California, United States of America, has developed a comprehensive set of environmental condition indicators designed to track regional progress toward environmental sustainability. The project goals are to present objective, fact-based information which increases the understanding of environmental trends and supports more informed decision-making by Silicon Valley's elected officials, companies, and the general public.

SVEP is an initiative launched by Joint Venture: Silicon Valley Network, a public-private non-profit organization that acts on issues affecting economic vitality and quality of life in Silicon Valley. SVEP promotes environmentally sound business and community practices through collaboration and education. SVEP is governed by a twelve-person Board of Directors representing business, government, environmentalists, education, and research. SVEP focuses on efforts that bridge the traditional "tension" between the environment and the economy, demonstrating that both goals can be achieved in a mutually supportive fashion to move the community toward sustainable development.

With a population of more than 2,2 million people, SVEP's service area includes Santa Clara County plus adjacent portions of San Mateo County, Alameda County, and Scoots Valley in Santa Cruz County. Silicon Valley is situated between the San Francisco Bay on the east and the Pacific Ocean on the west. The region's natural communities range from salt water and fresh water marshes to scrub brush, foothill woodlands, and coniferous forest. The hillsides surrounding and within the valley are an extensive land resource devoted to non-urban uses such as watershed, rangelands, and wildlife habitat. The San Francisco Bay, adjacent marshlands, riparian habitats, and open space are particularly important to the region.

SVEP does not have an environmental management system (EMS) in place, but rather is developing regional environmental condition indicators, in part, to assist organizations in identifying aspects and developing their own EMSs.

Planning EPE

SVEP has been in the process of developing comprehensive environmental condition indicators since early 1997. A draft set of indicators were selected in October 1998, with the first publication of them scheduled for mid-1999. A firm believer in the tenet that "what gets measured gets managed", SVEP embarked upon this in an effort to address gaps in public understanding of environmental issues, as identified in national surveys and discussions with local leaders.

The draft indicators were selected to gauge trend performance on local environmental issues, as well as to measure Silicon Valley's contribution to global environmental conditions. Using a risk-based approach to identify categories of indicators, SVEP focused its indicators on those issues ranked as relatively high risk by the Science Advisory Board to the United States Environmental Protection Agency. SVEP also considered local issues and risks specific to the Silicon Valley region. Data has been gathered for a total of 39 draft indicators spanning the following eight categories:

- species and habitats;
- resource use and waste;
- greenhouse gas emissions;
- stratospheric ozone depletion;
- air quality;
- water quality;
- hazardous materials; and
- human population.

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Selecting indicators for EPE

Table Q.1 provides a few examples of specific indicators along with a description of why they were chosen for the draft set, and some possible links to an organization's activities.

TABLE Q.1 - Examples of SVEP Draft Indicators (Incomplete List)

Draft ECIs	Why Was The Indicator Chosen?	Possible Linkages to Organizations
Percentage of South San Francisco Bay water samples exceeding guidelines for specific contaminants of concern due to bioaccumulation or effects.	Contamination in San Francisco Bay is of regional importance. Tissues of some fish populations have exceeded contaminant thresholds, prompting health advisories for human consumption.	Local organizations may want to assess the extent to which their activities contribute to discharges or emissions of organic chemicals such as Polychlorinated Biphenyls (PCBs) and Polycyclic Aromatic Hydrocarbons (PAHs) and trace metals including mercury, selenium, and cadmium.
Proportion of Silicon Valley stream samples exceeding acute water quality objectives for total copper, zinc, and lead.	Due to recently improved control of point-source pollution, attention has shifted to non-point source pollution as a source of local water quality problems.	Since brake pads are the major contributor to non-point sources of copper in Silicon Valley, organizations may want to assess their activities geared toward encouraging alternatives to single-occupant vehicle use, such as mass transit or telecommuting.
Number of unresolved fuel leak cases in Santa Clara County and Scotts Valley.	Leaks in underground fuel tanks can impact groundwater quality, which is significant since Silicon Valley relies on groundwater for half of its drinking water supply.	An organization may wish to keep track of the number of cases of leaking underground storage tanks generated by its activities or the activities of its suppliers.
Toxic Release Inventory (TRI) chemicals released into Santa Clara County's local environment.	As the center of the world's high-technology industry, this indicator tracks the progress of Silicon Valley companies in preventing pollution.	Organizations may wish to develop operational performance indicators measuring their emissions of Toxic Release Inventory chemicals.
Amount of pesticides used per year in Santa Clara County, arranged as most toxic pesticides versus all others.	Pesticides represent a potential source of pollution into local streams and San Francisco Bay.	Organizations may decide to track their use of pesticides for landscaping. Agriculturally-related organizations might develop operational performance indicators measuring their use of pesticides for crops, or the use of pesticides by their suppliers of livestock feed.
Number of species, federally or state listed as endangered, threatened, or species of concern, which occur, or may be affected by projects, in Santa Clara County. The indicator shows cumulative listings based on the date first listed.	Santa Clara County has been identified as an endangered species "hot spot" in the United States. A "hot spot" is defined as consisting of more than 9 endangered species per county.	Organizations may want to consider habitat issues when they locate and design new facilities and landscape existing facilities.

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Draft ECIs	Why Was The Indicator Chosen?	Possible Linkages to Organizations
Total water use in Santa Clara County.	Much of California is arid, creating competition for scarce water supplies. Water conservation reduces Silicon Valley's reliance on imported water supplies and relieves pressure on endangered fish species. Water is an important component of Silicon Valley's high technology industries.	Organizations may develop indicators to measure their water use for manufacturing, office uses, and landscaping.
Acres of particular wetland types in South San Francisco Bay.	South Bay tidal salt marshes, which have been substantially reduced since vast human settlement in the late 1700's, provide habitat to endangered and threatened species.	Organizations may assess the extent to which their operations, suppliers, wastewater discharges, and facility locations impact wetland habitats.
Estimated tons of carbon emissions per year in Santa Clara County from transportation and energy utility sources.	This indicator tracks Silicon Valley's contribution to global climate change.	Organizations can develop indicators to measure their annual energy use, as well as the estimated carbon emissions from raw materials procurement, product use and distribution, and employee transportation to and from the worksite.
Number of days per year that Silicon Valley air quality fails to meet federal and state standards for ozone and particulate matter of 10 µm or less (PM 10).	Ambient air pollutants can contribute to numerous health problems and affect regional regulatory status.	Since transportation accounts for over half of the Bay Area's air pollution, organizations may opt to measure attributes of their employee trip-reduction programs.
Silicon Valley's human population.	A growing human population increases stress on natural resources and ecosystems.	To the extent that job growth contributes to local increases in population, organizations may wish to consider how they might play a role in ensuring sustainable use and conservation of resources such as water and open space, and reducing transportation-related environmental impacts.

While all of the indicators represent measures of regional environmental performance, each indicator falls into one of the following five categories, measuring:

1. inputs or resource use;
2. outputs or waste streams;
3. habitat integrity including quality, quantity or ambient concentrations;
4. species integrity including quality or quantity; or
5. "leading" indicators that track activities which influence one or more of the previous four categories.

For a single facility, some of the indicators in the table above would be more accurately described as OPIs according to the guidance in ISO 14031. However, in the context of the work being done by SVEP, the indicators are in fact being used to measure regional environmental condition.

Although the majority of indicators are direct measures (i.e., “total”), in some cases SVEP decided to depict both total measures as well as normalized per-capita. Per-capita trends are important for gauging the region’s overall efficiency independent of population growth. However, despite the value of per-capita trend data, it alone can mask areas needing improvement from an aggregate regional perspective. For example, water use may have declined by 10% per-capita, but the human population may have doubled over the same

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time period, resulting in increased water use overall. Since environmental sustainability is a function of the region's total "ecological footprint" relative to carrying capacity, "total" indicators may be better than "per-capita" indicators in tracking this information.

Using data and information

Collecting data

Initial brainstorming on potential indicators and data availability was accomplished by extensively interviewing experts, reviewing scientific publications and other technical literature, reading local media coverage, and exploring information on the Internet. Because the indicators are focused on depicting trends over time, data will be updated annually where available. Data collection is executed by a team of student interns and industry volunteers led by a lead researcher affiliated with SVEP. Data is supplied by dozens of organizations including local, regional, state, and federal government agencies, non-profit groups, local pollution control plants, universities, companies, and industry trade associations. In cases where data is not available for the entire Silicon Valley, Santa Clara County is used as a proxy since it contains roughly three-quarters of Silicon Valley's population.

A 16-member Advisory Board was established to provide strategic oversight and technical assistance to the indicators project. To ensure a collaborative, multi-perspective approach, the Advisory Board has balanced representation from business, the environmental community, government, and academia. This combination enables rigorous quality control and the ability to factor diverse perspectives into development of the indicators and outreach tools.

Analyzing data

While most of the indicators show trend lines over time, in some cases data was not available to support this type of indicator. In these instances information may be portrayed using Geographical Information System (GIS) mapping, statistics showing performance at a single point in time, or qualitative narratives. Where applicable, limitations to the data are clearly described. The project team also compiled a "wish list" of indicators for which data was not presently available, but to which future research effort would be directed.

Assessing information

Each indicator is accompanied by a concise narrative, using language which is understandable by the general public, which describes "Why is this important?" and "How are we doing?" An effort is made to explain how environmental performance relates to economic vitality and quality of life. Linkages between indicators are also highlighted to demonstrate the importance of using a multi-media approach to environmental decision-making. For instance, linkages show how water consumption can impact fish populations, or how a gasoline additive to clean the air has inadvertently contaminated the groundwater. Prior to publication, all indicator data and associated analysis is reviewed and edited by the organization supplying the data.

Reporting and Communicating

The information compiled in the Silicon Valley Environmental Indicators is targeted to multiple groups including leaders in business, government, the community, education, and the media, as well as to the general public. A concise report with graphics and text will be distributed widely to these audiences, and the information will be posted on the SVEP Internet web site at http://www.svep.org. Public presentations will be held to feature each year's findings, and press releases will be issued to the media.

The Silicon Valley Environmental Indicators are a tool to help organizations and individuals in Silicon Valley understand and manage environmental issues. Information generated from the indicators can help companies and other organizations to identify their environmental aspects and evaluate their environmental performance. For example, a regional manufacturing trade association has used the information to measure local companies' progress toward pollution prevention. Also, a public-private consortium led by business, government, and community leaders is incorporating some of the information from the Silicon Valley Environmental Indicators into a community-based effort to develop a "vision" of Silicon Valley for the year 2010.

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Reviewing and improving EPE

Feedback from end-users will be solicited and factored into future updates of the Silicon Valley Environmental Indicators. The desirability and feasibility of using the indicators to positively influence policy decisions will also be considered, recognizing that the goals of “education and awareness-building” are related to, but distinct from, “influencing policy”. Further, future research effort will be devoted to the “wish list” of additional indicators for which data or resources were not readily available. Examples of these indicators include:

- acres of impervious surfaces in Silicon Valley;
- pollutants in tap water;
- proportion of intact (or well-functioning) riparian habitat in Santa Clara County; and
- proportion of South Bay water bodies meeting all designated uses.

Summary/conclusions

The Silicon Valley environmental condition indicators highlight regional success stories that offer encouragement and inspiration, and pinpoint priority areas that need improvement. Annual updates keep the region accountable for environmental performance improvements and enable evaluation of long-term progress.

If you have questions or require additional information regarding this example, please contact the ISO member body for the USA:

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