ECO-EFFICIENCY AND INDICATOR DEVELOPMENT IN CANADIAN INDUSTRY

Industry Canada

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EXECUTIVE SUMMARY

In 1992 the Business Council on Sustainable Development (now the *World Business Council on Sustainable Development)* introduced "eco-efficiency as its contribution to sustainable development. The World Business Council on Sustainable Development (WBCSD) defines eco-efficiency as:

> *"The delivery of competitively priced goods and services that satisfy human needs and bring quality of life, progressively reducing ecological impacts and resource intensity throughout the life cycle, to a level at least in line with the earth's carrying capacity."*

In addition ,the WBCSD identified seven elements which contribute to eco-efficiency, and should be considered at each stage in production process of all goods and services. These include:

1. reducing the ***material requirements***;
2. reducing the ***energy intensity***;
3. reducing ***toxic dispersion***;
4. enhancing ***material recyclability***;
5. maximizing ***sustainable use of renewable resources***;
6. extending ***product durability***;
7. increasing the ***service intensity***

The purpose of the study was to:

- determine the extent to which the concept of eco-efficiency and related indicators are being used and supported by the key industry sectors for which Industry Canada is responsible;
- describe the evolution in the implicit and explicit use of eco-efficiency indicators at the level of the firm, and their perceived and demonstrated impact on corporate environmental performance, productivity, profitability and/or shareholder value; and,
- identify opportunities to use practical eco-efficiency indicators for improving the environmental performance, competitiveness and trade opportunities of Canadian companies in the sectors under study.

Three broad areas of enquiry were established to gather information, including:

- a literature search to confirm the results of recent studies and reports prepared by international business, other governments and Canadian public and private sector organizations;
- a review of annual and environmental reports, web sites and documents made available by industry associations and companies in the twelve sectors for which Industry Canada

is responsible; and,
- completion of in-depth interviews and a questionnaire with industry participants in seventeen industry associations and forty companies representing ten of the twelve sectors.

Highlights of the Literature Search

The WBCSD is providing leadership at the level of international business in promoting the concept of eco-efficiency and indicator development. In July, 1999, the WBCSD Working Group on Eco-efficiency and Reporting released a status report for the development of a voluntary framework for the measurement of eco-efficiency indicators for the year 2000. The objectives include:

- broad principles for the development and use of indicators;
- a set of seventeen core indicators plus additional supplementary indicators which would vary by business and sector;
- a means to quantify the relationship between economic value and environmental influence; and,
- means of clear and transparent communication of eco-efficiency.

At the intergovernmental level, the Organization for Economic Cooperation and Development (OECD), the United Nations Environment Programme (UNEP) and other groups are also engaged in work on eco-efficiency. The first OECD report, prepared for Ministers in March, 1998, is of particular interest because it addresses not only the role of the private sector in achieving eco-efficiency, but that of government, in developing macro-economic indicators and facilitating industry's progress managing their own operations. Some key conclusions were that:

- governments should consider quality of life and human needs in addition to conventional economic indicators;
- government should focus on national indicators of eco-efficiency, such as developing measures for the total material requirements of an economy; and,
- complexities underlying these concepts require the use of a range of more transparent indicators of specific environmental pressures which have not yet been developed.

In March, 1999 the OECD held a workshop in Australia to assist in developing a series of case studies which illustrate trends and the potential for improvements in eco-efficiency. Some key conclusions were

- the role of business and government in achieving eco-efficiency are essential and complimentary;
- there is a need to improve eco-efficiency and to further develop and promote the concept; and,
- strategies for eco-efficiency must reflect individual corporate , sectoral or national circumstances and accommodate different approaches to implementation.

At the national level, in 1996 the National Round Table on the Environment and the Economy (NRTEE), under an agreement with WBCSD, undertook a study on the development of core indicators. They focused on three elements namely; material intensity, energy intensity and toxic dispersion. In 1998, the report of the task force stated that of the two indicators designed and tested, only energy intensity emerged as broadly applicable, technically feasible and relevant for both internal and external reporting. Only preliminary work was carried out for toxic dispersion

Industry Response and Reporting

Seventeen industry associations and forty companies representing ten of the twelve sectors for which Industry Canada is responsible were interviewed and/or provided information by completing a questionnaire. Information was requested concerning the level of industry awareness, priority assigned

the different elements of eco-efficiency and related concepts and current practices surrounding the use of indicators and reporting. Participants were also asked to identify the benefits and opportunities they perceived with adoption of eco-efficiency or alternate approaches, the potential for development and application of universal indicators and factors affecting further enhancement of the concept. From the response received, it appears that:

- the concept of eco-efficiency is recognized by some, endorsed by a few but not being widely promoted for two reasons: first, the definitions for each of the seven elements are subject to a wide interpretation and understanding and second, eco-efficiency, as defined only deals with economic and environmental issues and does not address the social dimension which is becoming very important;
- awareness of environmental performance is increasing within companies and there is a trend towards total integration of environment health and safety in the organization structure. The health aspects are increasing in importance;
- reducing energy intensity, reducing material requirements and reducing toxic dispersion were assigned the highest priority.

At the level of the firm, response indicates that:

- more emphasis is being placed on alternative concepts primarily the development of environmental management systems (EMS). ISO 14001 or equivalent seems to be the preferred system;
- seeking certification is usually site-specific, reflecting the type of business and the market pressures.

- life cycle or product life cycle analysis is gaining momentum for reasons of better product design, reducing waste and attaining more recycling capability; and,
- there is also a trend towards partnerships with suppliers and customers, the main purposes again are to develop better products, reduce waste and reduce material requirements.

Among the associations surveyed:

- four have taken a leadership role in developing an EMS which, in two cases, is a condition of membership;
- about half of the associations maintain environmental data and report on performance on behalf of their sector as a means of improving transparency and accountability. Most companies retain environmental performance data and report to the public by various means.

Among all respondents, it was agreed that the linkages betweeneco-efficiency and productivity, profitability and shareholder value are not well developed. The direct relationship of an effective EMS to enhanced communications, increased awareness, improved training, improved product and process quality to improved environmental performance to increased profitability, is understood by environmental managers, but effective indicators or enhancement of present indicators to clearly show these linkages are needed. Capital expenditure approval for environmental projects like any other investment, requires a business case showing the impact to the bottom line. Trade was not considered relevant.

In addition, there was agreement on the need to develop indicators for the financial and social aspects of business, both of which are becoming very important. Regulations or pressures from government will not be the driving force. Competitiveness, financial institutions, market forces and public pressure will be the primary factors. All felt time is a crucial factor in the development of effective indicators. Finally, there was minimal support for the development and use of universal indicators. Comparison between sectors and even between product lines within a company is challenging. Normalizing of data to production, which is common, is not feasible for companies with a number of product lines.

Conclusions

In analyzing the response received, the following trends can be discerned:

1. Most companies have or are developing environmental management systems. Most are using ISO 14001 although a few have designed their own;
2. Most companies and some associations are using indicators to measure environmental performance or for other specific environmental issues;
3. Total integration of environment, health and safety responsibilities within the corporate structure is quite common. For an effective EMS and to achieve continuous improvement in performance, this change seems rather important;
4. A high percentage of companies are using electronic media as a means to communicate environmental performance. Published annual environmental reports in many cases have proven not to be cost effective; and,
   A number of large companies are partnering with their suppliers or customers to improve product design, reduce waste and reduce material requirements.

Benefits and Opportunities for Enhancement

The main benefits that can be achieved through the use of eco-efficiency or the development of the seven elements are: cost savings, competitiveness, product design, business expansion and capital funding. Although eco-efficiency by name is not now fully endorsed and may not be for the distant future ,there are opportunities to further enhance the concept. Reducing material requirements, energy intensity and toxic dispersion will continue as high priorities and the continued enhancement of indicators will prove beneficial. Similarly recyclability, and customer service are gaining in importance.

The major focus of attention however, is in the area of financial indicators and the management of social issues (health, wellness, communities and equity). Indicators for health or wellness and the impacts of industry operations on communities and the related social equities will require research and development.

Most of the companies canvassed regarding eco-efficiency and the development and application of indicators are large, suggesting that significant gains in terms of cost savings, productivity, environmental performance could be realized if the concept were transferred to the many small and medium-sized enterprises which are not yet seized with the concept.

There is a clear move at the international level toward an ever widening number of eco-efficiency indicators which companies will be able to choose to meet their own particular needs and a move away from the idea of a "one size fits all" indicator. More work remains to be done in establishing the relationship between "eco-efficiency" and parallel systems for monitoring environmental and social performance and in raising awareness in the sectors for which the concept is relatively unknown, and among the small business community. Targeted research, initiatives aimed at transferring knowledge and technology from one sector to another, and from large to small business, are possible areas for government/industry partnerships to ensure that Canadian industry maintains its competitiveness in global markets shaped by concern for the environment, health and social issues.

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SECTION 1: INTRODUCTION

In 1992, as governments prepared for the United Nations Conference on Environment and Development (UNCED) in Rio, the international business community, represented by the Business Council on Sustainable Development (now the *World Business Council on Sustainable Development*), introduced "eco-efficiency" as its contribution to sustainable development. Eco-efficiency is a concept and management tool which provides business with the means to make measurable progress toward sustainability, but does not guarantee sustainable development. Governments and society also have a role in addressing the challenge of population growth and environmental impacts associated with increased consumption and production volumes.

Eco-efficiency responds to competitive market forces, challenging firms to reverse the trend of unsustainable growth, in the face of increasing demands from a rapidly growing global population. As a management philosophy, eco-efficiency offers increased competitiveness and market share by increasing value for the consumer and resource productivity and lowering the cost of production, and current and future environmental compliance and liability.

The World Business Council on Sustainable Development (WBCSD) defines eco-efficiency as:

> *the delivery of competitively priced goods and services that satisfy human needs and bring quality of life, while progressively reducing ecological impacts and resource intensity throughout the life cycle, to a level at least in line with earth's carrying capacity.* " (1)

Five "core themes" (2) are integral to this definition. These include:

- an emphasis on service and adding value to products;
- understanding customer needs and quality of life;
- adopting a life cycle approach which takes into account the upstream and downstream product impacts;
- accepting limits to the ability of the global ecosystem to yield resources and absorb pollution and wastes (eco-capacity); and,
- viewing eco-efficiency as a process of continuous improvement toward sustainable development.

In addition, the WBCSD identified seven elements which contribute to eco-efficiency, and should be considered at each stage in the production process of all goods and services. These include:

1. reducing the ***material requirements*** (total mass consumed);
2. reducing the ***energy intensity*** (energy consumed during every phase of production) ;

3. reducing ***toxic dispersion*** (release of toxic substances to all media);
4. enhancing ***material recyclability*** (re-use of materials or energy);
5. maximizing ***sustainable use of renewable resources*** (avoiding depletion of finite resources);
6. extending ***product durability*** (optimizing product life); and,
7. increasing the ***service intensity*** (creating added value while reducing environmental impacts).

A central tenet of eco-efficiency is that it requires improvement in most, if not all, the above elements over the medium-to long term, while maintaining performance with respect to the others. (3)

The purpose of the study was to:

1. determine the extent to which the concept of eco-efficiency and related indicators are being used and supported by the key industry sectors for which Industry Canada is responsible;
2. describe the evolution in the implicit and explicit use of eco-efficiencyindicators at the level of the firm, and their perceived and demonstrated impact on corporate environmental performance, productivity, profitability and/or shareholder value; and,
3. identify opportunities to use practical eco-efficiency indicators for improving the environmental performance, competitiveness and trade opportunities of Canadian companies in the sectors under study.

In approaching the study, work was divided into three broad areas. The first step involved a literature review of recent studies and reports which represent current thinking on the part of the international business community, other governments and Canadian public and private sector organizations. The emphasis was on emerging issues associated with the development of eco-efficiency indicators and the relationship of eco-efficiency to other measurement systems. The results of this phase of the study are discussed in a separate section which highlights conclusions reached by the WBCSD, the Organization for Economic Development and Cooperation (OECD) and the National Round Table on the Environment and Economy (NRTEE), among others.

The second step involved the detailed review and assessment of information made available to the public by industry associations and companies in the target sectors. This included annual and environmental reports , web sites and other documents provided by participants over the course of the study.

Finally, in-depth interviews were conducted with representatives of industry associations and selected companies in ten sectors for which Industry Canada is responsible. This consultation was supplemented by means of a survey distributed to additional contacts. The sectors included:

- Advanced Materials;
- Aerospace and Defence;
- Automotive and Transportation;
- Bio-Industries;
- Chemicals and Plastics;
- Consumer Products;
- Financial Services;
- Health Industries;
- Information Technologies and Telecommunications;
- Metals and Minerals Processing; and,
- Manufacturing and Processing Technologies.

Participants were asked to respond to a series of questions which addressed the following themes:

- *Level of Industry Awareness* (of concept, attributes, conditions, relevance);
- *Ranking of Elements* (industry preferences in relation to 7 elements - in total, by sector);

- *Priority Attached to Related Concepts/Indicators* (extent of reliance, perceived linkages);
- *Monitoring and Reporting* (perceptions/experience regarding the availability, access and transparency of data and other issues);
- *Perceived Benefits and Opportunities* (reason for adoption/application of EE and other indicators);
- *Universal Indicators* (development and application) and;
- *Barriers and Incentives to Enhancement of Eco-efficiency* (corporate & government role in promoting/facilitating adoption, necessary conditions for broader use of EE and related indicators).

Structure of the Report The following outlines the content of subsequent sections to this report:

Section 2, Evolution in Approach, provides highlights of the literature search undertaken to assess the evolution in the concept of eco-efficiency, as reflected in current research being undertaken by the WBCSD, the work programme of the OECD and several recent studies, including the 1998 initiative of the National Round Table on Environment and Economy (NRTEE). The latter study was undertaken in partnership with the WBCSD and eight Canadian firms, to test the feasibility of specific indicators.

Section 3, Sectoral Response , consolidates the comments received from seventeen industry associations and forty corporations in relation to the above themes, for each of the ten sectors who chose to participate in the survey.

Section 4, Summary and Analysis of Industry Response, summarizes and assesses the response for all ten sectors, for associations and individual corporations, including direct quotes from interviews or publications which illustrate current thinking and practices across all sectors. Summary information is also provided on the extent to which eco-efficiency and environmental performance, including indicators, are featured in the annual reports and web sites of sixty-seven (67) industry associations and companies. See *Annex D* for details on the type of information provided by each.

Section 5, Conclusions, identifies a number of trends, benefits and opportunities associated with eco-efficiency and the current status of indicator development and use on the part, based on the trends indicated by the literature review and industry survey.

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1. Livio D. DeSimone, , Frank, Popoff, World Business Council for Sustainable Development (WBCSD), *Eco-Efficiency: The Business Link to Sustainable Development* (Cambridge, MA: The MIT Press, 1997), p. 47.

2. Ibid., p. 89.

3. Ibid., p. 57.

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SECTION 2: EVOLUTION IN CONCEPT AND APPROACH

In recent years, national and international organizations, as well as individual companies and industry associations, have devoted considerable resources to achieving a better understanding of eco-efficiency, including developmental work on eco-efficiency indicators. Eco-efficiency has become part of international environment and sustainable development policy agenda and is reflected, to varying degrees, in the work programmes of major bodies of the United Nations, i.e., United Nations Environment Program (UNEP),and the UN Commission on Trade and Development (UNCTAD), the Organization for Economic Cooperation and Development (OECD), the International Standards Organization (ISO) and the International Institute for Sustainable Development (IISD), among others.

As a result, there is a growing body of research available to draw upon when attempting to characterize the state of eco-efficiency indicator development in Canada. Not all of the results are conclusive, or necessarily, consistent.

The literature review served two purposes. First, it was helpful in shaping the ture of questions to be directed to industry. Second, it helped to characterize the direction being tak y leading proponents of the concept as a backdrop for assessing industry response and identifying opportunities to enhance eco-efficiency development in Canada.

There were some deliberate limitations placed on this part of the project. Research was restricted to recent reports and studies which capture current thinking on the part of business and governments at the global, regional and national level, selected for their impact on the debate and relevance to Canada. There was no intent to be exhaustive in scope or to re-work understandings reached early in the development of the concept.

What follows is a brief overview of the key findings of three major initiatives which are focusing on the development of eco-efficiency indicators at the international, intergovernmental and national level relevant in the response of Canadian industry in the twelve sectors under study.

The WBCSD Framework for Eco-efficiency Indicators and Reporting

In July, 1999, the WBCSD Working Group on Eco-efficiency Metrics and Reporting released a status report on its work to develop a new, voluntary framework for the measurement of eco-efficiency indicators, for the year 2000. The framework will be used by a wider range of businesses in measuring progress toward environmental and economic sustainability. The framework is intended to support both internal management decision-making as well as communicate information to external stakeholders. The overall objective of the project is to secure agreement on:

- broad principles for the development and use of indicators and related definitions and terminology;

- a recommended set of "*core" indicators* that address the *environmental influence* (based on the environmental impacts of product development or use), as well as the *product or service value*, that together would establish the "eco-efficiency profile" of a company and would be relevant and meaningful to virtually all types of businesses;
- a process for developing "*supplemental*" indicators, which would vary by business and sector;
- a means to quantify the relationship between economic value and environmental influence; and,
- ways to ensure clear and transparent communication of eco-efficiency to management and external stakeholders for their decision making.

To date, the WBCSD has proposed 17 "*core*" indicators, in two broad groups. The following five indicators are put forward to capture "*Product or Service Value*":

- unit/number/mass of product or service made or sold;
- net sales;
- value added;
- gross margin; and,
- profit/earnings/income;

A further twelve indicators have been put forward to measure *Environmental Influence*, associated with the all aspects of the production of goods and services which include:

- energy (gigajoules) consumed;
- materials (tons) consumed;
- water (m3) consumed;
- green house gas (GHG) emissions (tons of CO_2 equivalents);
- ozone depleting substance (ODS) emissions (tons of CFC11 equivalents);
- acidification emissions (tons of proton equivalents);
- nutrification emissions (tons N&P substances) in water effluents;
- Chemical Oxyger Demand/Biological Oxygen Demand (COD/BOD) in water effluents;
- volatile organic compound (VOC) emissions;
- persistent organic pollutant (POP) emissions;
- priority heavy metals emissions; and
- land use.

Eco-efficiency is determined, for the WBCSD, by merging product or service value with environmental impacts, i.e., by calculating the relationship between environmental influence, for one or more of the above environmental indicators and one of the five product or service values, as in the following ratio:

$$\text{Eco-efficiency} = \frac{\text{Product/Service Value}}{\text{Environmental Influence}}$$

Specific calculations will depend on the needs of individual decision makers. By maintaining separate data for both types of indicators to maximize options for calculating eco-efficiency in ways that are most meaningful for the company or sector. Additional "supplemental" indicators, which may be needed to address the particular circumstances of a company or sector may be selected at the discretion of the company or sector, to address specific decision-making or reporting needs.

Regardless of the type of indicator (*core or supplemental*), or how eco-efficiency is calculated, the WBCSD emphasizes that it is important to recognize the inherent diversity of companies. This is particularly important when comparisons are made between companies. Comparisons should only be made when the companies being compared are producing the same product or service. Eco-efficiency estimates cannot be aggregated across products that perform different functions. The authors also point out that it is also important to recognize that the a change in the product mix may affect performance, in terms of eco-efficiency, independent of a firm's environmental activities.

There is a second initiative, worthy of note, which involves various businesses, non-governmental organizations, academics and private sector experts, known as the *Global Reporting Initiative (GRI)* which was established in late 1997 to design "*globally applicable guidelines for preparing enterprise-level sustainability reports.* A draft report is to be released in early 2000. This work is being overseen by the Coalition for Environmentally Responsible Economies (CERES) and is also developing a framework for reporting on the environmental economic and social aspects of sustainability

Agenda of the Organization for Economic Cooperation and Development (OECD)

The Organization for Economic Cooperation and Development (OECD) undertook focused work on eco-efficiency in 1996, pursuant to direction from Ministers to consider the potential it might hold "to decouple pollutant release and resource use from economic activity"[4] Since then, the OECD has incorporated eco-efficiency into its work programme and released a first report to Ministers, in March 1998. This work is important in that it addresses not only the role of the private sector, in achieving eco-efficiency, but also the role of governments in addressing eco-efficiency at the level of the macro-economy, as well as facilitating industry's progress, and that of governments, with respect to their own operations

In its report, the OECD defines eco-efficiency as "*the efficiency with which environmental resources are used to meet human needs*"[5] as measured by the ratio between inputs and outputs, i.e., the sum of environmental impacts generated in relation to the value of goods and services produced by a firm, sector or the economy as a whole.

The purpose of the 1998 report was to evaluate the experiences of business, governments, community organizations and households in carrying out strategies, primarily aimed at pollution prevention, waste minimization or other goals, and consider their effectiveness in promoting eco-efficiency. It also looked at the nature of technical and social innovation required to support the type of change that must be effected if the energy and material intensity in the major industrialized countries is to be reduced by "factor 10" over the next thirty to fifty years.

For the economy as a whole, it is indicated that the WBCSD explanation of eco-efficiency requires that governments consider *quality of life and human needs* in addition to conventional economic indicators. In addition to such indicators as the *unemployment* rate, number of *homeless people*, the *consumer price index*, and the *trade balance*, quality of life would include such things as *time spent with families* and *community involvement*.

Environmental pressure indicators and *state of the environment indicators* are available at the national level for defining goals of *sustainability*. They would include: pressures on the environment (emissions of pollutants from different sources, consumption of coal, oil, gas and minerals, consumption of renewable resources, economic valuation of environmental damage, and use of environmental services), and state of the environment (remaining mineral resources, concentration of pollutants in air, water, biota, land used for industry or agriculture, indicators of biodiversity, ecological footprint, and environmental capital

Governments should focus on specific types of indicators of eco-efficiency. An example of such an indicator would be the *total material requirement (TMR)* of an economy, which is an estimate of the total mass of materials disrupted each year by economic activities. It would include everything from soil erosion to the release of toxic compounds. The report concluded, however, that there are serious limitations to how these indicators can be used. They are not considered useful for examining long-term trends or for giving a good indication of the trends in, and causes of, specific environmental pressures, or for making comparisons between countries.

A key conclusion of the report, however, is that the complexities underlying these concepts can be revealed only by using a range of more transparent indicators of specific environmental pressures which have not yet been developed, as governments are just beginning to develop indicator series for their

reports on progress towards sustainable development.

In March of this year, the OECD Working Party on Pollution Prevention and Control, held a workshop in Australia, to assist in developing a series of industry case studies which illustrate trends and the potential for improvements in eco-efficiency as well as the experience of national governments such as the Voluntary Challenge and ARET for their contribution to eco-efficiency. Key conclusions reached by the workshop were that:

- there is a need to improve eco-efficiency and to further develop and promote the concept;
- most studies to date have been conducted at the level of the firm, which implies a gap in government studies and response at the macro-level and in terms of their own activities;
- eco-efficiency is valued by business because of its ability to reduce costs, improve relations with government and community stakeholders and overall competitiveness
- the role of business and government in achieving eco-efficiency are essential and complementary
- there is a need for government to provide "*fiscal, regulatory and other incentives to make eco-efficiency improvements more attractive to firms*" ;
- strategies for eco-efficiency must reflect individual corporate, sectoral or national circumstances and accommodate different approaches to implementation;
- "while detailed indicators of resource use, pollution and value-added are clearly needed at the level of the firm, sectoral and national indicators are also needed so that progress can be measured with respect to aggregate goals[(6)]"; and, finally,
- further work on the case studies being developed by the OECD should consider better indicators of *economic/financial* and *social outcomes* and *risk or hazard*; the identification of "*critical factors*" in the success or failure of initiatives; and increased focus on the *role of consumers* in improving eco-efficiency.

Canada's Experience

In 1996, the National Round Table on the Environment and the Economy (NRTEE) reached agreement with the WBCSD to develop a limited number of "core indicators" for eco-efficiency which would be widely understood and accepted, applicable to all companies and supportive of benchmarking within a sector. Accordingly, the NRTEE established a Task Force whose first product was a background paper for discussion at an international workshop organized by WBCSD in April, 1997.

In the Report, five initiatives were selected for focus, including Northern Telecom's *Environmental Performance Index*, which rates the company's annual environmental performance relative to a base year, using a weighting and scoring scheme. A number of others which provided normalized performance information were mentioned, including Dofasco *energy efficiency*, *air* and *water emissions* and *solid waste disposal)* and Ontario Hydro's *(Resource Utilization Index)*. All were found to meet the WBCSD's criteria for development of eco-efficiency indicators, i.e., appropriateness, measurability, verifiability and comparability over time, but some lacked transparency and did not permit comparison within or among sectors. It was also acknowledged that "*core*" (universal) indicators might need to be supplemented by industry-specific benchmark values and indicators, as well as absolute performance measures.

The NRTEE also proposed an initial group of three core indicators to measure: 1) resource productivity *(materials and energy use in relation to production and waste*; 2) toxic releases (*total production emissions over a given period of time*); and, 3) the ratio between product and disposal to durability *(product and disposal cost related to product life*)

In April, 1997, at the Washington workshop, participants recommended development of separate indices for material and energy intensity but rejected the proposal for a single indicator to measure toxic releases. This was based on concerns surrounding differences in definition, quantification and weighting of toxics, production processes and product mix and the need to address exposure, as well as toxicity, in addressing risk. There was no support for the proposal to measure product durability because of its limited applicability to eco-efficiency, the difficulty of making accurate calculations in the

absence of full cost accounting, and the emphasis on durability at the expense of factors such as recyclability and the need for innovation to create better products.

Based on the guidance received from the Washington workshop, the Task Force launched a pilot study, in partnership with 3M Canada, Monsanto, Noranda, Alcan, Nortel, Proctor and Gamble, Pacific Northern Gas (for Westcoast Energy) and Dow Chemical (with respect to toxic/pollutant dispersion only), to design and test *energy* and *material intensity* indicators and begin work on *pollutant dispersion*.

In 1998, the Task Force reported that , of the two indicators designed and tested, only *Energy Intensity*, (energy consumed from all sources related to a unit of output or service), emerged as broadly applicable, technically feasible and relevant for both internal and external reporting.

The NRTEE states that ".. *unlike materials which vary widely, energy is like a common currency unit in all businesses and countries*"(7). However, participants recommended the development of a further seven supplementary indicators to capture energy consumption and losses due to production, generation and delivery of the energy used in the production process, in transporting the product to market, during use, disposal and over the full life cycle of the product. A separate indicator to measure greenhouse gas emissions, associated with each stage in the product life cycle, is also needed.

Results with respect to *Material Intensity* were less positive. Two indicators were developed and tested. The first measured material consumed (*in-house*) per unit of output; the second focused on materials used in packaging, recovered , recycled and re-used. Both proved applicable to only the primary manufacturing sector and presented significant problems for the extractive industries and those involved in consumer product assembly, formulation or packaging.

Issues identified during testing tended to fall in one of the following three broad areas:

- *data collection* (scope, source, quality, completeness, representi ity);
- *technical feasibility* (availability of data, allocation of costs to products, processes and waste streams, changes in product mix, level of aggregation); and,
- *use and/or interpretation* (internal or external audience, level of aggregation, consideration of complementary/supplemental indicators, flexibility in selection of indicators reduces comparability, concerns regarding confidentiality).

Finally, only very preliminary work was done to support development of the many, issue-specific indicators needed to measure *Pollutant Dispersion* . While there are many systems in place to collect data on pollutant releases, there is no international agreement on the weighting and relative toxicity of substances, the underlying science regarding the weighting and relative toxicity of substances. The likelihood of securing consensus on broadly applicable indicators in the near future does not appear to be high.

Another initiative, which is relevant to the development of indicators for eco-efficiency in Canada is work sponsored by the Canadian Institute of Chartered Accountants (CICA). In their recent report, *Environmental Performance Measurement and Reporting: State of Play Summary*, on the practice and development of measurement and reporting tools, the CICA considered the work of the WBCSD, World Resources Institute, the UN system and others. They concluded that the three broad areas for focus should be work aimed at developing and implementing environmental performance indicators, including indicators of eco-efficiency, the development of practices and guidelines for external reporting and relationship between environmental performance and shareholder value.

In addition, the CICA noted the following trends:

- a new emphasis on eco-efficiency and interest in cross-cutting indicators for performance measurement
- the importance of links between performance and shareholder value;

- the emergence of mainstream institutional investors and analysts as users of performance information;
- an increased number of countries developing guidelines and improving reporting practices; and,
- the emergence of 'triple-bottom line' reporting which takes into account environmental social and economic factors.

Summary

Taken collectively, it would appear that the trend at the international level is toward the development of a wider range of indicators of eco-efficiency, which capture both environmental performance and traditional economic achievements. There is a growing consensus that many existing approaches, which have developed systems indicators for performance measurement, contribute to eco-efficiency and the larger goal of sustainable development, but that the exact relationship needs clarification. A second strand is the emerging consensus on the role of governments in promoting eco-efficiency. This includes the need to explore and promote the social aspects, as well as maximizing eco-efficiency in government operations and adapting the policy, regulatory and fiscal framework to facilitate wider adoption of eco-efficiency by business.

Pressures are also emerging for governments to consider the use of new and existing measures of environmental health and national accounting to establish eco-efficiency ratios for the economy as a whole. This last point is qualified by the recognition that comparability among nations is not feasible, given the differences in geography, climate, industrial and political structure, etc. Finally, despite early interest in "universal" indicators, experience at the international level and in Canada points to the need for agreement on the definition and use of many, rather than fewer, indicators which can be manipulated to address the very different circumstances of individual firms and sectors.

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4. Organization for Economic Cooperation and Development (OECD), Environment Policy Committee, Environment Directorate, *Eco-Efficiency: Environment Ministerial Steering Group Report*, (Paris, March 1998), p. 3

5 Ibid.

6 Ibid., p. 10

7 NRTEE, *Measuring Eco-Efficiency in Business: Feasibility of a Core Set of Indicators*, p. 10.

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Sectoral Response

AUTOMOTIVE AND TRANSPORTATION

Respondents: The following represents a summary of information received from Air Transport Association of Canada (ATAC), Daimler Chrysler, Air Canada and Canadian Airlines.

Formal Endorsement of Eco-Efficiency and Related Indicators	The level of endorsement varied among the respondents. Some supported the concept and others did not.
Level of Corporate Awareness	The term eco-efficiency is new to most respondents and not well understood. The concept of fuel and energy efficiency plus other eco-efficiency elements is practiced in the sector.
Corporate Priorities in Relation to the Seven Elements of Eco-Efficiency (8)	Reducing energy intensity is the most important element for the sector. Reducing the material requirements for goods and services and reducing toxic dispersion are also considered high priorities.
Importance Assigned to Related Concepts and Management Tools	The sector does place more importance on other related approaches. ISO 14001/equivalent, pollution prevention, life cycle management plus energy related programs are all equally important.
Monitoring and Reporting on Environmental Performance (9)	ATAC does not maintain environmental performance data for its members nor does it publish any reports. The companies do maintain records of performance including participation in voluntary programs and submit public reports. Some information may be restricted for competitiveness reasons.
Reason for Adopting Eco-Efficiency Indicators (or their proxy)	Indicators are used primarily to improve the design of goods and services and improve profitability. One respondent said indicators are used so the company can prioritize environmental issues.
Trade and Competitiveness	The respondents from the airline companies feel that the use of practical indicators could influence trade and competitiveness between

sectors but the auto respondent felt there was no benefit.

Environmental Performance, Productivity, Profitability and/or Shareholder Value	The airlines link performance and profitability through improving fuel efficiency, minimizing accidental releases of toxics and reducing material requirements. They all lead to reduction in costs through the reduction of raw materials, reduced risk of litigation and fines and reduced landfill costs.
Further Evolution of Eco-efficiency and Enhancement of Indicators	The respondents agreed that the development and use of indicators will evolve further.
Conditions for Success	The introduction of data collection systems and voluntary initiatives with government leadership are required to encourage wider adoption of eco-efficiency and related indicators. One respondent pointed out that the 1998 Commissioner of the Environment's report did not mention eco-efficiency at all.
Design and Implementation of Universal Indicators	There was minimal support for the development of universal indicators relating to energy use, toxic dispersion and material requirements.

BIO-INDUSTRIES

Respondents: The following represents a summary of information received from BioteCanada, AgrEvo and Monsanto.

Formal Endorsement of Eco-efficiency and Related Indicators	The term, "eco-efficiency", is not familiar to the sector. However the concept is supported in their management programs and indicators are being used to measure environmental performance. Monsanto is pledged to "*Environmental Sustainability*" and uses indicators to measure progress.
Level of Corporate Awareness	The level of understanding and awareness of eco-efficiency within the sector is minimal.
Corporate Priorities in Relation to the Seven Elements of Eco-efficiency [10]	The ranking of the elements varied with the respondents. There was general agreement that maximizing the sustainable use of renewable resources and reducing toxic dispersion were important. Reducing the material requirements for goods and services and increasing the service intensity of goods and services were also mentioned.
Importance Assigned to Related Concepts and Management Tools	The companies all indicated that other related approaches were being used in their environmental programs. ISO 14001 is common, along with waste reduction, greenhouse gas (GHG) reduction and life cycle management. Monsanto's promise, made in 1990, to reduce waste by 90% was met this year.
Monitoring and Reporting on Environmental Performance [11]	The Association publishes an environmental activity report but does not provide information on the environmental performance of individual members. The companies maintain their own performance information and publish environmental performance information through various media.
Reason for Adopting Eco- Efficiency Indicators (or their proxy)	The main reasons given for using indicators were to promote goods and services; public transparency and accountability/reporting, and to improve profitability. Indicators have been developed and are being used successfully to measure yield, quality, cost reductions and total agriculture input for growing crops. Opportunities exist for development of additional

indicators for product stewardship and service intensity.

Trade and Competitiveness	Practical indicators do have an impact on competitiveness but less on trade. Competitiveness in the sector is based on quality, cost and service. Costs are very competitive and leave little room to manoeuver so service and quality are critical factors influencing competitiveness.
Environmental Performance, Productivity, Profitability and/or Shareholder Value	Reducing input costs, improving consumption efficiency and continuous improvement are all linked to productivity and profitability. Customer partnerships and working directly with the farm community and providing information on new technology all build credibility which links to performance and profitability. Waste reduction and energy efficiency improve productivity.
Further Evolution of Eco-Efficiency and Enhancement of Indicators	The respondents all agreed that the use of indicators will increase over time but noted that the development and refining of indicators is time-consuming and resources, in terms of trained staff, are not readily available.
Conditions for Success	Government regulation will not enhance the development of eco-efficiency or promote the wider use of indicators. Voluntary programscan be and are successful and should receive recognition from government. One example would be the program to collect and recycle empty pesticide containers which is funded by the sector through their association. Another would be the soil conservation program for the reduction of carbon dioxide emissions by less tillage.
Design and Implementation of Universal Indicators	There is minimal support among those consulted for the development of universal indicators.

CHEMICALS AND PLASTICS

Respondents: The following represents a summary of information received from the Canadian Chemical Producers Association, the Rubber Association of Canada, the Vinyl Council of Canada, Dow Chemical Canada and Dupont Canada.

Formal Endorsement of Eco-efficiency and Related Indicators	Only one association formally endorses eco-efficiency but all support the concept through alternate management systems. All of the companies are using indicators that support some of the seven principles.
Level of Corporate Awareness	Awareness within the membership varies from high where energy and material inputs are costs, to minimal due to the confusion on the definition of the terms and principles. At the corporate level, environment, health and safety concerns are given a high profile but the concept of eco-efficiency is not widely recognized or used. However, most companies have developed internal environmental management systems which address many of the elements or objectives of eco-efficiency. It was suggested that public, and consequently, industry attention is focused on risks to human health and the environment

and that eco-efficiency, as an objective, is not perceived as a priority issue.

Corporate Priorities in Relation to the Seven Elements of Eco-efficiency (12)

Reducing material requirements for goods and service, the energy intensity of goods and services and toxic dispersion, as well as enhancing material recyclability were considered to be the most important elements for the Chemicals and Plastics Sector. A concern was expressed by the Rubber Association, regarding possible conflict between recyclability and product durability, which would render less material available for recycling and potentially increase the demand for raw materials.

Most of the elements of eco-efficiency such as: optimizing energy use and minimizing waste to realize cost savings and environmental benefits, have been internalized and are seen increasingly as "mainstream" activities by the industry. Both Dow and Dupont indicated that they are focusing on operations efficiency and product stewardship.

Importance Assigned to Related Concepts and Management Tools

All associations emphasized their reliance on other environmental management systems, such as ISO 14001 and Responsible Care and participation in various voluntary programs i.e. ARET, the National Pollutant Release Inventory (NPRI) pollution prevention, rather than "eco-efficiency".

The Canadian Chemical Producers Association cited the example of its Responsible Care Program, now global in scope, which was initiated by the Canadian Association in 1985 to address public concerns surrounding the manufacture, distribution and use of chemicals. Participation is also a condition for membership in the CCPA. The Association reports performance on an annual basis and the program is continuously reviewed by its members and it's National Advisory Panel

In addition, the Vinyl Council of Canada has also developed a very comprehensive EMS for its membership which provides the relatively small companies with a less costly alternative to meeting the requirements of ISO or related systems on their own. The program is based on six principles: development of mutual trust; EMS implementation; integration of priorities; exceeding compliance (compliance "plus"); the sharing of expertise and continuous improvement. The Program also includes specific areas of commitment and the related actions to be undertaken by the membership. The Association will be reporting performance on an annual basis and the program will be continually reviewed by the membership and an Advisory Panel.

Dupont's main focus is "Shareholder Value Added." Dematerialization continues to be a priority and they have established partnerships with suppliers and customers to improve their processes with the intent of using less material and reduce waste and energy.

Monitoring and Reporting on Environmental Performance (13)

All of the Associations maintain records of environmental performance of their membership and submit public reports as required.

The companies all have significant monitoring systems and publish reports on their environmental performance on a regular basis through various media.

Reason for Adopting Eco- Efficiency Indicators (or their proxy)

The reasons for adopting current indicators varied significantly. The associations cited protection for environmental liability, public transparency and accountability/reporting and improving the design of goods and services. The companies cited compliance, cost savings, waste reduction, the promotion of goods and services and improving process design and profitability as other

justified uses of indicators.

Trade and Competitiveness

Some companies consulted saw no connection between eco-efficiency and the use of indicators to enhanced competitiveness and trade opportunities. Others claimed there was a positive relationship to be achieved through new process development, increasing de-materialization and reducing energy consumption. The view of industry associations was that indicators to enhance competitiveness and trade have not been developed sufficiently. Individual firms also acknowledged that competitiveness can be improved by reducing the costs associated with resource inputs and energy use. Partnerships with customers were also cited as effective means to reduce costs.

Environmental Performance, Productivity, Profitability and/or Shareholder Value

The following comments with respect to performance, productivity and shareholder value were received:

" If industry's environmental impact per unit of production decreases, then environmental performance improves. Efficiency is closely linked to this, and improved productivity leads to improved profitability."

" Good environmental performance generally equals efficient production which leads to satisfied customers."

" Companies have shown the positive bottom line relates with a well

managed Responsible Care program. Opportunities for business result from credibility and environmental management systems, with appropriate indicators, are necessary to show continual improvements and good environmental performance."

At the company level, almost all respondents felt there were no specific links to productivity and shareholder value. Dupont is a firm believer that strong leadership is a major factor in achieving higher productivity and, hence, profitability. They have an extensive training program and are developing the necessary metrics to measure their progress.

Further Enhancement of Eco-efficiency and Wider Application of Indicators

All associations agreed that the use of eco-efficiency indicators will further evolve. Some felt that eco-efficiency by definition does not addresssocial requirements.

Opinions differed amongst companies regarding the potential for further development and implementation of eco-efficiency. While there was consensus that companies will continue to develop and apply environmental performance indicators for there own needs, support for "eco-efficiency"as the framework for development was absent. Instead, companies seem to be indicating that they will continue to rely on traditional measurement, environmental management systems and leadership. Some approaches to metrics were criticized for their complexity and lack of relevance as a practical tool for managing business activities.

The greatest opportunity for further development of eco-efficiency indicators is in the areas of energy efficiency, reducing greenhouse gas emissions and

financial accounting methods.

Conditions For Wider Use	Time is needed to implement environmental management systems and related indicators, and to understand how to present the current information in an eco-efficient format. Increased reliance on eco-efficiency and continued improvement in related indicators may require a change in corporate culture. Government can facilitate wider adoption of indicators by supporting and promoting the concept of eco-efficiency. Some respondents also suggested that it is essential for the Canadian government to recognize industry achievements in becoming more eco-efficient. Focus of government is also needed to deal with the issue of free riders and to create an enabling environment, including the provision of fiscal and other incentives.
Support for Design and Implementation of Universal Indicators	There was no support for the development of universal indicators by associations or individual companies. They viewed the aggregation of numbers for an industry as meaningless. Universal indicators, on the whole, are difficult to apply and interpret. There must be a business sense associated with the development and use of all indicators.

CONSUMER PRODUCTS

Respondents: The following represents a summary of information received from Labatts, Kraft Canada and Procter and Gamble.

Formal Endorsement of Eco-efficiency and Related Indicators	Eco-efficiency is not used as a management system. However, the concept is supported and indicators, developed to improve productivity or environmental performance, are commonly used.
Level of Corporate Awareness	Awareness tends to be restricted to environmental and, in some cases, operational staff.
Corporate Priorities in Relation to the seven Elements of Eco-efficiency(14)	Reducing the material requirements for goods and services and energy intensity were the two top priorities cited. Maximizing sustainable use of renewable resources and increasing the service intensity of goods and services were seen as secondary concerns.
Importance Assigned to Related Concepts and Management Tools	Response varied amongst the companies, ranging from none to formal environmental programs, such as ISO 14001/equivalent or the development of an internal EMS. Environment, like health and safety, is integrated throughout operations.
Monitoring and Reporting on Environmental Performance(15)	All companies maintained records of performance and reported to their stakeholders.
Reason for Adopting Eco-Efficiency Indicators (or their proxy)	There was no consensus on the reasons for adopting eco-efficiency or environmental indicators. Improving the design of goods and services, protection of environmental liabilities, public transparency and improving profitability are all regarded as important. Indicators in use tend to reflect company-specific priorities and often represent cost savings.
Trade and Competitiveness	Most respondents felt that links to competitiveness exist but no indicators have been developed to confirm the relationship. For example, reducing energy input per unit production could not only be related to a positive result for greenhouse gas emissions but as well to improvement in

productivity and profitability.

Environmental Performance, Productivity, Profitability and/or Shareholder Value	In consumer products, research is very relevant to the companies competitiveness. Increased profits come more from volume than reduced costs. The clarity of measurement will be very important.
Further Evolution of Eco-efficiency and Enhancement of Indicators	All participants agreed that the use of indicators will be further developed but will require metering and monitoring of systems to provide the necessary data.
Conditions For Success	Development of additional indicators must address specific business issues and/or serve as sectoral benchmarks to identify efficient operations and opportunities for improvement in environmental performance.
Design and Implementation of Universal Indicators	The development of universal indicators which would have relevance for multiple sectors is considered to be a very difficult task because even different products manufactured within the same sector could exhibit significant differences in terms of their resource inputs, production processes and environmental implications. Energy use is perhaps the only element that could be considered but warrants more discussion.

FINANCIAL SERVICES

Respondents: The following represents a summary of information received from the Canadian Bankers Association, Bank of Nova Scotia, Export Development Corporation and Scotia McLeod Inc.

Formal Endorsement of Eco-Efficiency and Related Indicators	The financial institutions, in general, do not endorse a specific set of eco-efficiency indicators or management system.
Level of Corporate Awareness	Eco-efficiency is not widely understood by the banking institutions and the term is not in common use. Banks are interested in indicators of environmental performance. This is reflected in their assessment of risk and in their support for the establishment of environmental registries and quality assurance standards for environmental professionals and the assessments they perform. Lenders can become liable for environmental clean-ups if it becomes the owner, or is viewed as being in control of a polluting enterprise or contaminated site. While regulatory compliance, on the part of their customers, is essential, the financial sector does not believe that they, as lenders, should enforce regulations or represent the public conscience. However, the existence of a well-managed environmental management system is viewed favourably when lending decisions are made.
Corporate Priorities in Relation to the Seven Elements of Eco-efficiency(16)	None of the elements of eco-efficiency are formally adopted by the financial institutions, although one respondent mentioned material recyclability as an important element. Instead, they are concerned with three aspects: liabilities, compliance and risk in relation to environmental impacts. Environmental risk means the potential for an adverse environmental effect to occur, as a result of the normal construction, operation and decommissioning of a project, or in the event of an accident or malfunction in relation to the project. Social impacts are also considered in the credit assessment process, in addition to environmental effects. In assessing environmental risk, banks will measure the ability of the borrower to repay a loan and whether the bank will attract any liability exposure for the remediation of environmental damage caused by the borrower or a third

party (either intentional or accidental). Liability concerns can arise during the ongoing management of a loan or during loan protection activities.

Importance Assigned to Related Concepts and Management Tools	Although none are actually endorsed, ISO 14001 is probably the system with which the sector is most familiar. Climate change and management of greenhouse gases are also issues receiving more attention. They do have their own "Policies on the Environment" and the Association has published a brochure entitled "Your Bank, Your Business and the Environment."
Monitoring and Reporting on Environmental Performance (17)	Financial institutions, by nature, are relatively benign when it comes to direct impacts on the environment. The institutions do not maintain any public records for environmental performance.
Reason for Adopting Eco-efficiency Indicators (or their proxy)	The financial institutions are not using the same indicators as industry. They basically require information that will minimize risk and their potential liability as a lender. Industries are rated for risk, which in turn drives due diligence. The Bank of Nova Scotia has developed an industry Environmental Risk Rating system (IERR). A high rating is related to major industrial manufacturing like refineries and mining and to potential property impacts like landfills and underground storage tanks. The level of review is driven by the level of risk. Other banks take a similar approach when evaluating environmental risk.
Trade and Competitiveness	Canada's major banks have decided not to make environmental management a competitive issue but instead to share information on environmental regulations and standards and to work with other environmental organizations (such as the United Nations Environment Programme) to share information on environmental problems.
Environmental Performance, Productivity, Profitability and/or Shareholder Value	If there are risks faced by borrowers, lenders will expect them to manage the risk in an appropriate manner to minimize the risk to the lender. A clear link has yet to be established between the use of environmental management systems and sustainable development. Environmental management systems are only one of the tools that a company would use to support sustainable development. The challenge for companies is to provide enhanced shareholder value and at the same time manage environmental risk in a socially acceptable manner
Further Evolution of Eco-efficiency and Enhancement of Indicators	The use of indicators is likely to be enhanced in the future and may become more relevant to the lending process. However, the banks will not be the driver. Ethical investment funds are continuing to attract new investors and have approximately $3 billion in assets. In addition, sustainable development funds such as YMG's Sustainable Development Fund and the Sustainable Investment Group's Sustainable Value Pension Fund are also coming onto the market. These funds only invest in companies with sound environmental practices and a heightened sense of their social and economic obligations to the communities in which they operate.
Conditions for Success	N/A
Design and Implementation of Universal	N/A

Other Pertinent Information

At present, only one Canadian institution - Citizens Bank of Canada is practicing "ethical lending."

Eco-efficiency and environmental performance are not major factors in the investment side of financial services. A very small percentage of investors consider the environmental performance of a company as a factor in making investment decisions. The potential growth and return on investment are the major factors considered. Although ethical funds are available they make up a very small percentage of the market. However, specific factors such as the use of child labour or a major environmental incident can impact on a company over a short term. It has also been shown that a well managed company showing a high return on investment is generally also managing its environmental requirements.

In a newspaper article written recently by Gordon Powers, he stated that socially responsible investment (SRI) is one of the fastest growing segments in the United States, sparked primarily by anti-tobacco sentiments. However, in Canada the picture is quite different. The growth of SRI options has actually decreased in recent years. Three reasons were given: a general failure to influence corporate behaviour,

inconsistent screening and spotty performance. He stated though, that he expects a resurgence of interest in SRI with a corresponding number of new, more focused products.

The Export Development Corporation (EDC), a federal crown corporation also operates as a commercial financial institution. Its mandate is to support and develop, directly or indirectly, Canada's export trade and Canadian capacity to engage in that trade and to respond to international business opportunities. Recently, the EDC has developed an "*Environmental Review Framework*" to implement a simple, clear and efficient process for reviewing, on a timely basis, the best available environmental information on projects for which EDC support is sought. Similar to the other financial institutions they are primarily attempting to mitigate risk and not support projects that are likely to cause significant adverse environmental effects. The EDC does not endorse any particular management system or the seven principles of eco-efficiency but companies who have well managed systems and factual indicators will be in a much better position to address the requirements of the Environmental Review Report. The EDC feels that environmental reviews to mitigate project risk can help encourage sustainable development by promoting consideration of the environmental benefits and costs of projects in host-country jurisdictions.

FOREST AND BUILDING PRODUCTS

Respondents: The following represents a summary of information received from the Canadian Pulp and Paper Association, Ontario Forest Industry Association, Bowater Canada, Nexfor and Weyerhaeuser Canada.

Formal Endorsement of Eco-efficiency and Related Indicators

The responses varied. One company stated that they endorse the concept, but feel they are still at the learning stage in using specific indicators. Others have not endorsed eco-efficiency because of differences in definitions and understanding of the concept. There was also a perception that eco-efficiency only deals with two aspects, environment and economics, but not social needs.

Level of Corporate Awareness	The level of awareness of the concept across the sector is minimal, but growing. Certainly the use of environmental performance indicators, as well as cost control, productivity, compliance, impact, risk, stakeholder image, is prevalent and increasing in importance. One of the companies when applying indicators is also establishing targets for different parameters
Corporate Priorities in Relation to the Seven Elements of Eco-efficiency(18)	There was no clear consensus in setting priorities among the seven elements However, the four mentioned most often include: reducing material requirements for goods and services, maximizing sustainable use of renewable resources, reducing toxic dispersion and reducing energy intensity
Importance Assigned to Related Concepts and Management Tools	All companies place more importance on management systems other than eco-efficiency ISO 14001/equivalent was most frequently mentioned with certification an option depending on markets Pollution prevention, life cycle analysis, green house gas reduction and a number of voluntary programs were also cited as important
Monitoring and Reporting on Environmental Performance (19)	In all cases, the companies have in-depth documentation in support of the programs and provide public documents through various media. Some data collected is for internal use only
Reason for Adopting Eco- Efficiency Indicators (or their proxy)	Protection of environmental liabilities, public transparency and accountability/reporting and profitability were given by all respondents as the main reasons for using indicators
Trade and Competitiveness	The indicators needed to link environmental performance to competitiveness and trade have not been developed. However, practical indicators would be beneficial .Opportunities to improve competitiveness and trade maybe achieved by using effective indicators for sustainability of natural resources, and energy intensity. New indicators will be developed to suit the specific needs of the companies and perhaps not under the banner of eco-efficiency
Environmental Performance, Productivity, Profitability and/or Shareholder Value	Development of indicators to reflect profitability and shareholder value would be beneficial. Shareholder value is comprised of profitability, productivity and social performance, so eco-efficiency is a link. The major driving forces for improved environmental performance have been public image and the demand for evidence of sound environmental management and sustainability. In this sector, the industry serves as a supplier of primary goods and does not deal directly with consumers. Their clients who serve the public directly require their suppliers to provide indicators of good environmental management and sustainability. Therefore, good forest stewardship is essential. Sound environmental management is considered to contribute, indirectly, to profitability/ shareholder value but in the absence of good indicators, the degree to which it contributes is difficult to assess Good environmental performance presents business opportunities and markets, especially internationally

Further Evolution of Eco-efficiency and Enhancement of Indicators	Systematic use of indicators for all seven elements might help identify problems in key cost control areas, improving profitability/competitiveness. All respondents agreed that the use of indicators will continue to be enhanced and will be of greater importance.
Conditions for Success	Eco-efficiency indicators should not be treated by government and the public as something new. The industry has been developing and applying indicators to support environmental and sustainable forest management, along with other programs and concepts. Most of the indicators needed to assess eco-efficiency are already in the tool box and don't need a new label. What is needed, on the part of government and industry, is a better appreciation of how eco-efficiency relates to existing concepts and indicators. Sustainability is widely discussed but application of the concept and performance metrics is a struggle.
Support for Design and Implementation of Universal Indicators	There was very little support for the development of universal indicators. Toxic equivalents or material recyclability were mentioned as possible candidates for consideration but the results would be difficult to compare between sectors.

HEALTH INDUSTRIES

Respondents: The following represents a summary of information received from Canada's Research-Based Pharmaceutical Companies, Baxter International Pharmaceutical, Bristol-Myers Squibb, Glaxo-Welcome, Janssen-Ortho and Merck Frosst.

Formal Endorsement of Eco-Efficiency and Related Indicators	Most of the respondents in this sector are multi-national pharmaceutical companies whose environmental programs are established outside of Canada. All of them have established a high priority on environmental management and have initiated numerous innovative programs. In all cases health, safety and environment have been combined and full integration has taken place throughout the corporation.
Level of Corporate Awareness	Although the banner of eco-efficiency is not used, its elements are certainly endorsed. Sustainability is used frequently in their reporting documents and their management focus is on the three aspects of economics, environment and social. Because of the extensive educational programs in place, the awareness of environment and related management programs within the companies is relatively high and growing.
Corporate Priorities in Relation to the Seven Elements of Eco-efficiency [20]	A number of the elements are receiving the same emphasis within the sector. Reducing toxic dispersion, reducing material requirements and reducing energy intensity are predominant although recyclability and maximizing sustainable use of renewable resources are also considered important.

Importance Assigned to Related Concepts and Management Tools	A number of other management systems have and are being actively utilized. Product life cycle analysis is used extensively in the sector. By analyzing each product, they can generate significant cost savings and the ability to reduce the footprint of any environmental impact. ISO 14001/equivalent certification is also being used extensively. After completing third party audits, Bristol Myers Squibb was the first company to declare that their company, on a world wide basis, either equaled or was superior to ISO 14001. Pollution prevention, energy efficiency and Total Quality Management are other programs of focus. Indicators for general emissions for air, waste and water plus water and energy use are common, while indicators have been initiated to track the reduction of wastes. Packaging and recycling initiatives have also been introduced. Baxter International has, over a number of years, developed an environmental balance sheet to itemize and total environmental costs and savings
Monitoring and Reporting on Environmental Performance (21)	All respondents indicated that they maintain extensive records for environmental performance and publish reports on a frequent basis through various media.
Reason for Adopting Eco- efficiency Indicators (or their proxy)	" Protection against environmental liabilities and public transparency" is cited as the main reason for using indicators. However, improving the design of goods and services and improving profitability were also high priorities.
Trade and Competitiveness	Opportunities in Product Life Cycle (PLC) analysis are expected to continue to reduce costs and environmental impacts which, in turn, improves competitiveness. PLC can also enhance the quality of new products and reduce costs through waste minimization, energy savings and by minimizing the use of chemicals, raw materials and packaging. Social indicators which demonstrate an improved company image also have a positive impact on competitiveness.
Environmental Performance, Productivity, Profitability and/or Shareholder Value	Bristol Myers Squibb feels that PLC reviews drives eco-efficiency. It identifies opportunities to improve the environmental, health and safety (EHS) performance of a new or existing product throughout its life cycle. Implementing PLC improvements results in reduced EHS impacts and business costs and increased cost savings. Additional benefits include enhanced communication across functional areas, increased awareness, training and improved product and process quality. All of this has a positive effect on profitability and/or shareholder value. Sustain ability is also linked to profits. As sustainability improves within a company and is understood and encouraged, so does innovation which improves performance and further increases profitability.
Further Evolution of Eco-Efficiency and Enhancement of Indicators	Eco-efficiency indicators are expected to be further enhanced over time. The ability to measure social impacts is becoming increasingly important. However, good social indicators which would assess such factors as employee health , safety and community impacts have not yet been developed. Financial management represents a second area for which indicators need to be developed. Finally, there are no accounting standards or rules to capture environmental costs and benefits and no consensus on how financial indicators should be presented. Better tools are required to link

environmental costs and benefits to the bottom line.

Conditions for Success	Not addressed.
Design and Implementation of Universal Indicators	There is minimal support for the use of universal indicators outside the sector. The normalization of data to production, which is commonly considered, is not feasible for a company producing a wide diversity of products. One company has normalized data to worldwide sales. However inflation, currency fluctuations and licensing agreements can affect sales without affecting production levels or environmental operating results.

INFORMATION TECHNOLOGIES AND TELECOMMUNICATIONS

Respondents: The following represents a summary of information received from Bell Canada, IBM, Nortel Networks and Telus.

Formal Endorsement of Eco-efficiency and Related Indicators	The respondents varied in their answers to this question. The majority supported the concept and a number reported that they were using indicators which do, in fact, support the principles. One company felt there were conceptual problems in applying eco-efficiency. More efficient products means higher demand and sales volume, meaning increased environmental pressures are associated with more efficient products. They see corporate social responsibility as the next important goal for business.
Level of Corporate Awareness	Awareness and understanding of eco-efficiency within the companies varies from minimal to very high. IBM has established an "Engineering Center for Environmental Conscious Products" that handles the design for environment products, plastic recycling and energy product efficiency. Increased communication with senior executives and education of staff through the use of Environmental Management Systems has also increased awareness within the companies Certainly the use of indicators is well understood.
Corporate Priorities in Relation to the Seven Elements of Eco-efficiency (22)	The consensus was that, of the seven elements, reducing energy intensity of goods and services was the most important. Others given high priority were reducing the material intensity, increasing the service intensity and enhancing material recyclability of goods and services.
Importance Assigned to Related Concepts and Management Tools	In most responses, emphasis is on other management systems ISO 14001 standards were mentioned most often, although for a variety of reasons, companies do not always s pursue certification. IBM received the first edition of a single worldwide ISO 14001 registration. Bell Canada sees huge opportunities in optimizing inputs and reducing wastes, but not necessarily through formal adoption of eco-efficiency and the elements associated with the concept. Emphasis is also placed on programs for energy efficiency and GHG reduction.
Monitoring and Reporting on Environmental Performance (23)	All of the participants monitor environmental performance in many areas, for which indicators exist and maintain records on environmental performance Environmental reports are published on an annual basis through various media.

Reason for Adopting Eco- efficiency Indicators (or their proxy)	Four reasons cited most often for using indicators were: to improve the design of goods and services, enhance public transparency and accountability, protection of environmental liabilities and promote goods and services. Minimizing environmental impact was also mentioned as being important. One company noted that size, in terms of employees and the heavy reliance on outside contractors to maintain technical systems, make it very difficult to standardize ways of tracking environmental costs.
Trade and Competitiveness	The use of indicators is seen to benefit competitiveness more than trade. Indicators relating environmental performance to the bottom line will become increasingly more important. Identifying and reducing energy costs is also seen as a challenge which offers potential market and competitive advantage. Product design presents the greatest opportunity to reduce the use of natural resources/materials and indicators would be beneficial. One respondent stated that practical indicators may help competitiveness, but the focus today is on service at the best price. Environment to competitiveness linkages might be ten years away.
Environmental Performance, Productivity, Profitability and/or Shareholder Value	Response to this question varied. One respondent did not see any relationship between eco-efficiency and these three objectives. Most recognized that an environmental program and performance measurement is an essential part of doing business. However, the continued pressure on the bottom line is putting the program in jeopardy. Another felt that the sector is limited to increasing energy efficiency through network design. This work and resulting improvement of performance would be done internally as the results or achievements made public could hinder their competitive advantage.
Further Evolution of Eco-Efficiency and Enhancement of Indicators	All respondents felt the use of indicators will be enhanced with market pressure being one factor.
Conditions for Success	Recognition for achieving eco-efficiency is necessary to ensure further development and increased reliance on indicators. Education using "best in class" cases to promote eco-efficiency within and across sectors should be priority. Governments should also encourage and recognize voluntary programs. Eco-efficiency and development of related indicators requires long term vision which corporate Canada is presently lacking. A workshop was also suggested with respondents to this study to review generic findings and make further recommendations. Others felt communicating eco-efficiency is straight forward: waste = lower profits and lower productivity. If you can design products with less resources then this helps all the seven elements.

Design and Implementation of Universal Indicators

There was no support for the development of universal indicators. They are seen as irrelevant and difficult to compare across sectors Confidentiality of information is also seen as a concern.

One company who participated in the NTREE project felt that the probability of success of one universal indicator would be quite low. Normalization factors are very difficult to agree upon and the indicator may not be applicable to all business. Eco-efficiency is seen as a relative concept which is not conducive to the establishment of common measures or useful in making comparisons among firms in terms of performance.

MANUFACTURING AND PROCESSING TECHNOLOGIES: ENERGY SECTOR

Respondents: The following represents a summary of information received from the Canadian Electrical Association, Alberta Energy, BC Hydro, Ontario Hydro, Saskatchewan Power, TransAlta and Westcoast Energy.

Formal Endorsement of Eco-Efficiency and Related Indicators

The Canadian Electrical Association understands the concept but does not use it. The Association has developed its own environmental public reporting program, known as the Environmental Commitment and Responsibility Program (ECR) which includes its own indicators. These indicators are not based on the seven elements but some correlations can be made. Reporting on performance under the ECR is a condition of membership in the Association.

All industry respondents either support the concept of eco-efficiency or are, in fact, using it as a management tool. Some feel the definition is too narrow to use in practice and have developed their own EMS.

Level of Corporate Awareness

While companies in this sector report a high level of awareness with respect to environmental management systems, indicators and the ECR, eco-efficiency is a term that is not widely understood. Maintaining public consent to operate is the primary focus for those companies which report to government and provide a public service. Environmental performance is considered a key factor in maintaining this consent. Saskatchewan Power includes an "Environmental Performance Index" in its corporate reporting.

Corporate Priorities in Relation to the Seven Elements of Eco-efficiency (24)

Although the seven elements of eco-efficiency were not used in the development of the indicators for ECR, there are some linkages. Maximizing sustainable use of renewable resources, reducing toxic dispersion, enhancing material recyclability, and extending product durability are comparable Reducing energy intensity is the primary or main purpose of business.

Importance Assigned to Related Concepts and Management Tools

All of the respondents indicated that ISO 14001/equivalent is receiving more emphasis. Certification is an option, depending on the needs of the specific company. Most of the generating divisions and corporate will be certified by the end of 1999. Other concepts and related approaches which are supported include are energy efficiency, GHG's, and life cycle analysis.

Westcoast Energy spends a significant amount of time with public interest groups and aboriginals dealing with education and economics of business which is mutually beneficial. This is part of the social responsibilities of corporations which some companies feel that eco-efficiency fails to address. They also use the "triple bottom line" concept (environment, economics, social) and the economic part is considered a must.

Monitoring and Reporting on Environmental Performance (25)	The CEA maintains records on environmental performance and publishes an annual report for the sector as a whole. The report does not provide information on results achieved by individual members. The indicators are continually reviewed for their effectiveness by an Advisory Board. All companies maintain records of their environmental performance, which is more exclusive than the data required for the ECR report, and publish a variety of reports on an annual basis through various media. None report on eco-efficiency specifically.
Reason for Adopting Eco- efficiency Indicators (or their proxy)	The ECR program was designed to address concerns for public transparency and accountability/reporting. However, it is expected that over time, improving profitability may also be an issue. There were two main reasons given by industry for using indicators: protection of environmental liabilities and public transparency and accountability Some companies also mentioned improving competitiveness, creating business opportunities and improving profitability and opportunities for capital borrowing. For those companies which report to government, a good public image is essential to maintain their licence to operate.
Trade and Competitiveness	There was general agreement that good environmental performance enhances competitiveness and, to a lesser extent, trade. In a newly competitive market, environmental management represents one way of differentiating between energy suppliers, particularly in the United States. Reducing toxic dispersion and environmental liabilities were also mentioned as contributing to competitiveness and retaining market share.
Environmental Performance, Productivity, Profitability and/or Shareholder Value	The CEA has developed 16 issue-specific indicators in consultation with its membership which do not address eco-efficiency directly. Their purpose is to demonstrate continuous improvement rather than set targets. Shareholder value and profitability are not seen as issues for indicators today but could be in the future. There are no real links to productivity Eco-efficiency affects environmental performance, productivity, profitability and shareholder value in that order. However, the relationship to eco-efficiency is not clear. Good environmental performance is recognized as a factor in seizing international opportunities. Social, health and wellness are becoming major issues and being able to measure the social footprint can be helpful to gain public trust. This indirectly would impact on shareholder value and profitability
Further Evolution of Eco-efficiency and Enhancement of Indicators	All respondents agreed that the development and use of indicators will further evolve but it will take time. It is not likely to be encouraged by government regulation. New ways to link environmental performance and/or eco-efficiency to the bottom line and continuous improvement in environmental performance are considered essential.. Ethical funds were cited as examples of how the linkage can be established. The " Economic Value Added" concept for financial management reflects sustainable development within the operation. However, emissions, incidents and energy efficiency will continue to have a high profile. Additional indicators are needed to address fish management and urban air

pollution as well as public accountability and/or public image.

Conditions for Success	Just as eco-efficiency will require a major shift in corporate philosophy, so governments will need to shift their current regulatory focus on arbitrary limits to environmental management. Conditions vary greatly across the country and companies should devote resources to those areas that do the most good, both for the environment and the company.
Design and Implementation of Universal Indicators	Universal indicators have appeal but are not practical. Very few principles can be reported on a universal basis and be meaningful. Even among utilities, comparability is limited and bench marking across the sector may not be possible. A menu-based approach, which allows companies within each sector to select the most appropriate elements to guide their activities is the better alternative. The intended use for an indicator also has a bearing on it. For example, information about energy intensity is good for internal use but its appropriateness for external audience is questionable.

MANUFACTURING AND PROCESSING TECHNOLOGIES

Respondents: The following represents a summary of information received from the Alliance of Manufacturers, Canadian Petroleum Products Institute, Canadian Wind Energy Association, Canadian Occidental Petroleum, Husky, Petro Canada, PPG Canada and Shell Canada.

Formal Endorsement of Eco-Efficiency and Related Indicators	The concept of eco-efficiency is fully endorsed at the level of associations but the term is not used in any documentation. Eco -efficiency is evident in environment health and safety programs as well as codes of practices and standards with Canadian Petroleum Products Institute. The Canadian Wind Energy Association is unique as any activity by the sector is automatically eco-efficient. Reporting companies either endorsed eco-efficiency or supported the concept. They all use indicators to a varying degree and most could be related to one or more of the seven elements of eco-efficiency. Many companies understand the importance of indicators in improving their environmental performance.
Level of Corporate Awareness	The awareness of the concept varies considerably from little used and understood to high amongst professional staff. The companies who have their own EMS feel there is a high level of awareness of the program and this affects corporate performance. Eco- efficiency concepts are used in major project reviews. In the oil and gas industry, awareness is higher amongst large rather than small and medium sized enterprises (SMEs).
Corporate Priorities in Relation to the Seven Elements of Eco-efficiency[(26)]	There were two elements which respondents accorded high priority: reducing toxic dispersants and reducing the energy intensity of goods and services. Other elements mentioned were enhancing material recyclability and reducing the material requirements for goods and services.
Importance Assigned to Related Concepts and Management Tools	All respondents indicated that more emphasis is placed on other approaches. IS 14001 is the predominant option with certification dependent on market demand Pollution prevention, greenhouse gas (GHG) reduction, energy efficiency and lif cycle analysis were also cited as important.

Monitoring and Reporting on Environmental Performance (27)	Two of the Associations do not retain any documentation of the membership's environmental performance nor do they publish any reports. The CPPI does maintain records and publishes results in several forms through various media. All companies maintain records and , with one exception, publish reports on environmental performance. Husky considers their program a team concept and training and education are very important. Good performance is spread through the community by the employees. They do, however, publish reports on specific issues. All companies maintain records on environmental performance.
Reason for Adopting Eco- efficiency Indicators (or their proxy)	The respondents agreed on four purposes of using indicators: protection of environmental liabilities, to improve the design of goods and services, public transparency and accountability and to improve profitability. The oil and gas industry has focused on "increasing resource productivity" so that more is obtained from less energy and raw materials input. Eco-efficiency indicators will continue to benefit the upstream petroleum sector in demonstrating their continued progress toward improving carbon dioxide and energy efficiency.
Trade and Competitiveness	Respondents felt there were better linkages with competitiveness than with trade. Practical indicators have not been developed that clearly show the connection. Increasing service intensity of goods and services will also be important relative to competitiveness. All respondents agreed that good environmental performance can improve competitiveness but that the linkages to trade were less evident. Encouraging industry sectors to develop and use indicators as benchmarks would be beneficial. Indicators could be used to increase market share, particularly internationally. Indicators which would confirm the relationship between business and environmental performance in terms of effect on the bottom line would be helpfu
Environmental Performance, Productivity, Profitability and/or Shareholder Value	The respondents felt that eco-efficiency has a direct linkage to productivity, profitability and environmental performance but that companies require time to understand the connections. Those elements that support the increased efficiency of operations translate directly into productivity and profitability through cost reductions and/or revenue enhancement. Increased efficiency means less waste and improved environmental performance. Shareholder value occurs as productivity and profitability increases. Effective and practical indicators will give you better knowledge of the business and have a positive effect on competitiveness.
Further Evolution of Eco-efficiency and Enhancement of Indicators	There was support for the further evolution and wider applications of indicators within the sector. The emphasis on economic indicators is required but new indicators must have a practical business application. Other opportunities for further development of indicators are in energy efficiency improvements, reducing material intensity (greater yield of primary product per volume of feedstock) and reducing wastes and toxics.
Conditions for Success	Stakeholder involvement in promoting awareness of eco-efficiency and developing indicators as well as government recognition of achievements would be beneficial. More exposure to successful examples in the sector or from other sectors plus technical assistance in identifying opportunities is needed to engage industry more.

Other conditions internally would be: liability perception, energy demands like Kyoto, co-generation and partnerships with communities or native groups.

Design and Implementation of Universal Indicators

Development of universal indicators was supported, as long as they are tailored to specific sectors. They may also have to measure by product group because an aggregate number and a comparison outside the sector or product group is meaningless. Elements which might be considered for universal application could include energy intensity, toxic dispersion, and reducing material requirements.

METALS AND MINERALS PROCESSING

Respondents: The following represents a summary of information received from the Canadian Steel Producers Association, the Mining Association of Canada, Alcan, Dofasco, Falconbridge, Noranda, Rio Algom and Stelco.

Formal Endorsement of Eco-Efficiency and Related Indicators

Most of the respondents do not formally endorse eco-efficiency and instead they have designed systems toaddress their own specific needs. Indicators are used by all the companies and correspond to some of the seven elements of eco-efficiency. One company, Rio Algom, endorses the concept and maintains a professional environmental management capability which follows and participates in the sustain ability debate. The CEO and Executive are aware of the importance of eco-efficiency to the future of the company and sustainable development and the triple bottom line (environment, economic and social) are part of the company strategy, as reflected in speeches made externally and internally.

Level of Corporate Awareness

The awareness varies within the membership from non-existent to active participation in the work of WBCSD and NTREE. However, the concept, as currently developed, has only limited value to the sectors and, depending on the issue, other approaches may be more relevant. The issues are prioritized not the process. The use of indicators is increasing and the training of all employees on environmental protection and responsibility is a high priority.

Corporate Priorities in Relation to the Seven Elements of Eco-efficiency(28)

There was consensus from the respondents on the ranking of the seven elements of eco-efficiency. Reducing energy intensity of goods and services was the highest priority followed closely by reducing toxic dispersion, maximizing sustainable use of renewable resources, enhancing material recyclability and reducing material requirements for goods and services.

Importance Assigned to Related Concepts and Management Tools

Life cycle analysis and recycling are related approaches which are receiving more emphasis. Energy efficiency indicators are being applied successfully by one association.

All of the respondents are focusing on effective environmental management systems, varying in their design fromISO-14001 compatible to ISO-certified. Most management systems include health and safety and community responsibilities or social impacts, the latter becoming more important for this sector. One company is also committed to the *triple bottom line*, i.e., economic, environmental and

social considerations in the way they do business and develop resources for the long term benefit of all involved. Greenhouse gas emissions, life cycle analysis and energy efficiency are other programs that are receiving significant attention.

Monitoring and Reporting on Environmental Performance (29)	There have been no references to date to eco-efficiency and there are no plans to include it in the future. All of the industry respondents maintain extensive records on environmental performance. Most companies publish annual and environmental reports through various media or make them available on request. Associations report progress at the sector level in relation to specific issues. One company which has never published a report does not do so because they believe this places too much emphasis on environment and not enough on sustainability and business efficiency. No report directly on eco-efficiency.
Reason for Adopting Eco- efficiency Indicators (or their proxy)	There was general agreement from the respondents on the purpose of indicators. Protection of environmental liabilities and public transparency and accountability/reporting were the two top choices and improving access opportunities for capital borrowing and improving profitability followed. Indicators to show energy efficiency for the purpose of reduced operating costs and contribution to climate change objectives will be very important. General cost savings and compliance were also mentioned. .
Trade and Competitiveness	All respondents agreed that practical indicators can improve competitiveness and to a lesser amount trade. Business opportunities outside Canada are measurable but the extent to which they can be realized will be affected by credibility in terms of environmental performance and management skills. Linkage of life cycle issues to choice of materials and indicators for recycling could also improve competitiveness. One company uses indicators to compare their product to other substitutes in the market place to either maintain or grow market share. The opportunities for using indicators to improve competitiveness and trade are to demonstrate that the company is a responsible corporate citizen and maintains a sound environmental performance. It also facilitates access to new mining projects and access to the capital necessary to develop them.
Environmental Performance, Productivity, Profitability and/or Shareholder Value	At this time, the linkages are not well developed. Eco-efficiency is only one small aspect of environmental performance or shareholder value. Development of indicators in life cycle analysis work could be helpful. By influencing environmental performance, productivity and profitability, eco-efficiency has an indirect impact on shareholder value. In mining they are inseparable. Eco-efficiency ensures that resources (human and financial) are placed where they are needed. It facilitates access to mine development projects, allows access to capital and to large joint venture partnerships with companies that are committed to the same policies. Social considerations, particularly in terms of dealing with local communities is becoming very important for the sector.
Further Evolution of Eco-Efficiency and Enhancement of Indicators	Eco-efficiency indicators are expected to be further enhanced, driven in part by the financial institutions, both domestic and international. Life cycle analysis concepts need to be translated into a more user friendly concept for purposes of comparing competitive processes or existing and new processes.

Indicators are also needed to support life cycle analysis and linkages between environment and profitability.

Social responsibility and social development are critical for mining operations and better indicators of success or achievement will be required. However, it is not clear that this aspect would be adequately addressed by eco-efficiency. Indicators are issue-driven and, to some extent , company specific. In the mining sector, compliance is a non issue as there is little room for improvement. Indicators to measure corporate responsibility for greenhouse gases (GHG's) and social aspects are of more interest.

Conditions for Success

The respondents suggested a number of ways to enhance the development of EE and indicators. They include; full integration of EHS management systems with operational decision making, government assistance to remove barriers to eco-efficiency e.g., the transboundary movement of wastes, development of co-generation facilities, research into plastics recycling, recognition from government either through tax incentives, early action or other means and promotion of the concept internally and externally.

Design and Implementation of Universal Indicators

There was little support for the development of universal indicators. At a certain level of abstraction, indicators become meaningless. It is difficult to establish a basis for comparability within sectors and impossible between.

The question first has to be asked, "Who would benefit and how would they benefit from universal indicators?" There is considerable variation between sectors, and even within a sector. Eco-efficiency is very strongly related to the technology being used. The choice and use, of indicators must be carefully tailored to the specific application being considered. Until it can be demonstrated that the companies interests are served by any "universal indicator" a one size fits all approach is not warranted.

Indicators have to have an absolute relevance to the business, the environment in which it operates and the issues that need to be managed. Measuring environmental parameters that do not have clear value or an obvious reason that makes business sense may lower credibility of eco-efficiency efforts which will then not be sustainable.

#8, #10,#12,#14,#16,#18,#20,#22,#24,#26,#28

1. *See **Appendix C** for detailed response from individual sectors.*

#9, #11,#13,#15,#17,#19,#21,#23,#25,#27,#29,

2. *See **Appendix D** for information provided by selected Canadian Industry Associations and Companies.*

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SECTION 4: OVERVIEW AND ANALYSIS

This section brings together the views of the ten industry sectors which participated in the survey, in relation to the same themes. It also includes the results of the review of corporate and association web sites as an indication of the extent to which Canadian industry relies on environmental performance indicators and, more specifically, eco-efficiency in their publicly available reports and communication via the Internet. Areas of difference, as well as consensus, are flagged in both sections

The section dealing with industry associations also profiles a number of association-led initiatives which are relevant to eco-efficiency and involve monitoring of environmental performance and development of indicators

Many examples of corporate-led initiatives are also highlighted, based on information and documentation provided by companies or made accessible on their Website

4.1 INDUSTRY ASSOCIATIONS

For the purposes of this study eleven (11) industry associations were interviewed. In addition, a questionnaire was sent to thirty four (34) associations of which six (6) were completed and returned. Therefore the data base represents information from a total of seventeen (17) associations representing eight (8) industry sectors.

Those Associations that participated were very helpful in addressing the purpose of the study. The Canadian Petroleum Products Institute canvassed their membership prior to the submission of their questionnaire and the Canadian Bankers and the Pharmaceutical Associations assisted with contacts within their sector and with the content of information. The Air Transport Association engaged representatives of major airlines in reviewing the questions. The size of the sector and the size of the companies within the sector, the public profile of the sector on environmental issues and the responsibilities given to the association by its membership, are all factors which influence their position on eco-efficiency and the use of eco-efficiency indicators.

Endorsement and Awareness of Eco-efficiency and Related Indicators

Overall, the use of eco-efficiency as a management tool is not promoted but the concept is recognized and in many cases endorsed. The use of indicators is prevalent and increasing. Where the association is taking a lead role in environmental management, the awareness within the total membership is naturally higher. In the remainder, the awareness of eco- efficiency varies significantly from non-existent to moderately high.

Ranking the Seven Elements of Eco-efficiency

Although most associations canvassed do not use the concept, when asked to rank the seven elements of eco-efficiency, the following four were most often cited as the most important and central to their environmental management activities:

- reducing the energy intensity of goods and services;
- reducing the material requirements for goods and services;
- reducing toxic dispersion; and,
- enhancing material recyclability.

This ranking reflects to a greater degree the issues that are of higher concern in environmental management today.

Related Concepts and Management Tools

In all cases, the associations indicated that more emphasis was being placed on other related approaches. Environmental Management Systems (EMS) such as ISO 14000/equivalent or sector specific EMS are very common. Four of the associations are aggressively taking the lead role in specific EMS, which in two cases are a condition for membership in the association. By way of illustration , the following outlines the main features of these programs:

Example 1 - Canadian Chemical Producers' Association - Responsible Care. A global initiative, established in 1985, to deal with the public concern on the manufacturing, distribution and use of chemicals, *Responsible Care* is now being extended to partners in related industries. Indicators have been developed and used for a number of parameters including; the emission of chemicals to the environment, reduction of waste, recycling, recovery and re-use of chemicals and management of hazardous wastes. Other aspects of Responsible Care are indicators for the safe transportation of chemicals and workplace health and safety. Verification of compliance with Responsible Care is an ongoing process and the protocol calls for an exhaustive and comprehensive review and assessment. New indicators for emerging issues like toxic chemicals and endocrine modulators are continually undertaken and the Association publishes annual performance reports on the program. The program is also reviewed annually by a National Advisory Panel.

Example 2 - Canadian Electrical Association (CEA) - Environmental Commitment & Responsibility. With the launch of the ECR program in November of 1997, the CEA, endorsed the concept of sustainable development, and announced its commitment to observe the following four principles:

- to be more efficient in their use of resources
- to reduce the adverse environmental impact of their business
- to be accountable to their customers
- to ensure their employees understand the environmental implications of their actions and have the knowledge and skills to make the right decisions

The indicators initially developed and implemented were for, recycling, reuse and energy recovery of insulating oil, utilization of solid combustion by-products, atmospheric emissions, volume of PCBs in use and in storage and public reporting of environmental performance. Evaluation of these indicators and the development of new indicators is ongoing. The program is also reviewed by an independent Public Advisory Panel. The first annual report was published in 1999 for 1997 data.

Example 3 - Vinyl Council of Canada - Environmental Management Program. Because their membership is made up of small and medium sized companies who do not have the resources to comply with an ISO/equivalent program, have developed an EMS for its members who wish to be seen as a responsible industry sector within Canadian society. The substance of the EMP involves 32 "Action Steps". Each participant commits to having a "practice in place" for each Action Step by the time the

EMP is implemented

The Vinyl industry, in approaching Environmental System Implementation, offers commitments in the following areas:

- management commitment, implementation & review;
- operations;
- resource conservation &waste management;
- product stewardship; and,
- communication.

Although early in the implementation stage, indicators will be used to measure parameters such as; resource consumption, waste generation, waste disposal options, waste management after use, data on environmental and health impacts, emissions and effluents and incidents and accidents. There will be an annual members report and the program will also be reviewed by a Public Advisory Panel.

Example 4 - Canadian Pulp and Paper Association - Common Ground This program has only been recently initiated by the sector. It is based on three guiding principles; careful use of resources, public participation and continual improvement. The guiding principles will govern all their member's activities while meeting or exceeding regulatory standards. The Guiding principles are further defined by guiding documents which detail the specific actions associated with achieving their goals in the areas of forestry, manufacturing and public participation. Details of the indicators to be used have not been finalized. The program will also have a Public Advisory Panel and the Association will publish performance repons.

The other related programs receiving emphasis by the associations are energy efficiency, GHGs, life cycle analysis and voluntary programs i.e. Accelerated Emissions Reduction (ARET), National Pollutant Release Inventory (NPRI) and the Voluntary Challenge Registry (VCR). Indicators being used for these programs are the traditional emission numbers and waste generated/ recycled etc. There is minimal information or reporting within the associations on economic and social indicators.

Monitoring and Reporting

Only about half of the associations contacted retained environmental data from their membership and published performance reports. Some associations publish reports on specific environmental issues of public concern that indicate the sectors policies and status. For example the Canadian Petroleum Products Association uses performance indicators in their CPPI web site, Annual Report, Environmental and Safety Performance Review and CIPEC report. They have successfully used indicators for energy efficiency benchmarking, refinery utilization, spills and emissions releases, catalyst utilization, product yield management and improvement and hydrocarbon lost management.

Reasons for Adopting Eco-efficiency Indicators

The main reason given for using indicators, as seen by the associations, is to improve public transparency and accountability/reporting. There is also seen to be an incentive to improve environmental performance and linked with that would be improved competitiveness and public image. The linkage can also be extended to profitability and shareholder value. The direct or explicit linkages to competitiveness and trade have generally not been developed. These along with financial, energy efficiency/greenhouse gas emissions and reducing wastes and toxics are the areas of enhancement with the greatest potential for indicator development. Most associations felt the development of good and practical indicators take time and are not always driven by eco-efficiency. Market pressures and public pressure are two factors which can have significant influence. Legislation by governments will not encourage this development.

Trade and Competitiveness

Other than a strong feeling that a well managed and successful company generally manages its environmental issues, the associations could not offer any direct linkages between eco-efficiency and competitiveness and trade. To date, they have been concerned with the standard issues of emissions and energy use and not with the social and economic factors. An exception is perhaps the Responsible Care program where a company with a well managed program generally has a positive bottom line relationship.

Environmental Performance, Productivity, Profitability and /or Shareholder Value

Establishing a link between eco-efficiency and productivity, profitability and/or shareholder value proved equally difficult. It is clear that most companies have not had time to assess the results of current environmental performance measurement in relation to either objective or to establish new indicators to capture that relationship.

Evolution of Eco-efficiency and Enhancement of Indicators

Approximately half of the respondents agreed that the use of indicators will continue to be enhanced and that the emphasis should be on economic and social indicators but they must have a practical business application. Stakeholder involvement and government recognition of achievements would be beneficial. The remainder of the respondents do not see the concept of eco-efficiency being further developed in their sectors in the short term. There was also a suggestion that, if necessary, the government could use the concept to report on Canadian business.

Universal Indicators

There was, without exception, minimal support for the development of universal indicators. Outside of individual sector analysis the values could be meaningless. It is difficult enough to establish a basis for comparison within sectors.

4.2 CORPORATE RESPONSE

For the purposes of this study, nineteen (19) companies were interviewed. In addition a questionnaire was sent to twenty eight (28) companies of which twenty one (21) were completed and returned. Therefore the data base represents information obtained from forty (40) companies representing ten sectors. Interviews were undertaken usually with one company representative so the views in all cases may not be totally representative of the company. Since only a few companies were interviewed in each sector, the views may not represent the position of the whole sector. As reflected in the above numbers, the companies contacted were very obliging in discussing the study and were very open in their discussion on their relative positions and generally gave detailed information in response to the survey questions.

Endorsement of Eco-efficiency and Related Indicators

Of the total companies involved in this study, less than fifteen percent (15%) indicated that they formally endorse and use the terminology of eco-efficiency. The term is infrequently used in their annual reports, environmental reports or web sites. The few companies using the terminology indicate that they are in the learning stages and awareness is only moderate among their employees. There were two main reasons that were given why eco-efficiency is not used. First, many felt that the definitions including the seven elements are subject to a wide range of interpretation which leads to confusion with staff. Similar statements were frequently given for the term "sustainability." Second, a number of companies felt that the term, " eco-efficiency", only included economics and environment and does not address the social aspects which are becoming a critical component of performance.

Although the term itself is not being endorsed, a high percentage of the companies support the concept of eco-efficiency and are actively using indicators that can be correlated with some of the seven

elements of eco-efficiency. Indicators have been used by industry in environmental management for a number of years. Initially they were used to measure the common aspects of air and water discharges, spills and contingencies and waste products. Today, business is becoming more sophisticated in its use of indicators in the area of economics and social impacts Many innovative management techniques are being developed by firms in all sectors. In most cases, the companies are using or developing indicators which address site-specific issues and corporate policies. The driving force for indicators does not appear to come from the regulators. Meeting regulations is a given. Markets, competitiveness, profitability and public opinion are the factors that have the most influence on their development.

> ***Rio Algom** stated; " The CEO and Executive are well aware of the importance of eco-efficiency to the future of the companyand discuss sustainable development and triple bottom line within the context of company strategy in speeches internally and externally."*

> ***Westcoast Energy** stated; " In the past, society measured progress on the basis of economic expansion and job creation. Today, a combination of economic, environmental, health, safety, and societal factors figure prominently in the measure of corporate success. Many people refer to the sum total of these considerations as sustainable development."*

> ***Canadian Occidental Petroleum** stated; "We must not lose sight of the third pillar of sustainable development - social equity. The concept of eco-efficiency is presently heavily weighted toward the biophysical environment."*

Level of Corporate Awareness

With the use of environmental management systems and indicators, awareness of environmental performance is increasing within most companies. A high percentage of the companies are focusing on total integration of environment, health and safety within their corporate structure. As more employees are trained in the use of environmental management systems and understand the relationship of indicators, environmental performance tends to improve.

Ranking of the Seven Elements of Eco-efficiency

When commenting on the seven elements of eco-efficiency and ranking their relative importance, over 75% of the participants stated "reducing the energy intensity of goods and services" was a priority. "Reducing toxic dispersion" and "reducing the material requirements for goods and services," were cited by over 60% and 50% of the companies respectively. "Maximizing sustainable use of renewable resources" was ranked as a high priority by 36% of the respondents.

The types of indicators being used by companies cover a wide range of environmental concerns. The most common indicators used by a majority of the companies measure air and water emissions, water usage, energy consumption, greenhouse gases (GHG's), safety, spills, environmental capital expenditures, etc.

> ***Falconbridge**, 1998 Sustainable Development report: " For the first time, we are introducing performance indicators and directly measuring environmental performance against it."*

> ***Weyerhaeuser Canada** has initiated a program for forest stewardship. It is based on eight principles; Products For People, Water Quality and Habitat Protection, Visual impact and Recreation, Aboriginal Peoples, Soil Productivity, Wildlife Habitat, Community and Stakeholders, and Research and Practical Science. For each principle they have developed a strategy and criterion along with indicators to measure progress.*

> *They have also adopted a program in manufacturing entitled, "Minimum Impact*

Manufacturing (MIM)." It also is referred to as maximizing output and minimizing input The program monitors or develops indicators for usage of raw materials, including energy and water. The totals are then compared to outputs including waste and by products.

***Dupont** has been developing a program for sustainability indicators The index is made up from three components; business, society and safety, health and environment (SHE). The business index is a function of shareholder and customer index, the social index is a function of society and employees and the SHE index is a function of safety, health and environment. The sustainability index is the total of the three*

A significant amount of development has also occurred in the use of indicators for waste reduction, dematerialization, and recycling.

***Dupont** stated; " When we stop making waste in our manufacturing operations, we will benefit environmentally and we will gain enormously in economic returns."*

***Bristol- Myers Squibb** is just beginning to collect data on materials use " Resource use is an important aspect of sustainable development The resources we use,- recycled or virgin, renewable or non renewable, hazardous or nonhazardous - affect the environmental, health and safety (EHS) impacts of our operations and products. Resource use can have social and economic implications as well "*

***Nexfor** uses the following formula to measure material efficiency*

Material Efficiency % 1 - Waste Product + By-products
As waste is reduced and by-products are increased the efficiency increases.

***Merck Frosst Canada's** waste reduction efforts include a "Packaging and the Environment" program to decrease the volume of packaging material that are eventually discarded by the consumer Over the past seven years, the program has saved the company over $10 million in raw materials and packaging components and led to a 35% reduction in waste generated.*

Some initial success has been attained by a number of companies in the use of social and economic indicators but much more work is required. Social impacts on communities is critical for the mining, oil and gas and energy sectors. Opportunities for future development work both domestically and internationally are dependent, in part, on past performance and credibility with respect to environmental performance and the "social footprint." Noranda, along with the common indicators previously mentioned, have committed to use indicators to measure; community dialogue, minimizing their footprint, and profitable growth.

Examples of successful financial indicators were not as evident. Other than capital expenditures on environmental projects and remediation costs, it is an area where development work is required. When senior environmental managers are requested to justify their environmental program with respect to the bottom line, they frequently have difficulty in responding. Most companies believe that sound environmental performance contributes to shareholder value, but are unable to show the linkage by the use of indicators.

***Baxter International Inc.** has developed an "Environmental Balance Sheet." The first simple version was developed in 1990 in an internal environmental report and has since been published and progressively extended and refined. The last environmental report includes a two-page statement of costs and savings with supporting definitions of accounting policies.*

Related Concepts and Management Tools

Without exception, the companies included in the study all placed equal or more emphasis on other management systems. Most companies are implementing, or have implemented, ISO 14000/equivalent in their operations. Some did this on a global basis and others have applied it by location. The decision for certification depends on the type of business and perceived market demands. A number of companies have developed their own distinct management system to meet their policies and long term goals.

Life cycle analysis seems to be gathering momentum, especially in the pharmaceutical, consumer products and metals and minerals processing sectors. By understanding the use ,life expectancy and recyclability of products along with associated waste and environmental impacts, one is better able to design better products and select more effective raw materials for manufacturing.

> ***Bristol-Myers Squibb*** *has spent considerable effort to minimize the impact of their products. Their Product Life Cycle (PLC) initiative is an important tool used by the business to identify and reduce their products' EHS footprint. "By minimizing packaging, using recycled and recyclable materials, we are decreasing the overall impact of our products, including use and consumption by consumers."*

Most companies have established energy efficiency and/or greenhouse gas reduction programs, and address environmental concerns through pollution prevention. In addition, many companies are committed to the various government and industry-sponsored voluntary programs. (*See Annex D for a list of the programs*).

> *The philosophy of* ***Westcoast Energy (WCE)*** *is to look at environmental management as three specific stages. First, the reactive stage where management is responding to issues. The second is the compliance stage where the company is becoming more proactive and compliance with regulations is a given. The third stage is sustainability, which will be ongoing as there is no definition or indicator to show attainment is reached. WCE feels it will complete stage two by 2000 and is now working towards sustainability.*

> ***Husky Injection Molding Systems Ltd.*** *has developed an EMS for Environmental Design and Construction Goals. This program outlines, for contractors, the environmental requirements for: energy, material, waste & recycling, indoor air quality water management, site construction, the community and maintenance for all projects.*

> ***Dupont's*** *main focus is on "Shareholder Value Added" at the global level. Sustaining their values and attaining zero incidents on safety and environment are their goals. They concentrate on dematerialization and partner with suppliers and customers to improve processes with the intent of using less material and reduce waste and energy.*

> ***IBM*** *established an "Environmentally Conscious Products (ECP)" program in 1992. It encompasses the best practices in design for the environment, product recycling technologies and product environmental metrics. The program has five design objectives:*
>
> *- develop products with consideration for their upgradability to extend product life,*
> *- develop products with consideration for their reuse and recyclability at the end of product life,*
> *- develop products that can be safely disposed of at the end of product life,*
> *- develop and manufacture products that use recycled materials where they are technically and economically justifiable, and,*

- *develop products that will provide improvements in energy efficiency and/or reduced consumption of energy.*

***The Bank of Nova Scotia** has in place an "Industry Environmental Risk Rating" (IERR) system to assist them in assessing risk and liability. A rating of 5, the highest, is related to certain property contamination and significant environmental concerns such as oil refineries, landfills and ore processing. A level 1 would be for industry such as clothing, retailing and financial operations.*

Monitoring and Reporting

All respondents maintain a data base of their environmental performance Reporting is done in a number of ways. The majority publish an environmental or sustainability report on a regular basis of one to two years. Others publish on the Internet or issue reports on specific issues However, the cost of publishing annual reports against the measured value is being questioned by a number of companies. Some feel that training employees on environmental issues and involving them in their EMS gives them equal or better credibility.

Reasons for Adopting Eco-efficiency Indicators

The reasons why indicators are used varies considerably between sectors and by company. Generally, all sectors agreed on two purposes: protection of environmental liabilities and public transparency and accountability/reporting. A number of companies, especially in consumer products, health industries and manufacturing sectors felt effective indicators improved profitability. Companies requiring access to capital borrowing suggested indicators for environmental performance would be beneficial. Companies with quasi-government status reported that good indicators of environmental performance helped to maintain their "*licence to operate.*" The financial community, as a lender, supports the use of indicators as a positive means to address the risk factor in order to minimize their liability.

***Monsanto** stated that " Indicators are being successfully used for measuring yield, quality, cost reductions and total agriculture input for growing crops."*

***Bell Canada** stated that indicators are viewed as useful for internal management and improving environmental performance, not for comparability across the sector.*

Competitiveness and Trade

There was general agreement from respondents that practical indicators do have an impact on competitiveness and, to a lesser degree, trade. Indicators which provide a direct link to competitiveness are not in place but improved productivity and continuous improvement of environmental performance does have a positive influence on competitiveness. Effective and practical indicators provide management with a better knowledge of the business and, therefore, will have a positive effect on competitiveness.

***Ontario Power Generation** cited environmental management as a means of differentiating between energy suppliers in a newly developed commodity market, particularly in relation to US markets. Reducing toxic dispersion and environmental liability are two major areas of focus in ensuring competitiveness and retaining market share.*

***Westcoast Energy** stated that practical and effective indicators can assist trade and competitiveness. If your house is in order, international opportunities are attainable. Being able to measure the social footprint can be helpful to attain public trust. Successful companies seem to also have high performance in environment management.*

***Nexfor** is committed to incorporating environment, health and safety goals and*

objectives into all strategic planning because sustainable business practices optimize resource use, reduce costs and strengthen the Company's overall performance.

Environmental Performance, Productivity, Profitability and/or Shareholder Value

Shareholder value can be interpreted as a combination of profitability, productivity and social performance. Since eco-efficiency contributes to improved environmental performance which can enhance profitability and productivity, by extension, it also contributes to shareholder value. The relationship, however, is not clearly defined. A well managed EMS which includes enhanced communication across functional areas, increased awareness, training and improved product and process quality, all impact on profitability and/or shareholder value. As sustainability improves within a company and is understood and encouraged, so does innovation which will improve performance which, again, is linked to profitability.

Even with this logic, most respondents agreed that much work is needed to develop explicit links between eco-efficiency, environmental performance and shareholder value.

> ***Noranda*** *stated that eco-efficiency and shareholder value are inseparable. Eco-efficiency ensures that resources (human and financial) are placed where they are needed. It facilitates access to mine development projects, allows access to capital and to large joint venture partnerships with companies that are committed to the same policies.*

> ***Westcoast Energy*** *feels that opportunities resulting in part from high environmental performance are measurable. Ethical funds have demonstrated this. "Economic Value Added" concept for financial management reflects sustainable development within the operation.*

> ***Monsanto*** *stated that customer partnerships, working directly with the farm community and providing information on new technology all build credibility which links to performance and profitability.*

Evolution of Eco-efficiency and Enhancement of Indicators

All participants in the study agreed that the use of indicators will be enhanced. As previously stated, the greatest need is for financial and social indicators, with some additional work to refine environmental performance measures. Indicators will continue to be developed to suit individual company needs, not only traditional metrics but those to measure the effectiveness of management systems and leadership. These indicators may not be developed under the banner of eco-efficiency, but more likely for reasons of market demands, competitiveness and public pressure. Some metrics currently being developed are seen as complicated and providing no business value.

The mining sector believes that the financial community, both domestically and internationally, is driving environmental performance. Social responsibility is seen as a critical consideration for the sector for which good indicators have not been developed. This includes such factors as employee wellness, safety and community impacts.

With regard to financial management, there is presently no accounting standards or rules for environmental costs and benefits and also no consensus on how to present financial data in relation to environmental performance. A number of companies also stated that environmental performance is not seen as a priority by their chief financial officers. To break down this barrier, better tools are required to link environmental performance to the bottom line. The financial institutions feel that indicators relevant to the lending process would also be beneficial.

> ***Rio Algom*** *stated; "Measuring environmental parameters or tracking indicators that do not have clear value or an obvious reason that makes business sense may lower*

credibility of eco-efficiency efforts which will then not be sustainable."

***Bowater Canada** stated that an opportunity for the use of practical indicators exists. This will require a better appreciation by our business/government leaders of how these indicators fit into concepts already entrenched or gaining acceptance, such as sustainable development and shareholder value. Sustainability is widely discussed but the application of the concept and performance metrics is a struggle. Eco-efficiency indicators are part of our toolbox for getting there and don't need to be labeled as something new.*

Conditions for Success

There were a wide variety of suggestions as to what steps could be taken to enhance this development. The critical element is time. Effective indicators take time to develop, use and modify to suit. Government regulations are not viewed as likely to improve the process. For companies, full integration of environment, health and safety (EHS) management systems with operational decision making is essential. Without a doubt, market forces and competitiveness will also be a major factor in further development of indicators. Companies need to be exposed to successful examples within and outside their sectors plus the technical assistance in identifying opportunities. Encouraging industry sectors to develop and use indicators as benchmarks would also benefit competitiveness. Industry sees a need for government, in its role as facilitator, to create an enabling environment, in terms of providing fiscal and other incentives. Recognition of industry achievements by government and education using "*best in class*" cases should be a priority.

***Stelco** stated, "Government should monitor where there are difficulties and barriers. For example the border for movement of wastes which impacts recycling ; the development of co-generation for energy efficiency, research and development for the breakdown and recycling of plastics."*

***Telus** stated, " Indicators will continue to be developed and enhanced. Market pressure may be one factor. There remains within government a lack of awareness and understanding of the concept. Recognition of industry achievements or the provision of incentives may be viewed as positive."*

***Dupont** has set their goal to go beyond zero for incidents in EHS. This requires the shift from the state of being to the state of consciousness. They have in place an extensive training program focused on developing leadership. They have developed and will continue to develop a set of metrics to measure their progress.*

***Saskatchewan Power** stated, "Government needs to adopt a focus on eco-efficiency as a means of environmental management instead of the current regulatory focus on arbitrary limits. Conditions vary greatly across the country and companies should devote resources to those areas that do the most good, both for the environment and the company.*

Universal Indicators

The development and use of universal indicators received minimal support from the respondents in the study. Although there may be benefits within the sectors, most companies felt that comparison between sectors was a very challenging task. Even different products produced within the same sector exhibit different properties and results could vary significantly. Normalizing of data to production, which is commonly used, is not feasible for a company producing a wide variety of products. Eco-efficiency is seen as a relative concept, not conducive to the establishment of common measures or useful in making comparisons among the firms in terms of performance. An aggregate number used for comparison for a company outside its sector group is perceived to be meaningless. Companies who took part in the National Round Table on the Environment and the Economy project on universal indicators found it interesting but of limited success. There was little apparent support for further work in this area.

Alcan stated, " The question first has to be asked,- Who would benefit and how would they benefit from universal indicators? - There is considerable variation between sectors, and even within a sector between companies. Eco-efficiency is very strongly related to the technology being used. The choice, and use, of indicators must be carefully tailored to the specific application being considered. Until it can be demonstrated that the companies' interests are served by any universal indicator, a one size fits all approach is not warranted.

Nortel Networks stated, "From my experience with developing an eco-indicator on materials and energy intensity for NRTEE, I have learned that the probability of success of one universal indicator could be quite low. Setting out specific guidelines, and agreeable measures may become difficult when applied to multiple sectors. Normalization factors are very difficult to agree upon and the indicator may not be applicable to all businesses.

Eco-efficiency and Environmental Performance Reporting

As part of this study, a review was undertaken of the environmental information provided by sixty-seven (67) Canadian companies in print and electronic format, drawn from their annual or environmental reports for 1998 and a review of online information maintained on their websites. They include, but are not restricted, to many of those canvassed throughout the study for information concerning their reliance on eco-efficiency and related concepts, and use of indicators. It also must be stated that some companies produce environmental reports that can be only acquired on request so these cases may not be reflected in this review. *(See Appendix D, Industry Association and Corporate Reporting by Sector for details on the information provided by each)*

The purpose of the review was to confirm the extent to which the concept of eco-efficiency, explicitly and by inference, is reflected in corporate reporting, as a means of confirming the information provided by industry. A second objective was to determine the range of indicators in use which could be said to contribute to achieving eco-efficiency (Appendix E is a summary of those indicators provided in the material reviewed, by sector). No financial institutions were included in the review of annual reports and other published material.

While much of the information provided is qualitative, and difficult to assess the following table indicates that eco-efficiency has not penetrated Canadian industry as a guid ng concept.

Industry Associations and Corporate Reporting by Sector(30)
Total Number of Organizations Included in the Review - 67

	#	%
Annual Reports Reviewed (Printed Material)	14	21
Environmental Reports + Annual Reports with *Environmental Sections*	32	48
Sources that provide *Environmental Performance Indicators*	30	45
Web Sites	57	86
Web sites with *Environmental Pages*	39	58

Web sites which *include* Annual or Environmental Reports	21	31
Annual/Environmental Reports and Web Sites referring to *Eco-efficiency*	2	3
Reports/Web Sites including *Eco-efficiency Indicators*	2	3

** Source: 1998 Annual and Environmental Reports, Web Sites and Other Publicly Available Documents]*

There are a few facts worth noting. First, of the 67 companies reviewed only forty-eight per cent (48%) published environmental information of one type or another, although nearly sixty per cent (60%) of those with web sites include pages dealing with the environment. Less than half, (45%) of the companies either in their annual reports, environmental reports or web site used indicators as a means of reporting performance. An extremely small number (3%) of companies referenced eco-efficiency or eco-efficiency indicators. This data seems to correlate with the information that was obtained from our formal study.

Environmental reporting has improved significantly over the years and with the use of practical indicators companies are initiating innovative ways to present their continual improvement in environmental performance. From the growth in web sites, it appears that this medium is likely to become a major vehicle for communicating environmental performance information in the future.

#30. *See **Appendix D** for information provided by selected Canadian Industry Associations and Companies.*

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SECTION 5: CONCLUSIONS

Eco-efficiency is not a common term which industry uses and only some elements of the concept are clearly understood by those who acknowledge its importance. There are many different interpretations of the elements i.e. material recyclability, sustainable use of renewable resources, product durability, and the question of arriving at a consensus on definitions is a major focus for the leading edge organizations involved in promoting its wider application. Despite the confusion over some of the elements, the majority of respondents could see a "fit" between their current efforts to address environmental performance and social responsibility and the basic principles of eco-efficiency.

Most, if not all, of the companies have or are developing environmental management systems (EMS). A majority are ISO14001 or equivalent, although a number of companies have designed their own EMS. Most companies and some associations are using indicators to measure environmental performance or using them for other specific environmental issues.

Some companies are more advanced than others in adopting and implementing these concepts, but the increasing recognition of the necessity to establish an EMS and develop and use indicators for performance measurement is the most important aspect. There are some innovative and fascinating developments taking place in this field of work which should be the focus of more detailed study and promotion to increase awareness on the part of stakeholders of the many approaches and their benefits.

From the survey, it would appear that the need to introduce a sound EMS and indicators to measure environmental performance is not being driven by regulations. Several other factors, among them market pressures, competitiveness, financial institutions and profitability, have provided a stronger incentive than the regulatory framework in Canada. Nor is it believed that regulation can effect the shift to more eco-efficient production and consumption, or the changes in society as a whole.

Other conclusions evident from the study were that:

- a high percentage of companies are focusing on total integration of environment, health and safety within their corporate structure. For an effective EMS and for continuous improvement in environmental performance this change seems to be very important;
- a similarly high percentage of companies are using electronic media as a means to communicate environmental performance. For some companies, published annual environmental reports have proven not to be cost effective and many are using more effective means of outreach; and
- a number of larger companies are partnering with their suppliers or customers for purposes of improving product design, reducing waste and reducing material requirements.

Benefits

The potential benefits from the adoption of an EMS, supported by a wide array of indicators can be attributed to a number of factors. First and foremast any major environmental program must make business sense. There must be economic value for the capital expended. In addition, based on the study, there are at least five motivating factors at play which can also result in benefits including:

1. Cost Savings: This is a common goal to all industry. Four of the seven principles of eco-efficiency i.e. reducing material requirements and energy intensity, enhancing material recyclability and reducing waste, if undertaken, can result in significant cost reductions and increased profitability. The Chemicals and Plastics, Consumer Products, Metals and Minerals and the Health Industries sectors have been very effective in this area;

2. Competitiveness: Competitiveness within industry sectors is a global issue. Successful companies not only have to be highly efficient with good product design and effective customer relations, but in most cases they must also have in place, an effective environmental program. This includes not only minimal impacts on air and water quality etc. but being able to manage risk and address social equities. In essence this entails addressing sustainable development as it is defined. All sectors must be effective in this area

3. Product Design. Product design is becoming a very important issue for a number of sectors. Maximizing value while minimizing resource use, minimizing waste, enhancing recyclability, meeting customer requirements are the main areas of focus. If done well, the results will have a direct impact on profitability and, indirectly, shareholder value. Companies using life cycle analysis, particularly those in the steel, chemical and pharmaceutical sectors shown extensive improvements.

4. Business Expansion: Energy, mining and to some extent pulp and paper companies are competing on a global basis for new capital projects, joint ventures or expansions. To be successful, an effective and proven environmental program which takes into account not only environmental protection from manufacturing operations but also local regulatory requirements and social and community needs, is essential. Market access is increasingly dependent on adherence to environmental protection, and sustainable development principles. For publicly owned companies, an effective and proven environmental program is key to maintaining the public support which is an integral part of their "licence to operate;"

5. Capital Funding: Effective environmental management, which takes into account environmental protection, risk management and social equity is a key determinant of success in acquiring capital for expansion or joint ventures. While financial institutions do not appear to support any specific program, the existence of an EMS and policies focused on sustainable development are becoming part of the basic requirements to establish eligibility for funding.

Opportunities for Further Enhancement

While eco-efficiency is not a term commonly used by Canadian industry internally or in public communications and marketing, there are clear indications that a number of the elements which contribute to eco-efficiency will continue to be developed and enhanced. Reducing material requirements, energy intensity and toxic dispersion are priority issues with a majority of companies. Similarly, recyclability and customer service are gaining importance. Enhancing indicators for these elements is critical to show continued improvement.

Over the past number of years, industry has been addressing environmental issues and, to a degree, the economics of environmental management. Now, social equity the third aspect of sustainable development is becoming a critical factor for many sectors. Many industry representatives who contributed to this study noted that, from their perspective, eco-efficiency in its present definition ignores the social dimension. However, industry will need to develop effective indicators for this aspect of environmental management

The financial aspects of environmental management has always been a concern with industry. Initially

environment was classified as a cost centre with minimal return. However, most senior environmental managers know that an effective environmental program within a company does impact the bottom line. The major problem has been the inability to have indicators to reflect environmental performance with profitability and/or shareholder value. There are no accounting policies for environmental costs that are uniformly practiced within industry and there is a need, in this area, for indicator research and development.

Activity at both the international and domestic levels indicates the need for an ever widening number of indicators which companies will be able to choose to meet their own particular needs. Although the development and use of universal indicators is not generally supported by Canadian industry, the development of core and supplementary indicators as suggested by WBCSD may be an acceptable alternative.

> *" One of the most important challenges is to develop metrics that serve the specific needs of users while simultaneously contributing to greater comparability across firms, industries and nations. The lack of comparability among companies is still a significant barrier to progress " [31]*

There is a clear move at the international level toward an ever widening number of eco-efficiency indicators which companies will be able to choose to meet their own particular needs and a move away from the idea of a "one size fits all" indicator

More work remains to be done in establishing the relationship between "eco-efficiency" and parallel systems for monitoring environmental and social performance and in raising awareness in the sectors for which the concept is relatively unknown, and among the small business community. Targeted research, initiatives aimed at transferring knowledge and technology from one sector to another, and from large to small business, are possible areas for government industry partnerships to ensure that Canadian industry maintains its competitiveness in global markets shaped by concern for the environment, health and social issues.

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31. National Academy of Engineering, Committee on Industrial Environmental Performance Metrics, Industrial Environmental Performance Metrics - Challenges and Opportunities (Washington, July, 1999), p. 5

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APPENDIX A

SURVEY AND INTERVIEW QUESTIONNAIRE

A list of those Canadian industry associations and companies from the twelve industry sectors which fall under the mandate of Industry Canada and who responded by agreeing to be interviewed or by completing a questionnaire forwarded by electronic means. The namesof those organizations that chose not to participate are not included

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QUESTIONS ASKED DURING INTERVIEWS/IN SURVEY FORM

1 Does your Company formally endorse and support the concept of eco-efficiency and specific eco-efficiency indicators?

2 What is the level of understanding and awareness, within your Company, of eco-efficiency and the use of eco-efficiency indicators?

3 The following seven elements outlined by WBCSD are considered to contribute to eco-efficiency. Please rank them in order of importance for your sector *(1 Highest, 7 Lowest)*

--- *reducing the* ***material requirements*** *for goods and services,*
--- *reducing the* ***energy intensity*** *of goods and services;*
--- *reducing* ***toxic dispersion***;
--- *enhancing* ***material recyclability***;
--- *maximizing* ***sustainable use of renewable resources***;
--- *extending* ***product durability***, *and*
--- *increasing the* ***service intensity*** *of goods and services*

4 Does your Company place more importance on related approaches, e.g., "*pollution prevention*", "*ISO 14000*", "*life cycle management*","*energy efficiency*" or "*greenhouse gas reduction*" to improve environmental and economic performance?

5 a) Is there information available to support the application of the above by your Company?
b) If so, can documentation be provided?

6 Does your Company maintain records and report as a whole on its performance in relation to the above

principles?

7. (a) For what purpose does your Company currently use eco-efficiency indicators:

--- to promote goods and services
--- to improve the design of goods and services
--- for protection of environmental liabilities
--- for public transparency and accountability/reporting
--- to improve access opportunities for capital borrowing
--- to improve profitability

8. Would adoption of practical eco-efficiency indicators improve the company's position relative to:

a) competitiveness; and,
b) trade opportunities?

9. How do you link eco-efficiency with environmental performance, productivity, profitabilityand /or shareholder value?

10. a) Do you believe that the use of eco-efficiency will further evolve with wider applications within your Company?
b) What steps need to be taken to assist in this enhancement?

11. a) Would your Company support the design and implementation of universal eco-efficiency indicators?
b) If so, which elements, in your opinion, would be more applicable?

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APPENDIX B

LIST OF INDUSTRY PARTICIPANTS

A list of those Canadian industry associations and companies from the twelve industry sectors which fall under the mandate of Industry Canada and who responded by agreeing to be interviewed or by completing a questionnaire forwarded by electronic means. The names of those organizations that chose not to participate are not included.

Automotive and Transportation

1 Air Transport Association of Canada
2 Air Canada
3 Chrysler Canada

Bio-Industries

4 BioteCanada
5 AgrEvo
6 Monsanto

Chemicals & Plastics

7 Canadian Chemical Producers' Association
8 Canadian Fertilizer Association
9 Rubber Association of Canada
10 Vinyl Council of Canada
11 Dow Chemical Canada
12 DuPont Canada

Consumer Products

13 Labatts Canada
14 Kraft Canada Inc
15 Procter and Gamble

Forest and Building Products

16. Canadian Pulp and Paper Association
17. Ontario Forest Industry Association
18. Bowater Canada
19. Nexfor
20. Weyerhaeuser Canada

Financial Services

21. Canadian Bankers Association
22. Bank of Nova Scotia
23. Export Development Corporation
24. Scotia McLeod

Health Industries

25. Canada's Research-Based Pharmaceutical Companies
26. Baxter International Pharmaceutical
27. Bristol-Meyers Squibb
28. Glaxo-Welcome
29. Janssen-Ortho
30. Merck Frosst

Information Technologies & Telecommunications

31. Bell Canada
32. IBM Canada
33. Nortel Networks
34. Telus

Manufacturing and Processing Technologies

35. Alliance of Manufacturers and Exporters
36. Canadian Electrical Association
37. Canadian Petroleum Products Institute
38. Canadian Wind Energy Association
39. Alberta Energy
40. BC Hydro
41. Canadian Occidental Petroleum
42. Husky Corporation
43. Ontario Power Generation Inc.
44. PetroCanada
45. PPG Canada
46. Saskatchewan Power
47. Shell Canada
48. TransAlta
49. Westcoast Energy

Metals and Minerals Processing

50. Canadian Steel Producers Association

51. Mining Association of Canada
52. Alcan
53. Dofasco
54. Falconbridge
55. Noranda
56. Rio Algom
57. Stelco

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APPENDIX C

RANKING OF ECO-EFFICIENCY ELEMENTS

Participants were asked to rank the seven elements of eco-efficiency in order of importance to their organization. The following tables consolidate the response for each sector, based on the rankings provided by the fifty-seven (57) industry association and company representatives who participated in the study

	Ranking						
Eco-Efficency Element	1	2	3	4	5	6	7
1. Reducing Material Requirements							
Automotive and Transportation	1	1	0	0	0	0	0
Bio-Industries	0	0	1	2	0	0	0
Chemicals & Plastics	3	0	1	0	0	0	0
Consumer Products	2	1	0	0	0	0	0
Forest and Building Products	1	1	0	0	0	0	0
Financial Services	0	0	0	0	0	0	0
Health Industries	0	0	1	0	0	0	0
Information Technologies and Telecommunications	0	1	1	0	1	0	0
Manufacturing and Processing Technologies	1	2	4	2	0	1	0
Metals and Minerals Processing	1	2	0	1	1	0	0
Total:	9	8	8	5	2	1	0
2. Reducing Energy Intensity							
Automotive and Transportation	2	0	0	0	0	0	0
Bio-Industries	0	0	1	0	0	0	0
Chemicals & Plastics	2	3	0	0	0	0	0
Consumer Products	0	2	1	0	0	0	0

Forest and Building Products	0	0	1	2	0	0	0
Financial Services	0	0	0	0	0	0	0
Health Industries	0	1	1	0	0	0	0
Information Technologies and Telecommunications	2	2	0	0	0	0	0
Manufacturing and Processing Technologies	3	6	2	0	1	1	0
Metals and Minerals Processing	4	3	1	0	0	0	0
Total:	13	17	7	2	1	3	0
3. Reducing Toxic Dispersion							
Automotive and Transportation	1	0	1	0	0	0	0
Bio-Industries	0	1	1	0	0	0	0
Chemicals & Plastics	1	1	2	0	0	0	0
Consumer Products	0	0	0	0	0	2	1
Forest and Building Products	1	0	1	1	0	0	0
Financial Services	0	0	0	0	0	0	0
Health Industries	1	0	0	0	0	0	0
Information Technologies and Telecommunications	0	0	1	1	1	0	1
Manufacturing and Processing Technologies	6	4	0	2	0	0	0
Metals and Minerals Processing	4	0	1	0	1	0	0
Total:	14	6	7	4	2	2	2
4. Enhancing Material Recyclability							
Automotive and Transportation	1	0	0	0	1	0	0
Bio-Industries	0	0	0	1	1	0	0
Chemicals & Plastics	0	0	0	3	0	0	0
Consumer Products	0	0	0	2	0	0	0
Forest and Building Products	0	1	0	0	1	1	0
Financial Services	1	0	0	0	0	0	0
Health Industries	0	0	0	1	0	0	0
Information Technologies and Telecommunications	0	1	0	2	1	0	1
Manufacturing and Processing Technologies	1	1	3	2	3	0	0
Metals and Minerals Processing	1	0	2	4	0	0	0
Total:	4	3	5	15	7	1	1
5. Maximizing Sustainable Use of Renewable Resources							
Automotive and Transportation	1	0	0	1	0	0	0
Bio-Industries	1	1	0	0	0	0	0
Chemicals & Plastics	0	0	0	1	0	1	0
Consumer Products	0	0	1	0	0	1	0
Forest and Building Products	1	1	1	0	0	0	0
Financial Services	0	0	0	0	0	0	0

Health Industries	0	0	0	0	0	0	1
Information Technologies and Telecommunications	0	0	1	0	0	1	0
Manufacturing and Processing Technologies	3	2	1	1	1	2	2
Metals and Minerals Processing	0	1	2	0	1	0	0
Total:	6	5	6	3	2	5	3
6. Extending Product Durability							
Automotive and Transportation	1	0	0	0	0	1	0
Bio-Industries	0	0	0	0	0	1	1
Chemicals & Plastics	1	0	0	0	0	0	2
Consumer Products	0	0	0	0	3	0	0
Forest and Building Products	0	0	0	0	0	1	1
Financial Services	0	0	0	0	0	0	0
Health Industries	0	0	0	0	0	1	0
Information Technologies and Telecommunications	0	0	1	0	0	2	0
Manufacturing and Processing Technologies	0	0	1	2	2	1	3
Metals and Minerals Processing	0	0	0	0	1	2	1
Total:	2	0	2	2	6	9	8
7. Increasing Service Intensity of Goods							
Automotive and Transportation	1	0	0	0	0	0	1
Bio-Industries	1	0	0	0	0	0	1
Chemicals & Plastics	0	0	0	0	1	0	0
Consumer Products	1	0	0	0	0	0	1
Forest and Building Products	0	0	0	0	1	0	0
Financial Services	0	0	0	0	0	0	0
Health Industries	0	0	0	0	1	0	0
Information Technologies and Telecommunications	2	0	0	1	0	0	1
Manufacturing and Processing Technologies	0	1	0	1	3	3	2
Metals and Minerals Processing	0	0	0	0	0	1	2
Total:	5	1	0	2	6	4	8

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APPENDIX D

In reviewing the attached summary of publicly available information provided by over sixty companies and associations in the twelve target sectors, it is important to note that:

1. The review took place in May and June, 1999 and was intended to provide a "snapshot" of information available from more than sixty selected companies and industry associations in each of the twelve sectors under study.

2. The scope was restricted to annual and environmental reports available for the 1998 fiscal year and on association and corporate web sites at the time of the survey. Since then, information on many of the web sites will have been updated;

3. Due to difficulties experienced in accessing some web sites, and the fact that some were under development, it is possible that some information available may have been missed; and, finally

4. It should be noted that some companies issue reports on environmental performance only every two years which may account for some of the apparent gaps or omissions in the following section of the report.

ORGANIZATIONS INCLUDED BY SECTOR, IN ORDER OF APPEARANCE

Advanced Materials

1. Canadian Association for Composite Structures and Materials

Aerospace and Defense

2. Bombardier

Health Industries

30. Baxter International
31. Bristol-Myers Squibb
32. Glaxo-Welcome
33. Merck Frosst

3. Spar Aerospace

Automotive and Transportation
4. Air Transport Association of Canada
5. Air Canada
6. Chrysler Corporation
7. CN Rail
8. Canadian Pacific Co.

Bio-industries
9. BIOTECanada
10. AgrEvo
11. Monsanto

Chemicals and Plastics
12. Canadian Chemical Producers' Association
13. Canadian Manufacturers of Chemical Specialties
14. Dow Chemical
15. Dupont
16. Nova Chemicals Corporation
17. PPG Canada Ltd.
18. Sterling Pulp Chemicals Ltd.

Consumer Products
19. Kodak
20. Kraft Canada Inc.
21. Labatt Breweries of Canada
22. Procter & Gamble

Financial Services
23. Canadian Bankers Association
24. Bank of Nova Scotia

Forest and Building Products
25. Canadian Pulp and Paper Association
26. Ontario Forest Industry Association
27. Bowater Pulp & Paper Canada
28. Nexfor Inc.

Information Technologies and Telecommunications
34. Bell Canada Enterprises Inc.
35. Bell Canada
36. Corel
37. IBM Canada
38. Intel
39. Nortel Networks
40. Rogers Communications
41. Telus

Manufacturing and Processing Technologies
42. Canadian Electrical Association
43. Canadian Petroleum Products Institute
44. Alberta Energy Co.
45. BC Hyrdo
46. Canadian Occidental Petroleum Ltd.
47. EPCOR
48. Gulf Canada Resources Ltd.
49. Husky Corporation
50. Ontario Power Generation Inc.
51. Pan Canadian Petroleum
52. Petro-Canada
53. Rennaissance Energy Ltd
54. SaskPower Ltd.
55. Shell Canada Ltd.
56. Suncor Energy Inc.
57. Syncrude Canada Limited
58. 3M Canada Company
59. TransAlta Corporation
60. TransCanada Pipelines Ltd.
61. Westcoast Energy

Metals and Minerals Processing
62. Alcan Aluminum
63. Falconbridge
64. Inco
65. Noranda Inc.
66. Rio Algom Ltd.

Other
67. TerraChoice

29. Weyerhauser

INDUSTRY ASSOCIATIONS AND CORPORATE REPORTING BY SECTOR	
ADVANCED MATERIALS	
1. **Canadian Association for Composite Structures and Materials**	**Website** (*http://www.cacsma.ca*) No information relevant to eco-efficiency.
AEROSPACE AND DEFENSE	
2. **Bombardier**	**1998 Annual Report** Seventeen of forty Bombardier plants are ISO14001 certified. Remaining plants are expected to attain certification by the end of 2000. Bombardier has an environmental management system. A short narrative describes the company's initiatives and accomplishments in improving its environmental performance. No references to eco-efficiency, no information on indicators. **Website**, environment page (*http://www.bombardier.com/htmen/9_1.htm*) Corporate Environmental Policy available online with Adobe Acrobat.
3. **Spar Aerospace**	**Website** (*http://www.spar.ca*) No information relevant to eco-efficiency. Annual Report available online with Adobe Acrobat.
AUTOMOTIVE AND TRANSPORTATION	
4. **Air Transport Association of Canada (ATAC)**	**1998 Annual Report** No information relevant to eco-efficiency. **Website** (*http://www.atac.ca*) No information relevant to eco-efficiency.
5. **Air Canada**	**Website** No information on eco-efficiency. No environmental section or annual report.
6. **Chrysler Corporation**	**Website** (*http://www.chrysler.com*) No environment page.
7. **CN Rail**	**Website** - Environment page (*http://www.cn.ca/cn/english/about/safety/envirosound*) No information about eco-efficiency. Environmental section discusses emission rates, reduction and the Responsible Care programme.
8. **Canadian Pacific Co.**	**Website** Stewardship page (http://www.cpr.ca/Cpr.htm/safety/Default.htm) Participation in the Responsible Care programme. Statement of principles on the Public Policy page. No information on eco-efficiency.
BIO-INDUSTRIES	
9. **BIOTECanada**	**1998 Annual Report** The report registers the association's concern over public perceptions of the sector, particularly in relation to issues surrounding genetically engineered foods and the Biosafety Protocol. The association hopes to raise the profile of the environmental biotechnology sector and to continue its participation in national and international processes that may affect the sector. There are no references to eco-efficiency or indicators.

	Website (*http://www.biotech.ca; info@biotech.ca)* No information relevant to eco-efficiency.
10. **AgrEvo**	**Website** - Environment page (*http://www.agrevo.com/env_health.htm*) No information relevant to eco-efficiency.
11. **Monsanto**	**Website** - Environment page (*http://www.monsanto.com/about/sustainability/default.htm*) 1997 Sustainable Development report available online. Much of the data presented in the Environment, Safety and Health Performance page is for 1996. Purchased energy is reported in millions of gigajoules, CO2 emissions in billions of pounds, and broken down into the categories; Injection wells, Offsite, POTW, air and water. Onsite releases are reported for seventeen priority chemicals. Work is underway on the development of sustainability indicators and eco-efficiency. There is no detail provided as to what this work entails. The website states Monsanto's commitment to its revamped corporate ideals as an environmentally sensitive "life sciences" company.
CHEMICALS AND PLASTICS	
12. **Canadian Chemical Producers' Association**	**Website** (*http://www.ccpa.ca*) A report on emissions reductions in the Canadian chemicals sector (for Adobe Acrobat), as well as reports on endocrine disruptors and the Responsible Care programme are all available online. The Responsible Care report contains a section on performance which describes sources of emissions and the sector's achievement in reducing emissions. It also gives figures for values of shipments vs. emissions by year. GHG emissions are also reported by year along with projected reductions. The Global Warming Potential of emissions is reported in kilotonnes of CO2 equivalents. Hazardous waste management is reported in percentages (i.e. waste managed by material recovery, energy recovery, destruction, treatment, underground injection, landfill or other treatment) and hazardous waste generated is reported by year in tonnes, with projected figures for the future. The waste is broken down into routine, non-routine and routine and non-routine (total) classes of waste. There is also information on transportation; the number of reportable incidents, and the rate of incidence-free shipments. The website also contains much discussion of sustainability principles and the sector's growing environmental awareness. No references to eco-efficiency, although some of the information lends itself to the idea (for instance the correlation of shipment value with emissions by year).
13. **Canadian Manufacturers of Chemical Specialties**	**Website** (*http://www.cmcs.org*) No information on eco-efficiency.
14. **Dow Chemical**	**Website** - Environment page (http://www.[illegible]com/environment/ehs.html) Environment, health and safety section gives figures and reduction goals, notes commitment to Responsible Care. 1998 Environment, Health and Safety Report available. Goals for 2005: reduce waste and waste water generated/pound of production by 50%, energy use/pound of production by 20%, priority compounds by 75% and chemical emissions by 50%. 1999 Quarterly Report also available online.
15. **Dupont**	**Website** - Environment page (*http://www.dupont.com/corp/environment/index.html*) Environment page sets goals, principles, notes commitment to Responsible Care. 1998 Safety Health and Environmental Progress Report available online: air toxics and air carcinogens are reported in millions of pounds released per year since 1987. GHGs measured in billions of pounds of CO2 equivalents released by year since 1991, including CFCs. These substances are carbon dioxide, nitrous oxide, fluorocarbons, methane, halon and others. Global Hazardous Waste reported in millions of pounds per country. Global energy use per pound of production is reported, indexed to 1991 as 100%.
16. **Nova Chemicals Corporation**	**Website** - Environment page (*http://www.novachem.com/Environment*) Participation in the Responsible Care programme (annual report available online for Adobe Acrobat reader), NPRI, TRI, ARET, VCR (annual submission available online for Adobe Acrobat reader). Use of a corporate Integrated Risk Assessment system. Reduction goals stated. No reference to eco-efficiency or indicators.

17. **PPG Canada Ltd.**	**Website** - Environment page (*http://www.ppg.com/frames/environ.htm*) Statement of principles. Some information on indicators: the basic indicator for wastes has been volume, but PPG now uses rates of waste generation per unit of production and a new global index of total wastes as indicators rather than volume. Tonnes of production per British thermal unit (Btu) indicates energy efficiency. No annual environment report online.
18. **Sterling Pulp Chemicals Ltd.**	**Website** (*http://www.sterlingchemicals.com*) No environment section.
CONSUMER PRODUCTS	
19. **Kodak**	**Website** - Env. page (*http://www.kodak.com/country/US/en/corp/environment/98CorpEnviroRpt/mainEnviro.shtml* **1998 Environment, Health and Safety Report** online: Corporate environmental management system is registered with ISO14001. The Key Thrust Program annual performance measurements track safety, waste reduction and corrective action. 30 chemicals are tracked against base year 1992. U.S. toxic releases and worldwide emissions are reported, respectively, by year in millions of pounds (individual substances aren't listed). Photoprocessing chemicals also reported (volume of chemicals required to process one roll of film, in fluid ounces) by year. Various recycling programs are described and figures given for amounts of specific products recycled by year (i.e. disposable cameras). New goals are set for 2004 in the areas of emissions reductions, preservation of natural resources and strengthening environmental management-registration of all major manufacturing sites to the ISO14001 standards. Detailed information on sites and programs available online. No references to eco-efficiency.
20. **Kraft Canada Inc.**	**Website** (*http://www.kraftfoods.com*) No environmental information.
21. **Labatt Breweries of Canada**	**Website** Environment page (*http://www.labatt.com/house/prenviro.asp?/uk=0186d5ae4c52fd5a*) Statements of environmental commitments, some description of packaging improvements and recycling initiatives. No references to eco-efficiency or indicators.
22. **Proctor & Gamble**	**Website** - Environment center page (*http://www.pg.com/docInfo/enviro/index.htm)* From 1998 Environmental Progress Update: Work underway on a new exposure assessment tool that measures concentrations of contaminants in European rivers, a computer model to test biodegradability and a wastewater treatment model. A 10 year evaluation of basic biological, chemical, hydrological and weather-related data is also underway to increase understanding of ecosystems and help in development of further modeling. Manufacturing and design practices are regularly assessed for possible improvement. Goals set for reduction in packaging and manufacturing wastes. No specific references to eco-efficiency.
FINANCIAL SERVICES	
23. **Canadian Bankers Association**	**Website** (*http://www.cba.ca*) No information relevant to eco-efficiency.
24. **Bank of Nova Scotia**	**Website** (*http://www.scotiabank.ca*) No information relevant to eco-efficiency.
FOREST AND BUILDING PRODUCTS	
25. **Canadian Pulp and Paper Association**	**Website** (*http://www.cppa.org)* A number of environment/sustainable development pages are accessible online. The page on initiatives is under construction. A page on effluent reduction explains processes for controlling releases and the means by which progress is measured-biochemical oxygen demand (BOD), total suspended solids (TSS), releases of dioxins and furans and of adsorbable organic halide (AOX). A narrative description of some initiatives such as ARET, and of environmental effects monitoring and life-cycle studies follows. A page on energy reduction

	describes the achievements of member companies. Other sections describe reductions in water use and recycling initiatives in the pulp and paper sector. A page on sustainable forestry is included. There are no references to eco-efficiency.
26. **Ontario Forestry Association**	**Website** No information relevant to eco-efficiency.
27. **Bowater Pulp & Paper Canada**	**Website** Environment page (*http://www.bowater.com.html*) Bowater participates in ARET, VCR, has Environmental Management Systems in place in a number of sites. Environment page describes use of new processes to reduce air, water, solid waste pollution, and company's commitment to sustainable forestry and recycling. Indicators not given, no references to eco-efficiency.
28. **Nexfor Inc.**	**1998 Financial and Environmental Report, "Moving Forward"** describes new practices that minimize soil disturbance. The Senneterre operation lowered soil disturbance from 33% in 1997 to 23% in 1998, in anticipation of Quebec legislation that requires disturbance to be less than 25% by 2001. Margin improvement projects underway to reduce costs and improve environmental performance. 30% of biosolid wastes sold to local farmers by mills as fertilizer rather than disposed of via landfill. Plans underway for commercialization of all biosolid byproducts. **Environmental Review** cites improvements and profit from the replacement of fossil fuels with wood waste (Edmunston reduced fuel costs by 75% compared to 1998 data). **Norbord, Fraser Papers, Maclaren** and **Northwood** have been targeted for immediate reform. Participation in National Pollutant Release Inventory and Toxic Release Inventory. **Website** - Environment page (*http://www.nexfor.com/env/fs_env.html?138,10*) Nexfor aims for full compliance, risk and forest management, and implementation of an Environmental Management System (EMS). 1998 Environmental Report, targets and operation highlights are available from the website but only can be read with Adobe Acrobat.
29. **Weyerhaeuser**	**1998 Forest Stewardship Report** (See below for further information from the 1998 Environmental Performance Report) The Forest Stewardship report gives a list of indicators for stewardship which will measure the company's progress towards sustainable development. The principle 1) "To manage public forest land for the sustainable production of wood and fibre" for instance, is paired with the indicator "harvest as a percentage of Annual Allowable Cut" and the indicators (as percentages) reforestation within one growing season, within two growing seasons, and of area Satisfactorily Regenerated within committed time frames. The other major principles (numbered) and indicators are: 2) maintain and/or enhance forest productivity: percentage of trees planted genetically improved, percent of area free growing within committed time frames (percentage), Health Strategy 3) make full use of timber resources: wood waste as a percentage of delivered volume, total additional fibre (value of m3/yr), fibre used below utilization standards as a percentage of delivered quota volume 4) recognize and consider ecosystem diversity: classification system, forest areas mapped, site level mapping on a percentage of areas prior to operations taking place 5) water quality: water objectives for creeks, stream, lakes and wetlands assessed on a percentage of blocks prior to harvest, method developed and followed at a percentage of cutblocks logged 6) water habitat protection: riparian areas classified in a percentage of cutblocks logged, operational standards developed, number of known infractions out of a total possible 7) conserve the productivity of the landbase: soil types field verified and classified as to sensitivity on a percentage of cutblocks logged, standards defined, a percentage of operational plans developed considering soil sensitivity rating for area harvested, percentage of cutblock ares in roads, landings and permanent skid trails, number of hectares of areas logged which are reclaimed or planned for reclamation 8) minimize the impact of operations on wildlife habitat: landscape level habitat

	objectives on a percentage of areas managed, stand level habitat objectives on a percentage of areas harvested 9) to not knowingly jeopardize R, E, T species: identified locations of rare, endangered, threatened species, percentage of known critical habitat location which have been identified. There are a number of other indicators - some quantitative, others qualitative, which measure Weyerhaeuser's progress in the areas of aboriginal peoples, community and stakeholders, research and practical science and visual impact and recreation. **Website** - Environment page *(http://www.weyerhaeuser.com/environmnt/)* contains the 1998 Environmental Performance Report. Weyerhaeuser supports American Forest and Paper Association Sustainable Forestry Initiative and Canadian Standard Association Sustainable Forest Management System standards. Partner to Innovative Forest Practices Agreement (B.C.). Metrics: acres harvested vs. planted by year, acres commercially thinned by year, seedlings produced and planted by year, cumulative area of watershed analyses conducted since 1993. U.S. Toxic Release Inventory (TRI) and Canadian National Pollutant Release Inventory (NPRI) submissions for methanol, acetaldehyde, formaldehyde, ammonia, manganese compounds, sulfuric acid, hydrochloric acid, methyl ethyl ketone, benzene, methylenebis, phenol, chlorine dioxide, cresol, barium compounds, nitrate compounds, other compounds and totals for emissions, in estimated tonnes per year. 1995 is the base year for comparisons for TRI, 1996 for NPRI. Carbon monoxide, volatile organic compounds, particulate matter, nitrogen oxides and sulfur oxides reported in estimated pounds emitted per tonne of production per year. Total reduced sulfur emissions in pounds per tonne of production per year. Water use (gallons), biochemical oxgen demand (pounds) and total suspended solids (pounds), total treated effluent (gallons) all reported by year. Pulp and paper chlorine use reported in tonnes per year against base year 1990. Discharges of Adsorbable Organic Halides (AOX) reported in pounds discharged per tonne of bleached production per year, base year 1990. Hazardous waste generation per year, solid waste sent to landfill by year and hazardous waste generated by routine production by year reported. Total paper collected, paper reused and overall recycled content used for paper products by year reported. Number of internal audits per year conducted reported. Number of noncompliance penalties, and of remedial measures taken are reported.
HEALTH INDUSTRIES	
30. **Baxter International**	**Website** - Environment page (*http://baxter.com/investors/citizenship/environmental/intro.html*) Baxter's environmental goals for 2005 (expressed as a percentage; reduction goals per unit of production) are: 80% less toxic air emissions (base year 1996), 35% less hazardous, regulated and nonhazardous waste generation (base year 1996), 20% less packaging materials (base year 1996), and 10% improvement in energy efficiency (base year 1995). An environmental/financial statement is also available, detailing costs and savings resulting from Baxter's environmental expenditures and initiatives. An Environmental Performance Report is available for Adobe Acrobat.
31. **Bristol-Meyers Squibb**	**Website** - Report on Environmental, Health and Safety Progress (*http://www.bms.com/ehs/sideba/data.introx.htm*) Product Life Cycle (PLC) reviews are conducted for all major product lines. The reviews are shared among facilities and operations through a Best Practices database. The corporation aims to integrate PLC more fully into product development. PLC integration into development is expected to increase eco-efficiency in that the corporation has identified significant potential savings through PLC reviews of operating sites, indicating the possibility of integrating environmental and commercial benefits. The corporate Environmental Management System (EMS) includes (among other aspects) 16 Codes of Practice, a Management System Self-Assessment and a tracking system with indicators for air, land and water releases. Water use is measured in gallons and liters, by year, per $1000 worldwide sales against base year 1994, as well as in billions of units, against the same base year. Corrugated use, and post-consumer recycled material use are measured in pounds and kilograms, by year, per $1000 U.S. sales, and in millions of units. Electricity use and fuel consumption are measured in

	BTUs and Joules, by year, in millions of units per $1000 U.S. sales and in billions and millions of units, respectively, against a 1994 base year. The preservation of biologically-diverse land is measured in acres, with specific commitments for the future. Amounts of non-hazardous waste recycled and disposed are measured in pounds and kilograms, against a 1994 base year, per $1000 worldwide sales and in millions of units. Hazardous waste, ozone-depleting substances and greenhouse gases are measured in pounds and kilograms generated by year, per $1000 of U.S. sales and in millions of units (for hazardous waste and greenhouse gases) and thousands of units (for ozone-depleting substances) against base year 1994. The report contains the last three years of Toxic Release Inventory data. The report gives detailed information about various operations' efforts and achievements in reducing pollution, improving packaging and in product stewardship.
32. **Glaxo-Wellcome**	**Website** (http://www.glaxowellcome.co.uk/about/corp_info/policies/hse_report/index.html) Site contains worldwide progress towards 1995 goals for Environment, Health and Safety. Contains progress made worldwide towards ISO 14001 standard and how to obtain copies of HSE reports back to 1995.
33. **Merck Frosst**	**1998 Environment, Health and Safety Progress Report** Merck tracks emissions of known or suspect carcinogens and its releases and transfers of Superfund Amendments and Reauthorization Act (SARA) toxics in millions of pounds, per year, at all Merck facilities (figures are also provided for U.S. and non-U.S. facilities). Carcinogen emissions have been reduced by 98% from base year levels (1989?). Packaging waste reduction performance is indicated by the total weight generated, per year, at Merck sites. The report describes the corporation's participation in various initiatives, such as Project XL, an American programme that recognizes achievements in environmental stewardship in relation to potential changes to current regulatory systems. Merck's commitment to environmental responsibility is described. No references to eco-efficiency.
INFORMATION TECHNOLOGIES AND TELECOMMUNICATIONS	
34. **Bell Canada Enterprises Inc.**	"*Highlights, Bell Canada and the Environment*" Various initiatives aimed at reducing air emissions and paper use and saving money are described-video- and tele-conferencing, an Electronic Data Interchange, (EDI) and the introduction of electronic phone books. Information on Bell's operations is also provided. Total hazardous residual materials handled are reported in kilograms per year. There are figures for the lead-acid batteries, ozone-depleting substances, PCBs, alkaline, Ni-Cd and Metal-Hyd batteries, oily containers and miscellaneous oil, absorbents, solvents, aerosols, paints and other materials that comprise the total figures for hazardous residual materials. Bell's pole recovery programme is represented by a chart measuring the percentage of poles recovered and the quantity in tonnes of poles recovered, per year. **1998 Annual Report** No information relevant to eco-efficiency.
35. **Bell Canada**	**Website** - Environment page (*http://www.bell.ca/en*) Includes a page on environmental management, noting Bell's Environmental Management and Review System (EMRS) and Corporate Environmental Plan.
36. **Corel**	**1998 Annual Report** No information relevant to eco-efficiency. **Website** (*www.corel.com*)
37. **IBM Canada**	**Website** - Environment page (*http://www.ibm.com/ibm/environment*) The 1998 Environment report is available online: IBM's management system is called Environmentally Conscious Products (ECP). Performance metrics focus on landfill reduction, use of recycled plastics, product energy efficiency and the incorporation of Design For the Environment (DFE) assessments into the design process. Figures given for energy consumption by product. Electricity use (in millions of Kwh) and CO2 emissions (in tonnes) are reported by year. Hazardous waste worldwide reported in 1000s of metric tonnes, by year, according to method of disposal (closed loop on-site recycling, off-site recycling and aqueous treatment, incineration and landfill. IBM tracks releases of pollutants with Toxic Release Inventory and Pollution Prevention Act reporting requirements as its international tracking system. Water conservation, consumption and treatment will now be evaluated against base year 1997 figures.
38. **Intel**	**1998 Environmental, Health &Safety Performance report** Section on **EHS Integration** notes Intel's consideration of environmental effects in the design process, inclusion of EHS language in

	contracts, recycling/reuse operations and successful, continuous reduction of amounts of chemicals used. 3rd party review of N. Mexico facility based on academic, government/ public input. Hazardous waste generation, solid waste recycling, NOx, CO and VOC emissions are reported.
39. **Nortel Networks Inc.**	**1998 Annual Report** No information relevant to eco-efficiency. **Website** (*http://www.nortelnetworkc.com/corporate/community/habitat/98ehsreport/performance_1.html*) Environment page mentions environmental management systems, life cycle management. 1998 Progress Report on the Environment, Health and Safety report available with Adobe Acrobat. From the Performance Report page: environmental performance data is normalized to company-wide Cost of Sales (COS). Nortel is working to make reporting more consistent with a draft corporate reporting standard. This standard is to be finalized in 1999. From the Progress on Eco-Efficiency page: Four targets for 2000 for eco-efficiency measured against 1993 base year. Pollutant wastes (air, water and hazardous wastes) and solid wastes sent for disposal to be reduced by 50%, paper purchases to be reduced by 30% and overall energy efficiency to be increased by 10%. Air emissions measured by sampling results or mass balance calculations. Emissions of ozone-depleting substances measured. Contaminants in waste-water measured by sampling results. Improved energy efficiency defined as decreased consumption. Greenhouse Gas emissions calculated with U.S. Environmental Protection Agency emission factors for all combustion sources. Nortel participates in the Climate Change Voluntary Challenge and Registry. **Environment and Performance Report** (*http://www.nortelnetworks.com/corporate/community/index.html*)
40. **Rogers Communications Inc.**	**1998 Annual Report** No information relevant to eco-efficiency.
41. **Telus**	**1998 Annual Report** No information relevant to eco-efficiency, no environment section. **Website** (*http://www.telus.com*) No environmental information.
MANUFACTURING AND PROCESSING TECHNOLOGIES	
42. **Canadian Electrical Association**	**1997 Annual Report, Environmental Commitment and Responsibility (ECR) Program** ECR Program participation a condition for membership in CEA. Principles "supported by Indicators" and performance monitoring and reporting with independent verification are required by the Program. **Overview of the ECR Program** explains that: **Principle 1** "To be more efficient in our use of resources" is supported by the following indicators: • **Recycling and Reuse of Insulating Oil** (vol. insulating oil reused/reclaimed/recovered (L) divided by this figure + vol. insulating oil disposed as waste multiplied by 100%) (98% in 1997 reused, reclaimed or recovered; • **Energy Conversion Efficiency** (*fossil* generation: total energy output (Gwh) divided by total energy input (Gwh) multiplied by 100%, *nuclear* generation: total energy output (Gwh) divided by total energy leaving moderator (Gwh) multiplied by 100%, *hydro* generation: water-to-wire system efficiency); • **Internal Energy Efficiency** (total internal energy use (Gwh) divided by total energy sales (Gwh) multiplied by 100% • **Utilization of Solid Combustion By-Products** (total mass of residue utilized (tonnes) divided by total mass residue produced (tonnes) multiplied by 100%; • **Public Satisfaction with Energy Efficiency Programs** (annual survey of public attitudes conducted by CEA).

	Principle 2 "To reduce the adverse environmental impact of our business" is supported by the following indicators: • Atmospheric Emissions (carbon dioxide, sulphur dioxide, nitrogen oxides reported on a total system basis and expressed as a mass emitted per unit of net system generation); • **Number of Reportable Incidents** (unplanned release of a regulated substance reported to an external regulatory agency), Ecosystem Management (currently a qualitative description); • **Volume of PCBs** in Use and Storage (inventory); and, • **R&D** Aimed at Improving Environmental Performance (currently a qualitative description). **Principle 3** "To be accountable to our constituents" is supported by the following indicators: • **Public Reporting of Environmental Performance** (percentage of utilities producing publicly available reports on performance); • Public Satisfaction with Environmental Performance (survey); and, • Public Satisfaction with Environmental Information (survey). **Principle 4** "To ensure that our employees understand the environmental implications of their actions and have the knowledge and skills to make the right decisions" is supported by the following indicators: • Evidence of an Effective Employee Awareness and Training Program (% of employees who received environmental training during the reporting period). Revisions underway to 1997 Protocol in order to implement an Environmental Management System (EMS) consistent with ISO 14001 by December 31 1999; initial indicators under review . An indicator for hydroelectric generating facilities is needed. A fish indicator is expected to be the first, with others to follow.
43. **Canadian Petroleum Products Institute**	**1998 Annual Report** CPPI companies use a hierarchical model for environmental protection, aiming first for pollution prevention, then for reuse and recycling, then for control and treatment, then for disposal. The Institute sets a number of guiding principles for its member companies, including: (a) integration of environment, health and safety concerns into product and facility design, operations and business practices, (b) energy efficiency, (c) continual improvement of management systems. A 1996 report on the oil sands sector describes some of the CPPI's performance indicators: the Solomon Energy Intensity Index, which employs a normalization approach to compare refineries with one another, is used to measure performance. An index of 100 refineries tracks energy efficiency. Energy consumption is measured by year in TJ, and as a percentage against base year 1990. Energy intensity is measured by year and as a percentage, and in GJ/cubic meters. Energy is also measured per unit of value added, in gigajoules per millions of 1986 dollars of GDP. Energy source comparisons are reported against base year 1990 as percentages. The sources are specified as petroleum ck., natural gas, electricity, middle dist., heavy fuel oil, liquid petroleum gases and still gas. Improvements in the oil sands sector in these areas are attributed by the CPPI to measures such as waste heat recovery, furnace upgrades, heat integration, on-line process energy monitoring,

	variable speed control of turbines, flare gas recovery, improved distillation efficiency, increased heat exchange capacity and improved energy focus. More than 90% of the Canadian refining industry have registered with the VCR and submitted action plans. The CPPI's 1998 Annual Report includes additional figures for sources of particulate emissions (1995), and registers the Institute's commitment to reduce sulphur, benzene and MMT in gasoline. GHG emissions in the petroleum products industry are reported as percentages due to production of petroleum products and use of petroleum products, respectively. National Pollutant Release Inventory figures are given in tonnes/meter cubed of crude throughput, per year. The 1998 Progress on Environmental and Safety Performance report describes major reductions in the concentration levels of suspended particulates, sulphur dioxide, carbon monoxide and nitrogen dioxide. Energy intensity index trends up to 1997, and NPRI figures comparing 1993, 1996 and 1997 levels of toluene, xylene (mixed isomers), ammonia, benzene, propylene and ethylene in tonnes are reported. Refinery effluent discharges in 1992, 1996 and 1997 are reported in kg per 100 cubic meters per day of crude for oil and grease, sulphide, ammonia, ammonia nitrogen, phenol and total suspended solids by Canadian refineries. The CPPI also reports on the amount of oil consumed during use, collected and reused and available for collection and reuse, respectively, in millions of litres.
44. **Alberta Energy Co.**	**Website** - Environment page (*www.aec.ca/aec/operate/envpol.htm)* No information on eco-efficiency or indicators. Commitment to sustainable development stated.
45. **B.C. Hydro**	**1998 Report on the Environment, 1998 Summary of BC Hydro's Climate Change Progress Report, and 1998 Report on the Environment Summary for British Columbians** See below for summary information from the 1998 Report on the Environment (available online). BC Hydro's EMS for Transmission and Distribution and other business units is to be implemented by the end of 2002. In 1998 the corporation completed and independent assessment of its environmental policies and practices which is to be used to further improve operations. Performance is measured using industry-wide indicators for thermal and diesel generation, local air impacts, GHGs, impacts of thermal generation on fish, hydroelectric generation (by facility, reporting efficiency as a percentage), flow impacts, impacts on vegetation, waste management and pollution prevention, internal energy efficiency, bird and mammal impacts and decontamination of PCB-contaminated oil (in litres, per year), among others. The *Power Smart* programme reports on energy savings in terms of cumulative energy gain (Gwh/year) and undertakes various environmental improvement initiatives, for instance collecting used refrigerators and recycling CFCs and metal from these. Recycling figures for the year are reported for paper, cardboard, scrap metal, wooden poles, toner cartridges, fluorescent tubes, dry cell batteries, ceramic insulators and waste sent to landfill. BC Hydro's commitment to eco-efficiency in the future is stated-alternatives to hydroelectric generating facilities are being considered (such as combined-cycle gas turbine technologies). The corporation is investigating the possibilities of alternative energy sources and considering how to manage its operations in accordance with its definition of eco-efficiency as "maximum benefits for minimum impacts". The *Climate Change Progress Report* index gives detailed information on measures that avoid and reduce GHG emissions. The information is broken down by year and by substance (i.e. CO2 and CH4 and N2O as CO2 equivalents) in kilotonnes. **Website** - Environmental information page *(http://eww.bchydro.bc.ca/html/lib_comp_bran_environment.html)* **1998 Environment Report** provides information on environmental concerns and practices of the corporation, eg. Environmental Management System. Greenhouse Gas (GHG) emissions measured in tonnes of CO2 equivalent/GWh, total kilogrammes of PCBs in storage and percentage destroyed per year measured. A new set of Key Performance Indicators (KPIs) are being coordinated with those of the Canadian

	Electrical Association's Environmental Commitment and Responsibility and with ISO 14001. These indicators pick out key areas: atmospheric emissions, PCB management, internal energy efficiency, employee awareness and training, impacts on fish. Cost-tracking and evaluation measurements for environmental management under development. A "***triple bottom line***" approach is being developed to consider social, financial and environmental concerns.
46. **Canadian Occidental Petroleum Ltd.**	**Website** - Environment page (*http://www.cdnoxy.com/about/ehandscontent.htm*) Participation in Responsible Care, ARET, NPRI, National Emissions Reduction Masterplan. No figures, indicators or references to eco-efficiency.
47. **EPCOR**	**Website** - Environment page *(http://www.epcor-group.com/pages/EPCOR/envcom/envcom.html)* Information on various initiatives to reduce environmental harm at specific sites (some figures; indicators not described, eco-efficiency not mentioned.
48. **Gulf Canada Resources Ltd.**	**1998 Annual Report** No information relevant to eco-efficiency.
49. **Husky Corporation**	**1998 Environment, Health and Safety Report** Husky has achieved some significant reductions. The use of chlorinated solvents (trichloroethane) for instance, has been reduced by 246 025 L/year by converting metal part cleaners to water-based washers. The report details other significant reductions and charts its environmental performance in terms of: Income generated, waste diverted (%), Husky's achievement in 1998 (%) and government diversion target (%). Environmental principles are stated, programmes for packaging and recycling improvements described. Indicators seem to be limited to expenditures. Savings and expenses of the EHS programme are graphed in terms of child care, wellness, fitness, landscaping, recycling plans, etc., but the indicators for these somewhat vague terms are not given. No references to eco-efficiency. **Website** *(http://husky-oil.com)* "People and Community" page (which is where any environmental information will presumably be found) is under construction.
50. **Ontario Power Generation Inc.**(*previously Ontario Hydro*)	Material reviewed included "*Assessing Sustainable Development*" (produced by the International Institute for Sustainable Development) which discusses Ontario Hydro's framework of Sustainable Development Indicators. Ontario Hydro's strategy consists of five broad aims: (a) promoting energy and resource use efficiency, (b) environmental integrity, (c) increasing the use of renewable energy, (d) financial integrity, and, (c) social integrity. Its indicators for energy and resource use efficiency are total electricity used and transmission losses as a percentage of sales, fuel conversion efficiency, water withdrawals, fuels and other commodities consumed and internal energy savings. Environmental integrity is measured through greenhouse gas emissions, waste management, ozone-depleting substance emissions, levels of radioactive waste produced, acid gas releases, compliance violations, hazardous wastes, reportable spills and environmental expenditures. The promotion of renewable energy is indicated by energy generated from renewable sources and energy generated by advanced renewable energy technologies. Financial integrity is measured by net income, interest coverage, debt ratio and total unit energy cost, social integrity by employee accident severity, the corporate citizenship programme, employee productivity, payments in lieu of taxes, number of public fatalities, aboriginal grievances and the number and severity of environmental complaints. A Corporate Performance framework aims, among other things, to further integration of performance targets into business plans and tie specific performance measures to compensation. The framework includes, as indicators of stewardship (one of its key aims), spills volumes lost to the environment, carbon intensity rate, annual internal energy savings, nuclear special safety system performance and nuclear reactor trips. To better integrate the aims of environmental integrity, resource use efficiency and renewable energy into the Corporate Performance programme, Ontario Hydro is designing a Resource Use Efficiency (eco-efficiency) composite indicator that focusses on inputs such as fuel, water and energy material and an Environmental Performance composite indicator that focusses on

	outputs such as emissions, effluents and wastes. The ***Resource Use Efficiency*** indicator will, it is hoped, encourage the reduction of resources used in production and electricity delivery, the reduction of production and material management costs as well as of waste and associated costs, and the development of business opportunities. The Environmental Performance indicators reflects the company's strategy to give priority to pollution prevention over end-of-the-line management and to consider voluntary initiatives and market-based mechanisms such as emissions reduction trading programmes. This indicator is expected to encourage the reduction of releases to the local, regional and global environment as well as community impacts, the minimization of waste and an increase in reuse and recycling, and to improve nuclear safety. These composite indicators are hopefully to be used as measures of progress towards sustainable development. A possible plan for an ***Environmental Performance composite indicator*** represents contributions by business unit of nuclear, fossil, hydroelectric, transmission and retail sources, as well as a performance target level, a stretched target level (a level consistent with strategic objectives but not constrained by resources and based on external benchmarking information or other factors) and a composite indicator score. The figures proposed show progress made by year. Sub-components of the proposed Resource Use Efficiency composite indicator include resource productivity, energy used/lost, internal energy efficiency improvements, use of renewable energy and major commodity usage, as well as a stretched target level, a performance target level and a composite indicator score. Ontario Power Generation Inc. will produce its first corporate reports in the year 2000 for 1999.
51. **Pan Canadian Petroleum Ltd.**	**Website** - Environmental page (*http://www.pcp.ca/no. _ndex_car.html)* Statement of environmental commitments. Environment page mentions some environmental improvement initiatives, participation in VCR. No references to eco-efficiency or indicators.
52. **Petro-Canada**	**Website** (*http://www.petrocan.com)* Website under construction.
53. **Rennaissance Energy Ltd**	**1998 Annual Report** Section on *Stewardship,* under *Corporate Responsibility* includes section on Health, Safety and the Environment (dealt with under separate heading) refers to: adherence to environmental standards, development of reclamation criteria for well sites; incorporation of latest environmental technology in new facilities; continuous upgrade of older facilities. Environmental programs include gathering systems, downhole corrosion inhibition (prevent breaks, prolong life) new technologies to accelerate degradation of hydrocarbons (natural soil bacteria), well/facility abandonment, cleanup, restoration program. No strip/minimum disturbance construction (topsoil left intact), reseeding of disturbed areas (native prairie grass). Regular environmental inspections, assessment of property to be acquired, detailed environmental plan (dev. of development criteria in critical wildlife areas (biodiversity). *Climate change* (efficient, cost-effective production), increased operational efficiency, reduced GHG emissions; increased electrical efficiency; reduced consumption of gas in production (despite increased production). Waste disposal policy includes reuse and recycling. Community information/consultation. **Business Initiatives**, includes section on ***Cost Efficiencies.*** It makes no reference to environment or eco-efficiency related indicators. **Website** (email): *info@renaissance.ca*
54. **SaskPower**	**Website** - Environment page *(http://www.saskpower.com/html/environment.html)* Statement of commitments, description of programmes such as the "Zero G" waste management system. No references to eco-efficiency or indicators. Annual environment report is available online.
55. **Shell Canada Limited**	**1998 Annual Report** Section on *Health, Safety and Environment* notes the company's continued implementation of the Health, Safety and Sustainable Development Management System and its support for the aims of regulatory compliance, product stewardship, waste and energy management and control of emissions and soil and groundwater contamination. **Website** - Environment page *(http://www.shellchemicals.com/HSE/env_rep.asp)* The 1998 Health, Safety and Environment report is available online. Indicators given: SO2, NOx, VOCs, measured in

	tonnes and kilotonnes per tonne of production by year, CO2 and total Montreal controlled substances (CFCs, Halons and TCE) measured in millions of tonnes by year. Chemical oxygen demand is measured in kilo tonnes and tonnes per tonne of production. Hazardous waste, industrial waste, waste to off-site incineration and waste to landfill are reported in kilotonnes. Energy use is measured in millions of Gigajoules and gigajoules per tonne of production per year. Priority substances (for instance benzene and styrene) are reported for total emissions and as emissions to air and water, per year, in kg. There is some explanation of the rationale behind Shell's criteria for arriving at emission reduction targets for the Shell companies as a whole. Energy efficiency targets are to be set for next year.
56. **Suncor Energy Inc.**	**Website** - Environment page (*http://www.suncor.com/01about/01framek1.html*) Description of initiatives and techniques, management system for environmental protection and improvement. Environment, Health and Safety reports available online (1998 report not yet available), VCR submissions available online. Company-wide emissions are reported. Greenhouse gases are measured in thousands of tonnes per year of carbon dioxide equivalent and in thousands of tonnes of carbon dioxide equivalent per metre cubed of production, by year. Sulphur dioxide is measured in tonnes produced per day, by year, and in kg per BOE produced and processed. Emissions from particular sites of substances (eg. hazardous wastes, benzene) are recorded in tonnes per year.
57. **Syncrude Canada Ltd.**	**Website** - Environment page *(http://www.syncrude.com)* Syncrude participates in VCR. Environment section describes commitments and techniques for improvement such as land reclamation, tailings management and waste management. The 1998 Environmental Progress report is available online. Air quality and particulate emissions are discussed. Indicators are not given. SO2, a variety of greenhouse gases and CO2 emissions are measured by barrel produced per year. Energy efficiency is also measured according to energy consumption per barrel produced, by year. 1988 is the base-year for emissions monitoring. No references to eco-efficiency.
58. **3M Canada Company**	**1998 Report on the Environment** 3M implementing an Environmental Management System in Canada, apparently "parallel" to ISO standards but based on internal 3M standards and procedures. 3M claims its measures will result in compliance with government standards or surpass them. Some measures reported are: energy consumption per tonne of product produced, increased office recycling, solid waste recycling, introduction of more energy efficient plants, product responsibility, pollution prevention policies. Year 2000 goals include the reduction of process releases by 90%, of process waste generation by 50%, of energy consumption by 3% per year, of air emissions (i.e. VOCs) and of energy by 15% per unit of production by 2000. Recycling programs and ozone-depleting-chemical reduction programs are underway. Specific information about indicators and monitoring practices is not addressed in the report.
59. **TransAlta Corporation**	**1998 Sustainable Development Report** (See below for further information from the Sustainable Development Report). Some additional information not available online: Transalta divides its sustainable development policy into a number of key areas of activity. Some significant areas, and targets set, are: a) Public reporting on sustainable development performance. This area is to be implemented through continued participation in the Canadian Electricity Association's Environmental Commitment and Responsibility, enhanced reporting on GHG management and public availability of relevant information; b) Environment, health and safety management is to be measured by adherence to ISO14001 standards. New operations are to meet these standards within two years of operation or acquisition; c) Greenhouse gas management is to be measured by Transalta's performance in achieving the goal of returning net Canadian contribution of GHG to the atmosphere to 1990 levels in 2000, by proceeding with internal efficiency initiatives for GHG reductions, acquiring a portfolio of offset projects,

	creating a market-based system for trading reduction credits and developing a post-2000 GHG strategy. **Website** - Environment page *(http://www.transalta.com/website/homepage.nsf?OpenDatabase)* VCR submissions and 1998 Sustainable Development Report available online. Transalta participates in ARET. Environmental Management Systems at Alberta sites are to meet the ISO14001 standards by the end of 1999. Greenhouse gases are reported against base-year 1990 levels as millions of tonnes of CO2 equivalents released per year. Sources of emissions reductions are calculated as percentages, broken down into: domestic and international offsets, internal efficiencies, impact of Ontario co-generation facilities and Edmonton co-composting centre offsets, renewable energy purchases and customer efficiencies. Monitoring and data gathering capacities are to be increased in coming years. Indicators for: Generation impact management. Net generation for world-wide operations reported in megawatt hours as a total and, respectively, for coal-fired, natural gas-fired and hydro-electric generation, per year. Further detail: Coal-fired generation indicators for (a) heat rate (Giga joule/megawatt hours by year), (b) SO2 and NOx emissions in tonnes by year, (c) particulate emission rates (kilo grammes/megawatt hour by year), (d) ash disposal (percentage of ash sold and disposed by year). Gas-fired generation indicators: (a) fuel conversion efficiency by year (ratio of total amount of energy output, both thermal and electrical, to total energy input), (b) electricity and stream generation (net generation in megawatt hours and steam sales in Giga joules), (c) NOx emission rates by year in tonnes and in kilo grams/megawatt hour. Environmental compliance is indicated in number of releases to air, to water, spills, other incidents, total incidents and enforcement actions, respectively, per year. There are site-specific figures as well. Numbers and kinds of assessments carried out are also used as indicators.
60. **Transcanada Pipelines Ltd.**	**1998 Annual Report** No information relevant to eco-efficiency.
61. **Westcoast Energy**	**1998 Annual review; Progress in Sustainable Development, 1998 Voluntary Challenge and Registry (VCR) Action Plan, Global Climate Change Report** West Coast Energy's Environment, Health and Safety Council is comprised of representatives of the various utilities and energy companies controlled by West Coast Energy. The Council is to provide guidance in EHS policy, suggesting best practices and identifying problems and solutions. A senior advisory group, to be developed in 1999, will integrate sustainable development and other strategic goals. The Sustainable Development report contains company-specific information on sustainable development initiatives, as well as a description of West Coast's general EHS principles and policies. Key Performance Indicators given in the report are: a) Environmental, Health and Safety Expenditures (measured in dollars rounded to the nearest thousand, per year-figures in this and other indicators are given for West Coast's subsidiaries such as Centra Gas British Columbia and Pacific Northern Gas Ltd.); b) Environment, Health and Safety Training (measured in average number of hours of training for full-time employees). c) Motor Vehicle Accidents-Frequency Rate (total recordable accidents, frequency per 1,000,000 km);

	d) Lost -Time Accidents-Frequency Rate (number of full-time employee lost time accidents per 200,000 hours worked, e) Reportable Spills (pursuant to applicable laws); f) Permit exceedences, g) Sulphur Emission (in tonnes per year); and, h) GHG Emissions (Per Unit Throughput, per year). Westcoast Energy has also published an issue paper for its managers discussing global climate change. The paper explains scientific thinking and controversy over the effects of human activity on the earth's atmosphere as well as international processes to address the climate change issue, such as Agenda 21. More issue papers are to be produced. West Coast's VCR Action Plan supplies an index of emissions data for individual companies. There are figures for CO2 in kilotonnes, N2O and CH4 (separately) in kilotonnes of CO2 equivalents, total kilotonnes of CO2 equivalents, throughput volume in millions of metres cubed and emissions per unit volume in tonnes of CO2 equivalents per million cubic metres. (All figures by year, dating back to 1990). The Plan also provides charts for West Coast's total gross emissions, total net emissions (total gross emissions minus offsets), both in kilotonnes of CO2 equivalents per year, as well as for emissions per unit throughput in tonnes of CO2 equivalents per million cubic metres per year against base year 1990. Total GHG emissions are reported in kilotonnes of CO2 equivalents per year, and GHG emissions per unit throughput are reported in tonnes of CO2 equivalents per million cubic metres of gas per year. Annual GHG offsets are calculated as GHG emissions baseline (calculated annually) minus emissions from the project (also calculated annually). The Plan also describes current environmental initiatives and aims, such as increasing internal efficiency and methane emissions reductions.
METALS AND MINERALS PROCESSING	
62. **Alcan Aluminum**	**Website** - Environment page (*http://www.alcan.com/WWWAlcan.nsf/Level2-E/LevelEnviro-E?OpenDocument*) Alcan is committed to product stewardship. Environment page outlines the company's Environmental Management System. No information on eco-efficiency. Description of technological innovations and ongoing programmes which have reduced emissions. Polycyclic Aromatic Hydrocarbons (PAHs) are reported as a % of 1983 emissions. Releases of water effluent, solid waste, PCBs, air emissions and the programs and processes used to control these are reported. Indicators not given.
63. **Falconbridge**	**1998 Sustainable Development Report** The first Sustainable Development (as opposed to Environment) report, integrating social economic and environmental reporting. Performance indicators are being used (also a first). In 1997 a risk assessment process was introduced into the company's operations. All operations are expected to receive ISO14001 certification by 2000. See below (website information) for some of Falconbridge's main eco-efficiency targets for company-wide operations. An annex provides extremely detailed data for sites, by sector and division, by year (i.e. mines and mill production, smelter production, divisional totals and general information) on emissions, non-compliance events, land and water use and land restored. **Website** - Environment page (*http://www.falconbridge.com/focus/focus.htm*) Environment page states commitment to recycling, reuse, etc., sustainable development. Participation in ARET. From the Sustainable Development section: Goal of 1% per year reduction in energy intensity (energy used per unit of output; Kwh/tonne), annual average nickel concentration in effluents reported by site. Eco-efficiency targets (base year 1995, target year end of 2000): water-10% reduction, SO2

	emissions-28%, metals released to air and water-50%. Ratio of tonnes of SO2 emitted to tonne of nickel produced reported. Particulate emissions and ground level concentrations are also measured.
64. **Inco**	**Website** - Environment page (http://www.inco.com/about/enviro/env00-g.htm) Initial report on the Life Cycle Inventory (LCI) project expected in 1999. Participation in the Accelerated Reduction of Emissions of Toxics (ARET) voluntary program. ***Environment, Health and Safety: Commitment to Sustainable Development*** notes that Inco aims to reduce nickel, copper, arsenic and lead emissions by 50% from 1990 levels by 2000 (1998 levels already register a 70% decrease). Indicator of energy efficiency is based on amount of energy required to produce a tonne of nickel.
65. **Noranda Inc.**	**1998 Environment, Safety and Health Report** Section on ***Significant Events and Performance*** lists compliance on air emissions at 99.97%, and on water discharges at 99.96%. Environment, Safety and Health Assurance Program to be launched this year. Eight indicators adopted to measure sustainable development progress, to be tracked year-to-year: 1) SO2 emissions in copper (goal of 90% capture by 2002), 2) metal emissions to air (goal to reduce by 80% or more from 1988 levels by 2008), 3) energy consumption (increase energy efficiency by 1% per year through CIPEC), 4) "minimizing our footprint", 5) community dialogue, 6) safety, 7) profitable growth, 8) environmental capital expenditures. Only mining and metals company to qualify for Responsible Care program for the safe handling of hazardous materials. Policy of product stewardship. **Website** - Envtl. mgmt pg. *(http://www.noranda.com/english/environment/index.cfm?system_id=6&environment=yes)* Noranda is in the process of developing sustainable development indicators and participates in Responsible Care.
66. **Rio Algom Ltd.**	**1998 Environment, Health, Safety & Community Report** EHS management and review programmes are in place. The review programme will be revised in 1999. Examples are given in the report of reporting methods, performance innovations and reductions in pollution. Land reclamation for the year is reported in total area in hectares of specific sites and the areas in hectares of these totals that have been reclaimed. Annual average metal loadings of zinc, copper, iron, manganese and aluminum are recorded in kg by year for sites. Discharges to water of ammonia, zinc, iron, manganese, copper, uranium and volume of water treated are recorded in kg/year and in water volume for sites. The corporation hopes to build capacity for "*triple bottom line*" (financial, environmental and social) reporting. **Website** - Environment page *(http://www.rioalgom.com/index2.html)* Statement of principles and some description of actions. No references to eco-efficiency or indicators. No annual environment report online.
67. **Stelco**	**Website** - Environment page of online annual report (*http://www.stelco.ca/Annual Report98/environment.phtml)* Resource recovery measured by year in pounds per ton of steel shipped. Environment section also notes the development of a fuel from a blast furnace residue, the increased shipping and use of blast furnace slag for cement production and road building, a waste water treatment programme and the installation of spill containment systems.
OTHER	
68. **TerraChoice**	**Website** (*http://www.terrachoice.ca)* Terrachoice provides environmental certification in co-operation with Environment Canada, including the Environmental Profile Data Sheet (EPDS) intended to help industry identify/monitor environmental performance/impacts. The EPDS is a standardized reporting form that consists of measurement data and explanatory comments related to environmental attributes covering the life cycle of pulp and paper products. Unlike other "ecolabels" the EPDS does not make explicit claims about the comparative preferability of one product over another.


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APPENDIX E

CURRENT INDICATORS

Provides a list of indicators provided in the annual and/or environmental reports or web sites of the sixty-seven industry associations and companies reviewed in Appendix D.

1 AUTOMOTIVE AND TRANSPORTATION

- monitoring of emissions rates, participation in Responsible Care programme

2. BIO-INDUSTRIES

- purchased energy (in millions of gigajoules)
- CO2 emissions in billions of pounds
- onsite releases of priority chemicals

3 CHEMICALS AND PLASTICS

- participation in Responsible Care, ARET, NPRI, TRI, VCR
- source monitoring of emissions, ratio of value of shipments to emissions by year
- GHG emissions (billions of pounds of CO2 equivalents released per year including CFCs)
- global energy use per pound of production, rates of waste generation per unit of production
- tonnes of production per British Thermal Unit (BTU) as indicator of energy efficiency
- global warming potential of emissions (kilotonnes of CO2 equivalents)
- hazardous waste management in percentages of waste managed by material recovery, energy recovery, destruction, treatment, underground injection, landfill or other
- hazardous waste generated reported by year in tonnes, with projections for future levels
- number of reportable incidents, rate of incidence-free shipment

4 CONSUMER PRODUCTS

- performance measurements: safety, waste reduction and corrective actions
- emissions tracking

5. FINANCIAL SERVICES N/A

6 FOREST AND BUILDING PRODUCTS

- participation in ARET, VCR, TRI, NPRI, CSA Sustainable Forest Management System, Innovative ForestPractices Agreement
- biochemical oxygen demand
- total suspended solids
- releases of dioxins, furans
- percentages of wastes disposed vs reused, sold or recycled
- monitoring of soil disturbance as performance indicator
- harvest as a percentage of Annual Allowable Cut, reforestation within one growing season, within two growing seasons (also percentages)
- percentage of area free growing within committed time frames
- wood waste as a percentage of delivered volume, fibre used below utilization standards as a percentage of delivered quota volume, water objectives for creeks, streams, lakes and wetlands assessed on a percentage of blocks prior to harvest
- acres harvested vs planted/year, acres commercially thinned/year, seedlings produced and planted/year, cumulative area of watershed analyses conducted
- emissions reporting for methanol, acetaldehyde, formaldehyde, ammonia, manganese compounds, sulfuric acid, hydrochloric acid, methyl ethyl ketone benzene, phenol, chlorine dioxide, creosol, barium compounds, nitrate compounds
- emissions reporting for CO2, VOCs, particulate matter, nitrogen oxides and sulphur oxides in estimated pounds emitted per tonne of production per year
- total reduced sulphur emissions in pounds per tonne of production per year
- water use (in gallons), total suspended solids (pounds) and total treated effluent (gallons) reported per year
- discharges of adsorbable organic halides reported in pounds discharged per tonne of bleached production per year
- hazardous waste generation, solid waste sent to landfill and hazardous waste generated by routine production reported by year
- total paper collected, paper reused and overall recycled content used for paper products
- number of internal audits, number of noncompliance penalties, number of remedial measures undertaken (as performance indicators)

7 HEALTH INDUSTRIES

- participation in Superfund Amendments and Reauthorization Act (SARA)
- water use by year (in gallons and liters) per $1000 worldwide sales against base 1994, as well as in billions of units, against the same base year
- corrugated use and post-consumer recycled material use in pounds and kilograms by year, per $1000 U S sales, and in millions of units
- electricity use and fuel consumption measured in BTUs and joules by year and in millions of units, per $1000 U S sales, against base year 1994
- amounts of non-hazardous waste recycled and disposed (in pounds and kilograms) per $1000 worldwide sales and in millions of units
- hazardous waste, ozone-depleting substances and GHGs (pounds and kilograms) by year per $1000 U S sales and in millions of units (in thousands of units for ozone-depleting substances), base year 1994

8 INFORMATION TECHNOLOGIES AND TELECOMMUNICATIONS

- participation in VCR, TRI
- total hazardous residual materials handled (in kilograms/year) such as lead-acid batteries, ozone-depleting substances, PCBs, alkaline, Ni-Cd and Metal-Hyd batteries, oily containers and miscellaneous oil, absorbents, solvents, aerosols, paints
- energy consumption by product, landfill reduction, use of recycled plastics, product energy efficiency, energy consumption by product
- electricity use (in millions of Kwh) and CO2 emissions (in tonnes) by year, hazardous waste worldwide (in thousands of metric tonnes) according to method of disposal
- water conservation, consumption and treatment evaluated against base year 1997
- solid waste recycling

- Nox, CO2 and VOC emissions reported
- pollutant wastes, paper purchases, overall energy efficiency, solid wastes sent for disposal, air emissions measured by sampling results or mass balance calculations
- contaminants in waste-water, improved energy efficiency defined as decreased consumption, GHG emissions calculated with U.S. EPA emission factors for all combustion sources

9. **MANUF/ CTURING AND PROCESSING TECHNOLOGIES**

- participation in ISO14001, VCR, NPRI
- CEA Environmental Commitment and Responsibility (ECR) Program indicators include:
  - volume of insulating oil reused/reclaimed/recovered (L) ÷ by this figure + volume of insulating oil disposed as waste multiplied by 100%) (98% in 1997 reused, reclaimed or recovered
  - fossil generation: total energy output (Gwh) ÷ by total energy input (Gwh) multiplied by 100%, *nuclear* generation: total energy output (Gwh) ÷ by total energy leaving moderator (Gwh) multiplied by 100%, *hydro* generation: water-to-wire system efficiency
  - total internal energy use (Gwh) ÷ by total energy sales (Gwh) multiplied by 100%
  - total mass of residue utilized (tonnes) ÷ by total mass residue produced (tonnes) multiplied by 100%
  - annual survey of public attitudes conducted by CEA).
  - carbon dioxide, sulphur dioxide, nitrogen oxides reported on a total system basis, expressed as a mass emitted per unit of net system generation),
  - number of reportable incidents (unplanned releases of regulated substancesreported to an external regulatory agency)
  - ecosystem management (currently a qualitative description)
  - volume of PCBs in use and storage
  - support for R&D (to improve environmental performance, a qualitative description).
  - public reporting of environmental performance (percentage of utilities producing publicly available reports on performance);
  - public satisfaction with environmental performance (survey)
  - public satisfaction with environmental information (survey)
  - % of employees who received environmental training during the reporting period
- *Solomon Energy Intensity Index* used to compare refineries with one another
- energy consumption measured by year in TJ, and as a percentage against base year 1990
- energy intensity by year, as a percentage, and in gigajoules/cubic meter
- energy also measured per unit of value added, in gigajoules per millions of 1986 $ of GDP
- energy source comparisons reported against base year 1990 as percentages
- particulate emissions, sulphur, benzene, MMT in gasoline, suspended particulates, sulphur dioxide, carbon monoxide, nitrogen dioxide, toluene, xylene, ammonia, propylene and ethylene are reported
- refinery effluent discharges reported in kg/100 cubic meters/day of crude for oil and grease, sulphide, ammonia, ammonia nitrogen, phenol and total suspended solids
- amount of oil consumed during use, collected and reused and available for collection and reuse reported in millions of liters
- performance indicators: thermal and diesel generation, local air impacts, GHG emissions, impacts of thermal generation on fish, impacts on vegetation, flow impacts, hydroelectric generation, bird and mammal impacts, internal energy efficiency, decontamination of PCB-contaminated oil in liters by year
- energy savings in cumulative energy gain (Gwh/year)
- releases of CO2, CH4, N2O as CO2 equivalents (GHGs) in kilotonnes/year and /Gwh
- total kilograms of PCBs in storage, percentage of these destroyed/year
- use of chlorinated solvents (trichloroethane)
- income generated, waste diverted (percentage)
- total electricity used and transmission losses as a percentage of sales, fuel conversion efficiency, water withdrawals, fuels and other commodities consumed and energy savings

- soil and groundwater contamination
- Montreal Protocol controlled substances (CFCs, Halons and TCE), measured in millions of tonnes by year
- chemical oxygen demand in kiltonnes and tonnes per tonne of production
- priority substances reported for total emissions and as emissions to air and water/year, in kg
- coal fired generation indicators: (a) heat rate (gigajoule/megawatt hours by year), (b) SO2 and Nox emissions in tonnes per year, (c) particulate emission rates (kilogrammes/megawatt hour by year), (d) ash disposal (percentage of ash sold and disposed/year)
- gas-fired generation indicators: fuel conversion efficiency by year (ration of total amount of energy output, both thermal and electrical, to total energy input), (b) electricity and steam generation (net generation in megawatt hours and steam sales in giga joules), (c) Nox emission rates by year in tonnes and in kilograms/megawatt hour
- GHG emissions per Unit Throughput/year

10. **METALS AND MINERALS PROCESSING**

- participation in ARET, ISO14001
- Polycyclic Aromatic Hydrocarbons (PAHs) as a percentage of base year 1983 emissions
- releases of water effluent, solid waste, PCBs, air emissions
- annual average nickel concentration in effluents reported by site
- annual average metal loadings of zinc, copper, iron, manganese and aluminum in kg by site
- discharges to water of ammonia, zinc, iron, manganese, copper, uranium and volume of water treated recorded in kg/year and in water volume by site
- ratio of tonnes of SO2 emitted to tonne of production
- particulate emissions and ground level concentrations reported
- releases of nickel, copper, lead, arsenic
- energy efficiency as amount of energy required to produce a tonne of nickel
- energy consumption
- resource recovery measured by year in pounds per tonne of steel shipped

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