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Eco-Controlling

— *A Tool to Implement Value Based Environmental Management*

This article is based on a lecture held at the European Brewery Congress 1997 in Maastrich (NL).

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Content

Introduction **3**

The Concept of Eco-Controlling **4**

Module 1 — Objectives and Targets **4**

Module 2 — Data Management **8**
Environmental Information 8
Financial and Environmentally Induced Financial Information 10

Module 3 — Performance Evaluation **11**

Module 4 — Value Based Environmental Programs **14**

Module 5 — Communication **15**

Conclusion and Outlook **16**

References **17**

About the Authors **19**
Andreas Sturm (Partner, Ellipson Ltd.) 19
Kaspar Müller (Partner, Ellipson Ltd.) 19

Introduction

This paper presents eco-controlling as a new tool for efficient and effective environmental management of production sites and firms in line with current standards like EMAS and ISO 14001 without covering every aspect of these standardized environmental management systems.

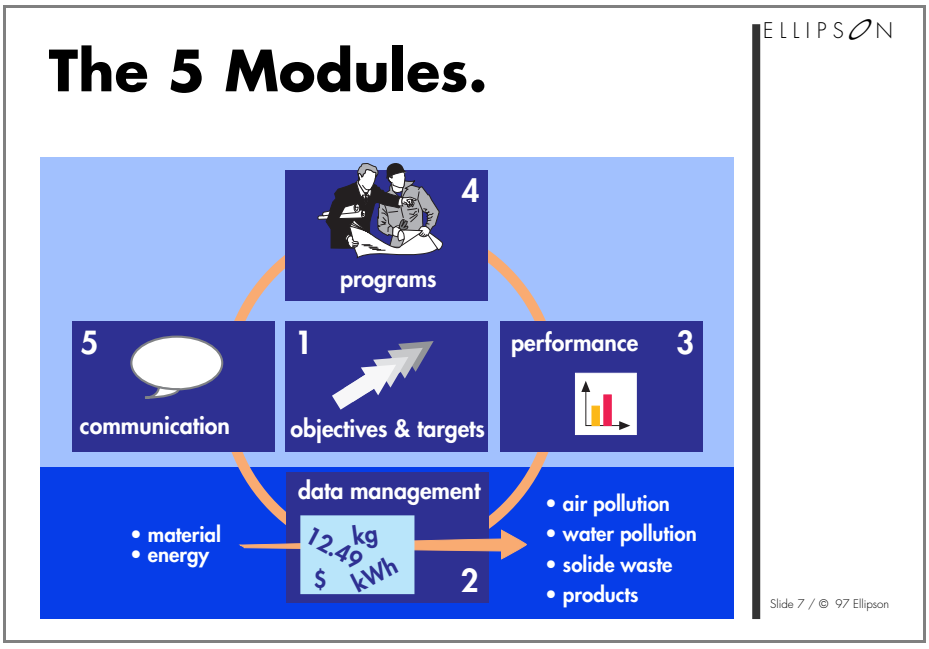


Figure 1: The concept of eco-controlling

Managerial eco-controlling is based on the basic process of financial controlling.[1] Eco-Controlling envisages a strategic approach to environmental issues and proposes a systematic management procedure with various steps from target and strategy formulation to data management, decision support, control, implementation and communication [Schaltegger & Sturm 1995]. The concept is specifically developed to link environmental strategy with the financial and strategic targets of top management. The system therefore focuses on the improvement of eco-efficiency.

Eco-Efficiency is defined as the ratio between environmental impact added [2] and value added. In real world applications of the concept of eco-efficiency these two figures are adapted to the special needs of a particular industry or company. One such eco-efficiency figure widely used is, for example „global warming potential per unit of turnover" in relation to „return on net assets".

The concept presented here [3] has benefited from the experience gained in several projects and is an operational system in several companies in Europe.

The Concept of Eco-Controlling

The concept of managerial eco-controlling presented here [4] corresponds to methods of financial and strategic controlling. The matters to be managed here are the environmental impacts as well as the financial impacts of a company.

The eco-controlling concept can be divided into the five modules (see figure 1):

- Module 1: Objectives and Targets
- Module 2: Data Management
- Module 3: Performance Evaluation
- Module 4: Value Based Environmental Programs
- Module 5: Communication

Module 1 — Objectives and Targets

Although the formulation of clear objectives and targets is the most important step of environmental management, this step is often neglected. The rational for investing in environmental management has to be clear for a company to be a credible and a efficient environmental performer and to reap the benefits of being an environmental leader in its markets. To ensure a company's commitment towards a formulated environmental strategy, it is therefore essential that top management is involved in the process of target setting.

The formulation of environmental objectives and targets starts with a commitment to comply with all relevant environmental regulations and to continuously improve environmental performance. Environmental performance is linked mainly to environmental impacts caused either by risks (accidents) or by continuous interventions in the natural environment.

The first step of eco-controlling is to assess the exposure and therefore the importance of different environmental issues for a company's overall performance. The analysis of the expected exposure of a company to different environmental problems and the weight given to these aspects by various stakeholders enables management to prioritise on environmental issues with high priority for the company. This is represented in the quadrant in the upper right corner of figure 2. Whilst less significant, the two quadrants on the left in figure 2 should also be observed.

Issues with low public priority to which the firm contributes heavily become a problem as soon as the perception of the stakeholders and the public environmental policy changes (the quadrant in the upper left corner of figure 2) Shell's „Brent Spar" dumping case illustratee that such change can be very rapid. Investments in new production capacity or new products can increase the environmental impact of the firm when they are not anticipated early enough. In this case, a problem ranked in the lower right corner in figure 2 would shift to the field with highest priority. Problems ranked in the lower left corner are of no priority. No measures should be taken there.

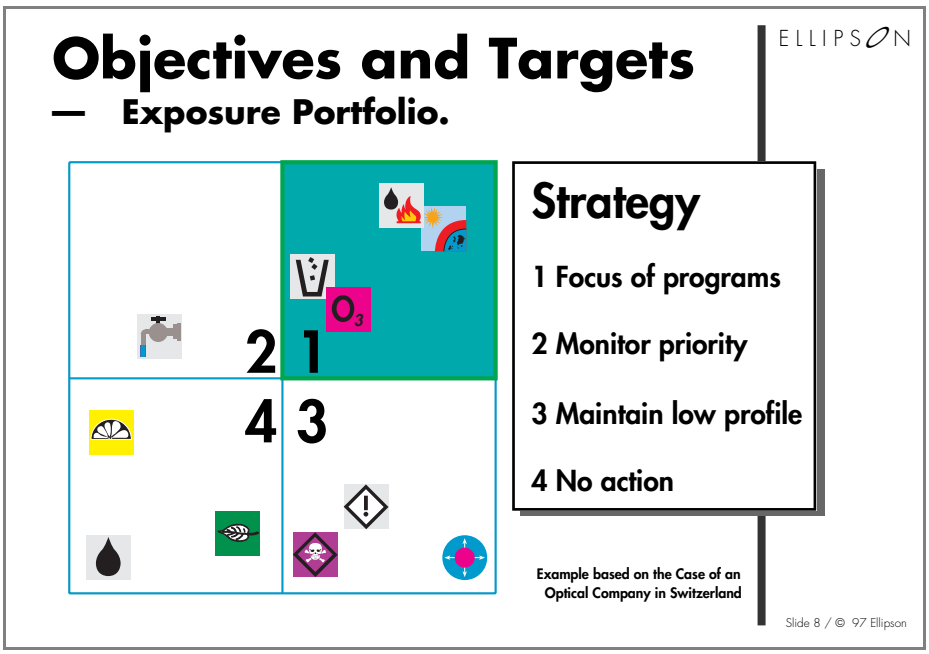


Figure 2: Environmental exposure portfolio (© 1997 Ellipson AG)

The method for measuring environmental exposure is based on data from questionnaires given in table 1 and table 2. The higher the importance of an environmental problem (high score in table 1) and the greater the company's environmental impact (high score in table 2) then the higher the priority from a company's point of view. In the example shown in figure 1 gives the following priorities:

1. Energy Consumption
2. Global Warming
3. Municipal Waste
4. Photo Smog
5. Toxic Waste
6. Ozone Depletion
7. Human Toxicity
8 Water Consumption
9. Acidification
10. Nutrification
11. Fossil Resources

Topic / Perspective	Environmental Problem Area				
	Resource Depletion		Environmental Impact		
	Energy	Water	Global Warming	Toxic Waste	...
▶ Importance given by scientific evaluation					
▶ social awareness today					
▶ social awareness in the near future					
▶ governmental policy awareness today					
▶ governmental policy awareness in the near future					
▶ regulation density today					
▶ regulation density in the near future					
Total					
Ranking by Importance					

scoring: 4 = high; 3 = middle; 2 = low; 1 = very low; 0 = none) © 1997 Ellipson AG

Table 1: Module 1 - Table for measuring the importance of environmental problems

Topic / Process	Environmental Problem Area				
	Resource Depletion		Environmental Impact		
	Energy	Water	Global Warming	Toxic Waste	...
▶ pre-production processes					
▶ in-house production processes					
▶ consumption of our products					
▶ disposal processes					
Total					
Ranking by Importance					

(scoring: 4 = high; 3 = middle; 2 = low; 1 = very low; 0 = none) © 1997 Ellipson AG

Table 2: Module 1 - Table for measuring the environmental impact of a company

After the environmental objectives are approved by the CEO, top management should set targets — at least for the highest priority environmental aspects— that include a time frame within which they must be achieved. To set targets management must put the environmental priorities in concrete terms. This can be done by

evaluating the causes of a specific resource depletion or environmental impact problem.

To complete module 1 of an eco-controlling system, an environmental target system has to be approved by top management. An example is given in figure 3. It is of great importance that the targets are set on the environmental problem level rather than on a causal level.

As an illustration assume that a company wants to reduce its global warming impact by 10% over the next 5 years. Traditionally, a 10% reduction in fossil fuel consumption would be set as a target. If we follow the approach based on the problem (impact) rather than the cause, as presented in figure 3, a company has at least 4 more options to achieve its target of reducing the impact on global warming:

1. Reducing CFC-Emissions,
2. changing the mix of energy consumed,
3. installing a catalytic end-of-the-pipe methane reduction facility or
4. banning the use of HCFCs.

All of these measures lead to a decrease in global warming. The question now is, which alternative has the least cost or the best return, while achieving the target. In other words, which alternative has the best efficiency assuming the effectiveness is comparable (–10 percent reduction in the contribution to global warming). Management needs a decision support system to answer such a problem. One such system is shown in module 3.

If targets were anticipated correctly, the expenditure needed to achieve these targets may be a wise investment particularly once competitors are forced by cost drivers (for example, rising energy or waste treatment costs) and/or legislation to improve environmental performance. The sooner a company starts to evaluate alternatives to end-of-the-pipe solutions — for example, by modifying the product and packaging — the higher the return of investment will be. As soon as the competition is forced to improve environmental performance because of costs, consumer pressure and/or environmental law, the initial cost will become a benefit and a competitive advantage.

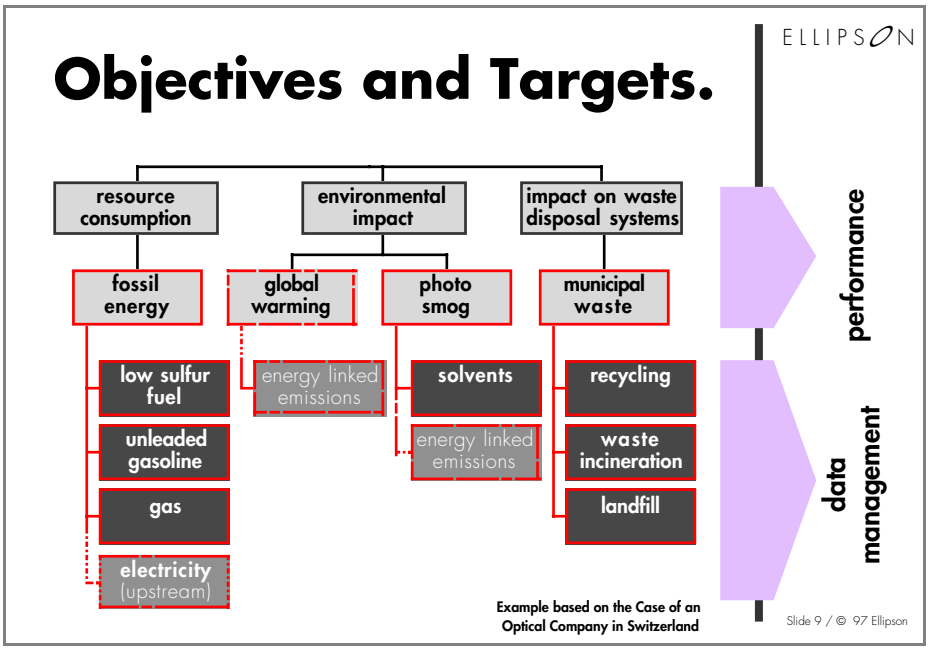


Figure 3: Module 1 - Environmental objective and target system

Besides giving environmental policy a clear focus, this target system serves as a basis for data management in module 2 and for performance evaluation in module 3 (see figure 3).

Module 2 — Data Management

The recording of environmental data and environmentally induced financial information is necessary as a basis for effective decision making. For every environmental target the company needs to collect the necessary data (see figure 3). Both the financial and ecological data systems have to be adapted or built up, because eco-efficiency has an ecological and an economic dimension.

Environmental Information

The collection and preparation of ecological information is a relatively new task for managers. Besides collecting information about risks and applicable regulations, the main focus in module 2 is an environmental inventory of inputs and outputs (so called environmental interventions). Since managers typically have extensive experience with accounting and the management of economic information, it makes sense to apply similar methods to the recording and analysis of ecological information and to conduct an inventory analysis on the basis of environmental accounts. This procedure follows the methodology of

management accounting but all the figures are measured in either kilograms or megajouls (see table 3).

Environmental Accounts Feldschlösschen Ltd. (Switzerland)	
Inputs (kg)	***Outputs (kg)***

▶ raw materials
▶ water
▶ fossil fuels
  ▶ operating materials
  ▶ main operating materials
  ▶ auxiliary operating materials
  ▶ packaging
	▶ main products
	▶ by-products
	▶ waste
	  ▶ waste for further treatment
	  ▶ recycling
	  ▶ incineration
	  ▶ landfill
	▶ emissions
	  ▶ air
	  ▶ water

***Table 3: Module 2 - Classification of environmental accounts** (approx. 200 sub-categories))*

Recording starts once the specific accounts for the company have been set up. The identification of potential sources of data is the first step in data collection. Special attention should be given to the structure of the accounts and the existing sources of environmentally relevant data, such as management accounting for materials and the amount of energy used, site permits for particular pollutants, production statistics, technical specifications of the production machines, etc.

Once the data is recorded, the question arises where and by which products the pollution was caused. In an analogy to cost centres and costs carriers, environmental impact added centres and environmental impact added carriers are identified. These enable the users of eco-controlling to analyse where a pollutant is emitted and by which products. Depending on the industry this information can be important, for example, to assess the impact of a CO_2-tax on the product portfolio and the underlying production technology. To open the possibility of influencing environmental performance, the exact sources of environmental interventions should be known.

Economically, it does not make sense to aim at a full inventory of all mass and energy flows – apart from the fact that this target can hardly be achieved. The process of data collection will usually be spread over several years, becoming more in-depth each year until the marginal benefit of more detailed information matches the marginal costs of collection.

The close link to the management accounting methodology and terminology ensures a quick understanding of the data collection process by management and staff

who must contribute to the process as well as to the use of the data. Management accounting benefits from an environmental data inventory in that environmentally induced costs, such as energy costs or pollution abatement costs can be allocated to the cost centres and the cost drivers that cause them.

Financial and Environmentally Induced Financial Information

Corporate (as well as public) environmental protection can only be successful if it is economically sustainable. It is therefore necessary to consider economic information in environmental protection.

From a conceptual point of view, the necessary methods of accounting are known. Nonetheless, in practice, financial and managerial accounting are often not differentiated according to environmentally induced information and other financial information. The process of differentiation can be started by searching for environmental costs and revenues in the existing financial and managerial accounting systems. All costs and revenues related to environmental performance must be identified, such as disposal costs, clean-up costs, emission reduction costs, etc. This information gives a preliminary indication of which fraction of total costs is due to environmental issues and how much money can be saved by better environmental performance.

For the next step, the allocation of overhead costs has to be analysed. The main question here is: Do the allocation methods reflect the different environmental effects of the materials used or the pollutants emitted? For example, does the allocation of sewage costs take the financial impacts of different qualities of waste water into account, or are these costs allocated by cubic meter of waste water, without consideration of the incurred treatment costs? In the latter case, environmentally friendly products would subsidise environmentally harmful products and distort the calculation of prices.

Mostly neglected are the costs that occur for the handling of excess material (which becomes waste in subsequent steps), the use of machine capacities, etc. (see II in table 4) as well as the costs for the purchase of excess material in other words inputs which become waste (see I in table 4:). These costs (I and II) should also be allocated to the product as waste costs.

The reallocation of environmentally induced costs is an important part of making a company more environmentally efficient, because it highlights the potential for shared environmental and economic benefits.

Usual Method of Calculating Environmentally Induced Costs		Correct Method of Calculating Environmentally Induced Costs	
Costs of Disposal (III)		**Costs of Disposal (III)**	
▶ Fees	500,000	▶ Fees	500,000
▶ Disposal Costs	300,000	▶ Disposal Costs	300,000
Total	***800,000***	***First Total***	***800,000***
		Costs Incurred in Production (II)	
		▶ Logistics & Transportation	150,000
		▶ Additional Personnel	250,000
		▶ Additional Depreciation	200,000
		▶ Storage	100,000
		Second Total	***1,500,000***
		Excess Material Input (I)	
		▶ Purchase	4,500,000
		Correct Total	***6,000,000***

Table 4: Example of the significance of correct calculation of environmentally induced costs [Wagner 1995].

Module 3 — Performance Evaluation

The reasons for collecting data about corporate environmental impacts as well as environmentally induced financial impacts are to calculate eco-efficiency, and to measure how well the operations of the firm contribute to or detract from sustainable development. Eco-efficiency is defined by the ratio of value added per environmental impact added, respectively, the ratio between an economic performance indicator and an environmental performance indicator [Schaltegger & Sturm 1990].

The denominator of this ratio, environmental impact added, is the measure of all environmental interventions which are assessed according to their relative environmental impact. As no economic activity is without environmental interventions, environmental impact added is the correlative of value added.

In the performance module, a system is necessary to assess, aggregate and present recorded data to support decision making. Decisions for setting environmental priorities within a company rely (often implicitly) on impact assessment approaches.

Ideally, all environmental interventions would be assessed according to their actual impact. However, most of the existing impact assessment approaches were developed for life cycle impact assessment and provide only information about potential

environmental impacts [for an overview, see Schaltegger & Sturm 1994, for a further discussion of some approaches, see Braunschweig et al. 1994].

The most widely used approach to assess environmental impact is the two-step approach of classification and characterisation. In this approach environmental interventions are clustered by their potential link to a specific environmental problem and then assessed according to the contribution to this problems. For example, methane is a gas that can be classified as an emission with an impact on global warming. When the relative impact is characterised it can be seen that the greenhouse potential of 1 kg of methane is about 20 times as high as the potential of the same amount of CO_2 (based on actual scientific knowledge). According to the approach of the Centre of Environmental Science of the University of Leiden (CML) currently sixteen different classes of environmental problems are defined [Heijungs et al. 1992], but further developments are to be expected.

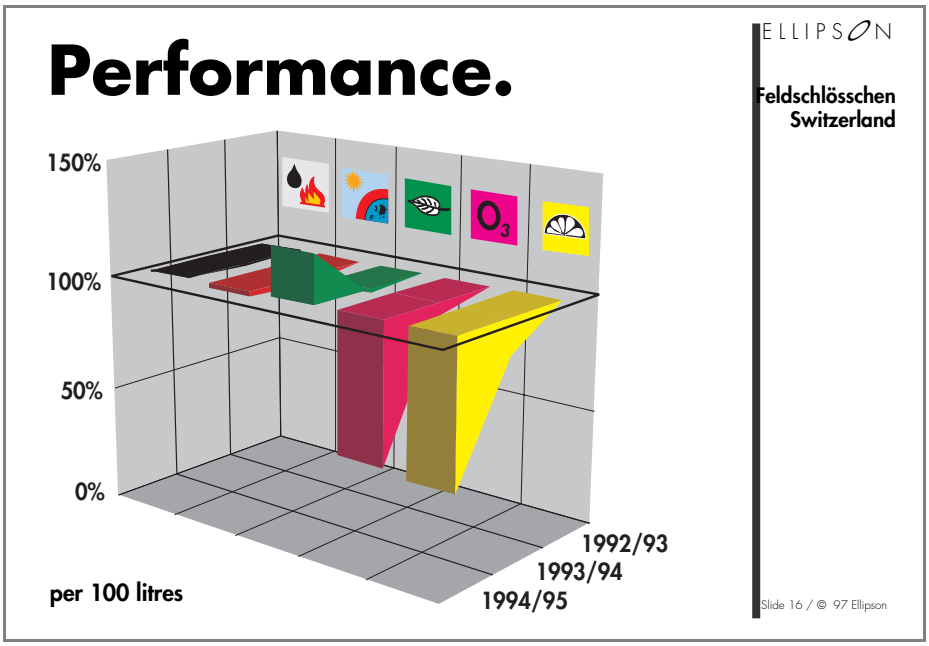
Systems of classification and characterisation are based on natural sciences. They therefore enjoy a greater acceptance in the scientific community. The problem in using them for eco-controlling is that they do not give an indication of environmental performance in one score. However, this is also an advantage, as weaknesses are visualised with the respective environmental impact added indicators even if the overall score would point in a positive direction. These indicators show, for example, when the potential contribution to global warming has increased whilst the potential contribution to acidification has been reduced.

To reach a clear conclusion about corporate environmental performance, it is necessary to make a qualitative assessment of the importance of the various indicators (such as the contribution to photochemical smog per working day in summer). Also, the specific stakeholder exposure of the firm should be considered when defining priorities for action. Therefore, the priorities must be based on the targets and policies defined, as detailed in the first module of eco-controlling. This process of weighting indicators is quite similar to the assessment of financial data, where a consensus on the importance of key figures for the company has to be found.

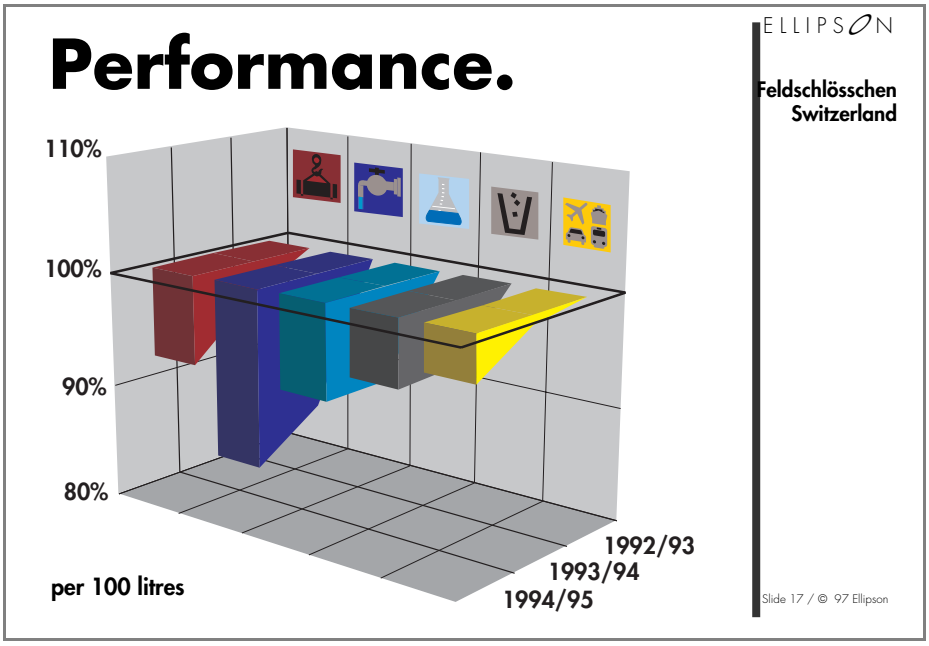
For every environmental objective with high priority, an environmental performance figure should be calculated accordingly. As a result, the organisation has a set of key figures that measure environmental performance based on the environmental effects register. Theses figures are then compared to the objectives and targets. Figure 4 shows that Feldschlösschen focused on two main problems, photo smog and acidification, by changing the energy-mix.

Environmental performance indicators should always be put into the context of economic performance. This can be done by drawing an eco-efficiency portfolio, in which the environmental performance is shown on the vertical axis and eco-

nomic performance on the horizontal axis or by relating all environmental impacts to an economic performance figure (see figure 4).



from left to right: primary energy input [MJ], global warming [kg GWP], nutrification [kg NP], ozone creation [kg POCP], acidification [kg AP]



from left to right: material input [kg], water input [kg], chemical use [kg], waste [kg], transports (tkm)

Figure 4: Eco-Efficiency of Feldschlösschen (Switzerland)

Module 4 — Value Based Environmental Programs

Many of the existing environmental management tools fail to consider the importance of the implementation process.

Eco-controlling addresses different levels of the organisation and combines the very different tasks of shop floor environmental data collection and strategic environmental management. Using a language which managers are accustomed to, helps to lower the barriers of implementation.

Environmental activities should be taken not only by the reduction in the harm done to the environment, but also by the contribution to increased shareholder value. For setting up programs environmental protection is brought into harmony with the interests of investors. To achieve this aim the program should be analysed by the potential costs and benefits to make sure that the program provides a positive economic return.

A useful approach for analysing the costs and benefits of programs is the shareholder value concept [RAPPAPORT 1986, COPELAND 1990]. This concept takes a long-term perspective and clearly shows the sensitivities of different factors - so-called value drivers - on corporate or shareholder value.

The costs and benefits of programs can be quantified by analysing the economic effect of management decisions regarding environmental issues on value drivers in terms of decreasing or increasing shareholder value. Value creation along with reduced environmental impact added can be regarded as sustainable growth from a company perspective. A closer look at the factors which increase or decrease shareholder value and discounted free cash flows, shows that the management decisions and value drivers shown in table 5 are linked with value creation [RAPPAPORT 1986, COPELAND 1990].

Management Decisions	**Operating**	**Investment**	**Financing**
Value Driver	Sales Growth Rate	Investment in Working Capital	Cost of Capital (Debt and Equity)
	Profit Margin	Investment in	
	Tax Rate	Fixed Capital	
Value Creation	Free Cash Flow (FCF)		Discount Rate
(Corporate Value)	Σ Discounted Free Cash Flow (DFCF)		
Shareholder Value (SHV)	Corporate Value - Debt		

Table 5: Management Decisions and Corporate Value

The analyis of the costs and benefits of implementing programs is based on quantitative estimates of the effect of these value drivers. Table 6 provides some examples of potentially impacts of environmental programs on shareholder value.

Finally, education of employees, management and customers plays an essential role in a successful implementation of an eco-efficiency strategy and its programs.

Module 5 — Communication

Internal and external communication are an integrated part of eco-controlling. Internally, communication addresses issues such as the role of the environmental strategy for the success of the company, or progress towards the targets documented. Each manager should understand their responsibilities and envoronmental issues applicable to his/her reole and how the company is dealing with them. He or she should also have a clear picture of how to use the information eco-controlling can provide for improving the company's competitiveness.

The increasing importance of external communication of environmental issues can be seen by the rapidly growing number of so called „environmental reports". These reports document the environmental activities and performance of a company. Although many of these reports still look very much like mere public relations brochures, there are some that reflect a clear environmental strategy and report in some detail the targets of the company, the progress towards these targets and the environmental management tools used. While no clear standards have been established, interest in these reports from various groups of stakeholders is growing.

Effects of Environmental Measures (examples)	Affected Value Driver		SHV
reduced waste disposal costs	profit margin	▲	▲
product innovation & environmental label	sales growth rate	▲	▲
pollution prevention	fixed capital investment	▼	▲
less material & energy	working capital investment	▼	▲
risk prevention	cost of capital	▼	▲

Table 6: Management Decisions and Shareholder Value (SHV).

The content of a report should reflect the specific situation of the firm as well as the information needs of the stakeholders addressed. A balance between local, site-oriented reporting and consolidated figures for the whole company has to be established. Site-specific data will be of importance for neighbours of production facilities, local authorities, and the employees working in a specific

site. consolidated, company wide data is more relevant for shareholders, customers and top management trying to position the company. A comprehensive guideline is given by the EMAS standards.

Conclusion and Outlook

Eco-controlling puts the focus of environmental management on the particular processes of a given company. It does not attempt to include environmental impact over the life cycle of a company's products. This management tool is adjustable to the specific situation of production sites and firms. A chemical company, for example, handling thousands of toxic substances, will definitely need a more sophisticated concept of eco-controlling than a manufacturer of furniture or a service company.

More and more companies are broadening their focus and stating eco-efficiency as an important corporate target. It is widely agreed that eco-efficiency has an economic and an environmental dimension.

It has been shown that via eco-controlling eco-efficiency, the environmental performance as well as the environmentally induced financial impacts of the company and its production sites can be managed and improved substantially [see Schaltegger & Sturm 1995].

Today, the tools for implementing eco-efficiency are becoming increasingly important for the success of a company. Eco-controlling is rapidly growing into a core management tool, passing through stages of development similar to financial controlling.

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- He has been a partner of Ellipson AG since 1992.
- Masters Degree (lic.oec.HSG) in Business Administration at the University of St. Gallen, Switzerland in 1987.
- Doctorate at the „Management Institute" at the Basle University, Switzerland. The doctorate was a combined task with Dr. St. Schaltegger under supervision of Prof. W. Hill and Prof. R.L. Frey. Issue of the thesis: "Environmental decisions in companies: Environmental management accounting versus life-cycle-analysis. Necessity, criteria, concepts."
- He is specialised in eco-controlling, environmental management system design and implementation and value based management.
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- He previously worked as a financial analyst and head of corporate finance department at a Swiss Private Bank (1980 – 1989). He was member of the strategic planning team. 1986 two months Bear Stearns, Corporate Finance, New York
- Co-Chairman of the Commission on Financial Accounting of EFFAS (European Federation of Financial Analysts' Societies).
- Member of the board of the Swiss Association of Financial Analysis and Investment Management.
- Member of the Accounting Standard Setting Committee of Switzerland (SWISS - GAAP/FER).
- He was chairman of the "Swiss Shareholder Information Committee" (1987 - 1994).
- Board member, Held AG, Steffisburg, Switzerland. Held is a producer of environmentally friendly washing and cleaning agents.
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Remarks

[1] For an overview of the basic concepts of controlling, see, for example, Horvath (1994); Horvath et al. (1991); Kraus (1990); Horvath & Reichmann (1993); Serfling (1992).

[2]
- Environmental Impact Added (EIA): The total of all environmental interventions of a product or production system evaluated (weighted) according to the harmfullness of each intervention to the environment.
- Environmental Intervention: Exchange between the antroposphere (the economy) and the environment.
- Product and Production System: The set of processes and flows of goods and services which contribute to the life-cycle of a functional unit (product or production process).

For a more detailed definition of environmental management terms and concepts see Schaltegger & Kubat (1995). This German handbook also contains an English section.

[3] For other approaches to eco-controlling, see for example, Seidel (1988), Schulz (1991), Hallay & Pfriem (1992).

[4] The concept was developed at Ellipson Ltd (Basel, Switzerland) in close co-operation with the University of Basel. For a more detailed description and applications of this concept see: Schaltegger & Sturm (1995), Schaltegger & Sturm (1996a), Schaltegger & Sturm (1996b), Sturm (1997a), Sturm (1997b).