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Book 3
ENVIRONMENTAL MANAGEMENT & AUDIT 3
EU - Tempus Project RECOAUD

CONTROLLING AND STAKEHOLDERS

Borut Jereb & Darja Kukovič (eds.)



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Daria Meyr, Edeltraud Günther, Vladimir Permyakov, Vitaly Parfenov, Sergei Alexandrov, Yuri Sivkov, Arthur Nikiforov, Natalia Mikhalenok, Pavel Pervov, Elena Gerasimova, Iurii Kholopov, Elena Lukenyuk

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Retraining Courses for the Sensibilization for and Integration of Eco-Audit Programs in Corporate Decision-Making

Экологический менеджмент в российских компаниях
курсы повышения квалификации для адаптации и интеграции программ экоаудита в процесс принятия корпоративных решений

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CONTROLLING

Thinking in options – finding and evaluating alternatives

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After this general observation of decision processes we want to have a look at two decision making situations, that necessitate these processes, more detailed: Investment decisions are on the agenda for small and medium-sized companies, while acquisition decisions are more relevant in larger companies.

1 Internalized vs. external effects – economical-ecological net effect

Demarcation
As demarcation criteria for internalized and external effects serve the causation of the effect and the responsibility for the effect. In both cases, the company causes the environmental pollution, but in case of external effects, the company is not responsible for his actions (Table 1). For a better understanding, instead of "effects", it can also be spoken of "costs" and "revenues".

Table 1: Causation versus Responsibility

Decision usefulness / demarcation criteria	internalized effects	external effects
causation by company	given	given
responsibility by company	given	not given

Source: Günther, 1998.

Internalized effects
The requirements of stakeholders on the company are internalized for all environmental goods that are purchased on the market (basic effects). In addition, all effects based on a recognition requirement are internalized, as it is for example given due public requirements. Although effects are already internalized, they are often included in other cost positions and thus not recognizable as such. In order to make statements about the ecological effects of a decision, environmental protection measures therefore have to be shown separately or isolated.

External effects
External effects arising from the use of resources and represent influences relating to the direct benefits of others, are not covered by the price mechanism and on which the economic entity, which is affected by the external effect, cannot intervene. External effects can be based on production or consumption activities and can influence the production or utility function of other economic entities; thereby the overall economic efficiency is damaged.
External effects occur whenever goods are scarce and a resource is not used according to its economic value. In practice, it can already be spoken partly of a value reversal, since properties

taking into account formed provisions for inherited liabilities or commodities taking into account disposal costs can have negative values.
The reasons for the non-value congruent use may lie in the lack of measurability or the lack of attribution of responsibility. External effects can thereby occur in positive or negative form whereas the requirements of the stakeholder groups refer exclusively to negative effects, which lead to the material or intangible impairments (external costs). Characteristic features are the non-fulfilment of the polluter pays principle, the passing on to uninvolved third parties and the non-coverage by the market mechanism.

Internalization
A voluntary internalization of external effects in the form of imputed effects may include new information or identify scope for decision-making, i.e. "it will make visible that which is currently invisible" (Gray, 1992). According to the traditional allocation of imputed costs into outlay costs and additional costs, it can be made a distinction between outlay effects and additional effects. Outlay effects are considered when internalization has already been performed, but does not yet include external effects completely. Additional effects are to be taken into account, if consequences have not been considered yet. With an internalization, it is to ensure that the external effects are compensated. Ideally, they should be completely avoided.

Optimal degree of internalization
An economic solution for the treatment of external effects can - in the extremes - on the one hand be reduced on the mandatory (only already internalized effects) or on the other hand try to include all the resulting effects. Since the absolute lower limit, on the basis of statutory regulations (e.g. waste water discharge), is adhered to by all companies and an internalization of all external effects in the short term leads to the cease of any production, i.e. would lead to collective suicide of mankind (non-production), it is to ask for an optimal solution. An imputed consideration of external effects allows a rapid estimation of consequences of future environmental conditions (e.g. new environmental regulations). Thus, all effects caused by the company could already be considered in the decision-making process today and long-term, only products are manufactured, for which all effects can be internalized. If external effects originating from the company are included in the decision, depends on the chosen ecology orientation of the company and the estimation of probabilities for a compulsory internalization.

Detection difficulties
When considering the caused effects, detection difficulties occur:
<u>Diffusion effects:</u> Because of their complexity, scientific contexts are partially not sufficient to analyse the causal relationship between source of damage and damage (e.g. impact of new pharmaceuticals).
<u>Synergy effects:</u> If a company emits several pollutants, they can lead jointly to other or higher damages than the sum of the damages caused individually (e.g. reaction of various pesticides in agriculture).
<u>Cumulative effects:</u> The loads of a certain type of load caused by a company can considered isolated have only minor consequences, but cumulating the load of the same type of load of several companies, the damage can increase exponentially (e.g. water withdrawal).
<u>Long-term effects:</u> The interaction between source of damage and damage often occurs only after several years, so that the polluter is no longer clearly identifiable and the effects can assign to several periods (e.g. climate change).
<u>Distance effects:</u> In particular, in energetic emissions, between the source of damage and the triggered load can be large distances (e.g. acid rain).
<u>Compensation effects:</u> Finally, there is the possibility that two effects cancel out each other (e.g. CO_2 sources and CO_2 sinks).

Derive from the complexity of the effects and the described problem areas, the conclusion that integration of ecological aspects into business information and decision tools could not be achieved, would be shortened. Goal of ecology-oriented corporate management must rather be to detect where and in what form internal and external loads are caused by the company to clarify the question of responsibility in a second step, or in the case of non-existing loads, just to show that no loads were caused (cradle-to-cradle thinking).

Principles for the detection of ecology-caused consequences (PDCO)

After selecting the system boundary, i.e. the space to be included in the analysis, the ecology-caused consequences are to be considered. To ensure a targeted detection, the following principles for determining the consequences, the so-called PDCO are to be considered. These are based both on the principles of proper accounting and the, in force until 2008, DIN 33922 "Guide - environmental reports for the public".

Principle of completeness: To determine the ecological situation of a company, all monetary and non-monetary consequences of both internal and external manner are to be included in the considerations.

Principle of arbitrariness: The estimated consequences must be identifiable by other people. This means that the focus is on primary effects, which are directly and uniquely assignable to the company.

Principle of clarity: Similar situations are to be summarized in order to ensure the clarity of the procedure or facts shall be separated from others, if mixing of effects affect the clarity of information.

Principle of Consistency: To enable information acquisition as comprehensive as possible and a similar assessment of information, a multi-period comparability is desirable.

Principle of factual demarcation: In the isolation of internalized costs delamination problems always occur when measures, facilities or systems serve both environmental protection and the provision of services in a strict sense. As demarcation criteria main purpose principle and the principle of reason come into question.

Main purpose principle: After the main purpose principle, costs are allocated entirely to the main purpose of the operation, facility or system. A problem can possibly be the distinction in primary and secondary purpose.

Principle of reason: The principle of reason leads to an assignment of the costs for the purpose, which has led to the realisation of the action. An assignment to the triggering action is often not possible because environmental protection measures often imply follow-up investments and/or running costs.

Principle of temporal demarcation: In addition to the factual problems of demarcation, it can also lead to temporal attribution problems. Thus, it is to determine how long reduced output for ecological reasons or at a decommissioning the associated revenue losses and idle time costs are accounted as ecological costs or at what time external costs should be recognized for the first time.

Principle of materiality or profitability: Especially in the field of ecology-related information, a complete data collection is not feasible. Once more, as with all business decisions, the principle of materiality or profitability applies.

Ecology orientation of costs and revenues

The following systematization shows, for the example of the company MOBILITY UNLIMITED, which ecology-related consequences, broken down by cost and revenue types, can affect monetary values on each value-added chain. If the costs and revenues can clearly assign to a value-added stage, this has been done. An attempt was made, to select the cost notations, that they can be used for all industries, services and trade. The assignment is made in accordance with the scheme of the total cost method of HGB (Table 2). In addition, more subdivisions are possible, according to the environmental sectors soil, water and air, according to the measures avoiding,

reducing, substituting, recycling and disposal, the stakeholders or the value-added chain. In this example, only one assignment to the value-added stages is made.

Table 2: Selected examples of costs and revenues

Cost/revenue type	Change	Ecology-caused consequences	Value-added stage
Revenues	+	New, environmentally friendly products	Research and Development
	-	Increased downtime due to incidents	Production
Increase/decrease in finished and unfinished products	+	Increase in inventory of motor oil	Procurement
	-	Reduction of vehicles in inventory	Distribution
Company-produced additions to plant and equipment	+	Hybrid vehicle for the company-owned fleet	Procurement
Other operating income	+	Financial aids and subsidies for research and development	Research and Development
	+	Sale of old plants	Recycling
Material expense	+/-	Substitution of environmentally hazardous substances	Procurement
	-	Reduction of packaging	Distribution
Personnel expenses	+	Waste management officer	Disposal
	-	Low absence times	Human Resources
Depreciation	+	Extraordinary depreciation on ecologically critical plants	Procurement
	+	Acquisition of control and measuring devices	Production
Other operating expenses	+	Use of foreign patents through licenses	Research and Development
	+	Advertising for environmentally friendly products	Distribution
Dividends from associated companies	+	Distribution of earnings from investments in environmental research institutes	Management Accounting
Income from other securities	+	Investing in green funds	Management Accounting
Other interest and similar income	+	Interest income from bank deposits	Management Accounting

Depreciation on financial assets	+	Impairment of an investment by losses due to the environmental damage	Management Accounting
Interest and similar expenses	+	Credit for purchase of environmentally friendly production plant	Production
Result of ordinary business activity	=		
Extraordinary income	+	Sale of secondary raw materials	Recycling
	+	Sale of old plants	Production
Extraordinary expenses	+	Punishment for administrative offenses	Disposal
	+	Preparation of environmental reports	Production
Extraordinary result	=		
Taxes on income	+	Corporate income tax	Entire company
Other taxes	+	Motor vehicle tax	Logistics
Net income/net loss for the year	=		

Monetary assessment in general

Now this individual cost types and revenues must be evaluated. Goal of an assessment is to assign values to certain alternatives, goods or services . In the operational management control process, especially decisions about companies, processes, products and services require a sound assessment basis. This assessment is necessary to achieve the best possible benefit (benefit or target perspective) of by scarcity characterized resources in the form of goods and services (resources perspective). Since the scarcity cannot be affected by economists (here eco-effective solutions of scientists and technicians are asked), it must be their task to guarantee the best possible benefit in the form of a minimax or maximum solution. However, an assessment must fulfil the following requirements:

- *goal-oriented objectivity* of the assessment, which allows an intersubjective verifiability using a disclosed target system,
- *validity* of the assessment, which seeks to ensure that the results of the assessment process meet the desired requirements,
- *Reliability* of the assessment, which is guaranteed, if a repeatedly used method leads to the same result,
- *Practicability* of the assessment, i.e. the value determination must be carried out without unreasonable effort.

Monetary assessment of internalized effects

Within the traditional accounting system already internalized effects are captured as so-called action costs for avoidance, reduction, substitution, recycling and disposal or revenues and assessed with market prices (market price approach). These include, for example, personnel costs for the company officer or costs for an in-house wastewater treatment plant. Even though

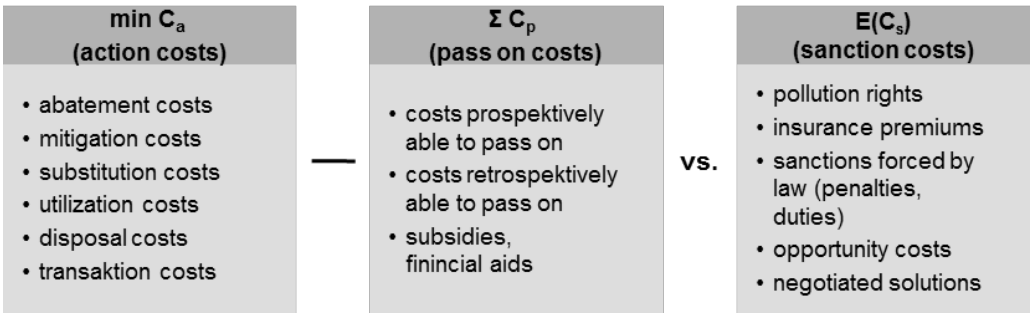
for cost finding it can revert to customary methods, some special features with regard to the structuring of ecological costs and revenues are to be considered when performing assessments. Thereby ecological costs mean „all costs or revenues arising from the environmental impact of the company in the form of fully quantifiable material and energy flows between system and environment“(Günther, 2000). Even though for cost finding it can revert to customary methods, some special features with regard to the structuring of ecological costs and revenues are to be considered when performing assessments (FLEISCHMANN/PAUDTKE 1977, p. 20 f.; RENTZ 1979, p. 113 f.; STÖLZLE 1990, p. 403):

End-of-pipe environmental protection measures are often very *capital intensive*. The sum of ecological costs varies less than proportionally with employment fluctuations, since they often represent *fixed costs*. Ecological costs can usually not be assigned directly to cost units, but only via cost allocations. They are therefore mainly representing *overhead costs*. Environmental protection measures are usually *irreversible*.
Since environmental protection measures and production processes are coupled, the elasticity of costs increases in relation to higher ecological standards. Environmental protection measures are based on direct and/or indirect effects. Direct effects refer to the costs that are directly assignable to the measures. In contrast if prices for bought-in parts or raw materials increase, indirect effects are existent. If ecological costs are not clearly determined, the additional costs or savings caused by the measure can be measured using a *differential or marginal consideration*. Using *value-based allocation formula*, products are considered. In form of an incremental approach changes in the characteristics of the products caused by environmental protection measures are also recorded and evaluated. The differential amounts are determined as ecological costs.

Monetary assessment of external effects

If internalized effects already exist, the demonstration of the consequences informs on their impact on decisions (information function). If the consideration of external effects is questioned, a predicate them on the result of a trade-off process (decision function). The willingness to pay and revenue shortfalls are compared with the costs applied for the internalisation. The aim of the assessment of external effects is to show the consequences of alternative resource allocations. The costs at the microeconomic level can thus be derived from the alternative courses of action which may be taken by the company on its own to make damages do not arise (cf. Endres, 1983)) and the methods of the convention of the UMWELTBUNDESAMT for the assessment of external effects, cf. (CF. UMWELTBUNDESAMT, 2007A).
This so-called action costs are possibilities of passing on and comparison of expected sanction costs, resulting in the economic-ecological net effect of a measure. For examples of the individual cost, see Figure 1.

Figure 1: : Economic-ecological net effect



Source: based on Günther, 1994

Action costs

For the evaluation on the on hand values are to be considered that are based on consequences within the scope of a company (action costs c_a). These can be divided into measures of avoidance, mitigation, substitution, recycling and disposal:

Avoidance costs: From the perspective of the environment, the preference lies in the avoidance of interferences, i.e. in the implementation of the precautionary principle. Avoidance costs can thus be defined as costs that are to internalize in order not to let influences occur. They can also be referred to as cost of preventive measures. In the most severe case, this would lead to a termination of any economic activity (non-production), which excretes due to the supply function of the economy and would lead to the already mentioned collective suicide of mankind. By avoiding burdens also cost savings potentials (e.g. for waste charges) can be detected, so that finally only costs for the collection of the necessary information arise.

Mitigation costs: Due to the already mentioned supply function of the economy, the possibility of complete avoidance often excretes. Therefore, a mitigation as second-best solution, which is expressed in critical values that have found their way into the legislation, is to access. If the loads caused by the company are over legal or in-house agreed limits, in-house costs arise to achieve a reduction of loads, e.g. by throttling the production. The approach of mitigation costs as imputed additional costs is suitable for determining the impact of future legal framework conditions on the corporate success.

Substitution costs: If the use of a factor of production should be restricted for environmental reasons (substitution pressure), any technical substitution alternatives are to be determined. For example, the column model according to TRGS 440 of the BUNDESGENOSSENSCHAFTLICHES INSTITUT FÜR ARBEITSSCHUTZ provides a good support for the substitution test in accordance with the Hazardous Substances Ordinance. The costs of these alternatives may be referred to as substitution costs. To determine the amount of them, the ecological and hereinafter the economic consequences are to be taken fully into account. Most the objectives of avoidance or mitigation will only be achieved if adequate alternatives are available, i.e. the substitution costs are closely linked to the avoidance and mitigation costs.

Recycling costs: Since the objective of action measures is not to let external effects arise and on the other hand avoidance, mitigation and substitution options are often missing, with the help of recycling measures an internalization of external effects can be made. For this, the companies can choose from mechanical, biological, chemical and thermal methods, which can be used with the aim of reproduction and reuse or recycling. In a decision for recycling measures, the ecological value has to be considered due to the second law of thermodynamics (net effect of recycling). The resulting additional effects that may occur as follow-up costs, are therefore to be considered for determining the costs of recycling.

Disposal costs: If damages cannot be reduced by avoidance, mitigation, substitution or recycling at the end of the production or consumption process costs of disposal occur. For this purpose, environmental aspects emanating from the company shall be collected in a first step. In a second step, removing them with the aim of restoring the original state of the environment is to assess in monetary terms. The limits are seen in the cases, which are irreparable or not monetarily assessable. Here non-monetary assessment methods are to use flanking.

Costs for information or decision-making processes: Costs for information and decision-making processes are often neglected in the evaluation of external effects. To meet the criterion of materiality or profitability, also the transaction costs are to be included. These include the costs

of information procurement about the initial state, the estimation of the effects and the development of measures to achieve the environmental objectives (e.g. green procurement) and critical values. Of particular importance are the transaction costs from the point of view that external effects are difficult to measure and assess.

Other cost categories

The total economic costs are often not detected by the five identified categories of costs (excl. costs for information and decision processes); especially in part damages are not degradable. Although values on the economic level can be assigned to them, so-called costs of damage, e.g. in terms of health costs, but they only meet the criterion of internalization. Therefore, there is a judgment of the EUROPEAN COURT OF JUSTICE (ECJ) that external costs should be taken into account in the form of health costs in the procurement of buses for public transport (Erdmenger & Winter, 2005). In addition, costs may arise because economic agents avoid loads, so-called avoidance costs, e.g. by moving away from areas affected by noise. In terms of practicality, here are the limits of measurability of external effects. The weaknesses of the concept should not lead to forego entirely an assessment, especially since each step that promises to promote the protection of the ecological environment, is better than a categorical rejection of concepts, which shows the limits of applicability.

Pass on costs

After that it is to examine to which extent third parties can contribute the action costs, i.e. the costs of an active ecology orientation. The passing on of costs k_p can be examined using the illustrated stakeholder concept. The stakeholder group of the customer to verify on their willingness to pay. The suppliers are to ask for their willingness to act. Considering that subsidies and financial aids will be awarded purpose based, one can speak of a passing on of costs to the state. Consequently, three ways of passing on can be distinguished ($c_p = \sum c_p$.), the prospective costs able to passed on (to customers) k_{pp}, the retrospective costs able to passed on c_{pr} (to suppliers) as well as subsidies and financial aids (by public authorities) c_{ps}. Because of the inevitable profit making, companies will determine all the possibilities of passing on to third parties. If they decide on an active ecology management, this can also be related to the reason that there are earning opportunities because of the passing on.

Prospective passing on: Measures of avoidance, mitigation, substitution, recycling and disposal are options of an active ecology management. To ensure the continued competitiveness, companies will try to pass on internalized additional costs to customers. To which extent people are willing to participate in it, can be determined using the willingness to pay concept. This concept, mainly discussed in the economic and marketing-oriented literature, addresses the question how high the consumer willingness to pay is for the use of a public good. A transfer into a managerial ideology aims to determine the consumer preference, i.e. the value that customers attach to protecting the ecological environment and they are willing to bear (willingness-to-pay). In addition, it can also be asked for the compensation requirement, which the concerned person require for a non-improvement or a deterioration of environmental quality (willingness-to-sell). The willingness to pay can be determined either directly by survey or in an indirect way via the reaction. The determination of the passing on using this concept suffers from several inadequacies: Studies on the dissemination of information that there is a time lag of several years with 15 intermediate steps between the first discussion of a topic among experts and the existence of a general problem consciousness (diffusion curve) (cf. Steger, 1993). The personal involvement also influences attitudes toward the protection of the ecological environment (NIMBY effect - one is not affected if the problems are not in the own back yard). If there are information distortions and adjusted level of information can be

determined, the determined willingness to pay is to be adjusted accordingly (information problem). If information about the value of conserving the ecological environment are present, these are to be measured (measurement problems). In this context, the person concerned are faced with the question of measuring the benefits of improving the ecological situation in monetary units (abstraction problem). If consumers are informed about existing environmental instruments, their willingness to pay may decrease, because they know that the costs must be internalized and there is no need to create an incentive for the company about their willingness to pay a higher price (free-rider problem). With regard to the representativeness of the survey it is to ensure that sufficient target people who are actually interested in the question (motivation problem), from all walks of life (representativeness problem) take part in the survey. A restriction may occur when the willingness to pay depends not only on the personal appreciation, but also on the income (allocation problem). Entirely neglected is often the eventual appreciation of future generations (generation problem), which would be involved in terms of sustainable development. Their lack of ability to articulate needs to be solved through the political allocation mechanism, which however is faced by the short-term planning horizon of the parties.

Retrospective passing on: Measures of an active protection (avoidance, mitigation, substituting) start at the beginning and not via "end-of-the-pipe" solutions at the end of the production process. With sufficient market power for suppliers, incentives (e.g. increased sales volumes, higher prices) will be created to make the inputs more environmentally friendly. Thus, the costs can pass on upstream value-added steps (retrospectively). Suppliers who fail to adapt to changing patterns of demand from their customers, are at the risk of being punished by the market. Suppliers can also be forced by legislation to take over costs, as for example in the case of the end-of-life vehicles ordinance. Retrospective passing on can lead to costs for ecology-oriented measures do not arise in abating companies. That this approach has already been incorporated into classical business management calculus shows the jointly developed approach of direct product profitability by retail and consumer goods industry (see additionally Günther, 1994) for further reading). The concept is intended to achieve environmental effects, and thus cost saving potential in trade by appropriate product design at the upstream consumer goods industry, e.g. in the form of concentrates or types of packaging. Behind the concept is the goal to optimize costs and revenues across multiple value-added steps (total system efficiency). In addition, the realization of identified potentials opens the possibility to realize ecological benefits in the form of lower transport activity, less area and space requirements and reduced packaging volumes.

Subsidies and financial aids: Financial aids and tax concessions are granted by the State to enforce environmental objectives. The passing on is foreseen ex ante (before the corporate decision), to provide an incentive for the company. In addition to this planned passing on measures can be promoted, that were performed independently of concessions (passing on ex post). In various legal provisions, the legislature has established measures to promote active ecology orientation of the company. Government support measures are known ex ante (e.g. in the renewable energy law) and thus represent a predictable part of the passing on.

Penalty costs

The remaining net action costs after the deduction of costs be passed on are now face the costs, which occur if the identified measures are not taken. Valuations, which do not occur in the immediate control of the company, but represent consequences of passive ecology management are called penalty costs k_{Pe}. They occur as opportunity costs k_{SO}, i.e. lost profits due to anti-environmental behaviour, law-related sanctions k_{SL}, insurance k_{SI}, pollution rights $k_{SR,}$

that allow an anti-environmentally behaviour within specified critical values, and negotiating solutions k_{SL}, which suggest an allocation between the involved economic agents.

Opportunity costs: A decision by companies against offensive, active environmental protection measures can cause quantity or in terms of value demand reactions. The consumer boycott represents the extreme case of a quantitative demand response (e.g. Shell because of the planned sinking of the Brent Spar oil platform), which is restricted to a product or can cover the entire product range of a company. The evaluation shall assess such demand behaviour ex post with the revenue losses suffered between the event inducing consumption change and the time of observation. Ex ante, only estimations for demand response or case- best/worst-case analyses can be made. In addition, ecology-related opportunity costs through quality and thus measure value losses can be measured: The contamination of soil surfaces for example, leads to a decline of land prices, which can be negative in the extreme. In addition, quality losses lower the market price.

Law-related sanctions: If environmental protection measures in the form of requirements have entered the legislation, they are legally binding and set action limits for economic decisions. A decision option is therefore not given. But if companies act with the goal of profit maximization, without feeling bound to the legislation for ethical reasons, They can choose between taking one environmental measure (action) including a possible passing on and the risk of a penalty (cf. Terhart, 1986). These penalties may occur in the form of fines, but also as a subsequent order or revocation of a license. Criminal law punishes offenses against the ecological environment with imprisonment or fines. In contrast to penalties for environmental offenses already committed, the state demands a decision for companies through market incentives in the form of duties. If this alternative is in favour of the „avoidance and passing on “, duties fulfil the mentioned steering function.
Insurance premiums: Due to the tightening of government regulations and the strengthening of controls, but also due to the increasing sensitivity of other stakeholders and not least because of natural phenomenons, the requirements on the company increase. Due to the environmental liability and the environmental damage law companies are obliged to vouch for the environmental damage they caused. The amount insurance premiums to be paid depends on the height of the potential damage. In the context of liability insurance, so-called standard insurance amounts are used. In general, the parameters insurance premium, scope of coverage, probability of occurrence and extent of damage flow into the calculation of insurance premiums. Therefore, the unspent action costs can be covered.

Pollution rights: Pollution rights are not directly attributable to the concept of sanctions, but are to be taken into account to the above decision rule. They allow a legal, pecuniary use of resources. If the acquisition of pollution rights is less expensive than the cost of measures of protection of the ecological environment, a company will decide to purchase the rights. On the other hand, because of the tradability the instrument also provides an incentive to avoid. The problem with this approach is that emissions are legalized because certain emission limit values are assumed. Furthermore, the Pareto-optimal determination of the amount of emissions requires knowledge of marginal utility and marginal cost curves whose determination is difficult in practice. However, purchases and sales of pollution rights could be seen as negative or positive sanction costs in terms of the economic-ecological net effect.

Negotiated settlements: Finally, a more theoretical proposal should be presented. The idea to achieve a solution through negotiations, goes back to the Nobel laureate COASE (cf. COASE, 1960). He considers the case that the actions and decisions of a company have negative impacts on other economic agents. Therefore, the marginal costs or revenues of the parties involved are compared. To what amount a compensation is agreed now depends on the outcome of the

negotiations. This approach is based on the assumption of a perfect market. Task of economics in such cases is not to discuss and change the scope of action and decision-making, but starting from a given or even possible situation to show the consequences that lead to a Pareto-optimal situation. If transaction costs are included in the analysis, these are taken into account for the information, the contacting, the negotiations, the contract and the control. If the state as an institution is proposed for decision-making, it must be remembered that there occur costs as well that must be internalized. The negotiated solution then provides an alternative if the own action costs can thereby be reduced, that the person concerned gets a reasonable compensation. However, the practical relevance of this possibility is likely to fail because usually more than two groups are involved and an identification of the perpetrator due to the aforementioned diffusion and accumulation problem is hardly possible. In addition, the bargaining power of the parties plays a significant role in finding a negotiated solution.

Strategy choice according to the economic-ecological net effect

The assessment of action options and passing on as well as sanction risks is the basis for business decision (economic-ecological net effect). The choice of an appropriate strategy is based on the comparison of net costs, which are not be passed on, and the penalty costs. If there are several options for actions, passing on and sanctions, these are to be integrated in the decision calculus:

- From an economic point of view, the minimum, the alternative with the lowest cost is to choose.
- The amount of the costs passed on is determined by the sum of the available options for passing on.

If the level of sanctions is unknown ex ante, this shall be stated at the expected value. Under certain circumstances, the risk preference of the decision is to be considered.
If the sanction costs excess the action costs, which are not able to pass on, an active ecology orientation is advantageous for the company. Otherwise, companies will prefer a passive ecology orientation, unless other strategic reasons are an argument against. If there are interdependencies between strategies, these should be taken into account in determining the cost components.

$$\min (c_a) - \Sigma (c_p) < E(c_s) \quad \text{active strategy}$$
$$\min (c_a) - \Sigma (c_p) > E(c_s) \quad \text{passive strategy or accepting the costs of strategic considerations}$$

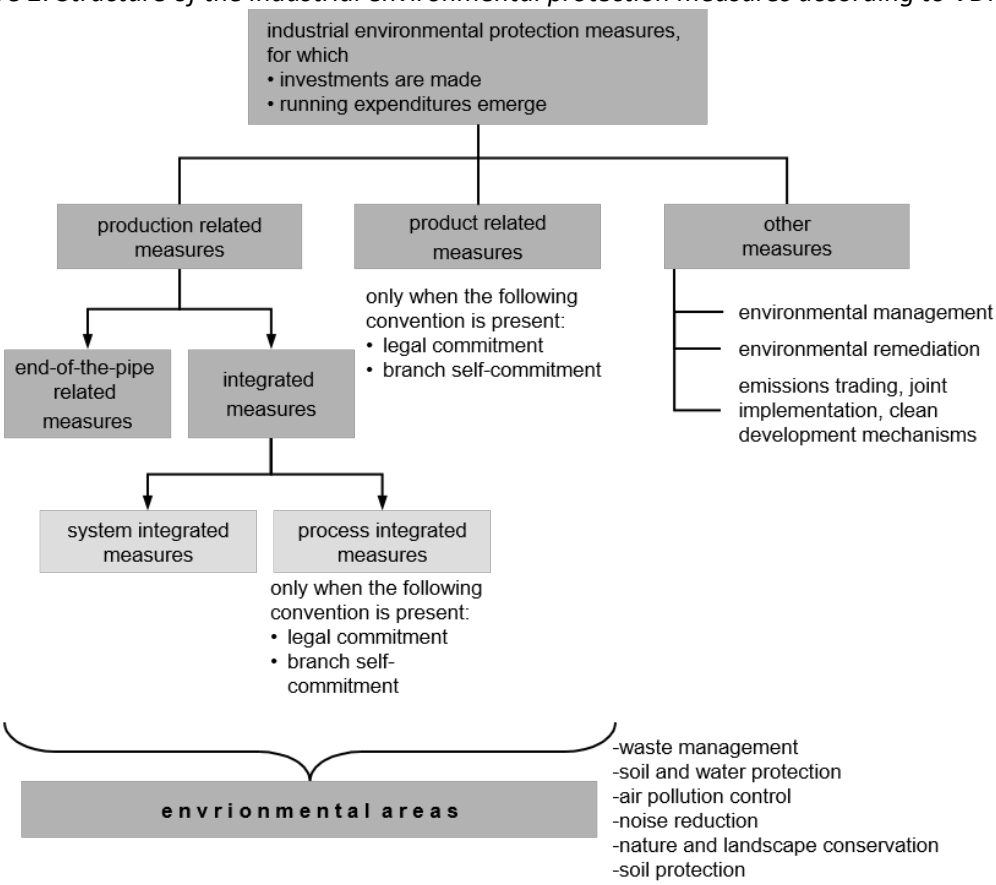
2 Investment decisions

Investments for environmental protection

In order to differentiate environmental relevant investions, we will, first of all, look at policies, that can be found as EC-regulations for business statistics, Environental Statistics Act and VDI 3800.
The regulation (EC) no. 295/2008 of the European Parliament and the European Council from March 11, 2008 on the structural business statistics (new version) (ABl. EU no. L 97 p. 13) distinguishes between "investment in equipment and plant for pollution control, and special anti-pollution accessories (mainly „end-of-the-pipe-equipment")"(code 21110), "investment in equipment and plant linked to cleaner technology ("integrated technology")" (code 21120) and „total current expenditure on environmental protection" (code 21140).
Elicitations on the environmental expenditures as federal statistics are being done according to § 11 Environmental statistics act. Every year, the investments and the value of additionally hired or leased tangible assets, that solely or mainly serve the protection of the environment, by no more than 10.000 companies and firms are being ascertained. Every three years, the respective running expenditures are being ascertained. Since 2006, these elicitations are subdivided into the areas of waste management, water protection, noise reduction, air pollution control, environmental protection, nature conservation, landscape conservation as well as soil remediation.

The VDI Guideline 3800 on the „determination of costs for industrial environmental protection measures" from the year 2001 defines these expenditures for those measures of the company or third parties by order of the company, that intend to avoid, reduce or eradicade, respectively observe and document environmental burdens or environmental damage caused or anticipated by business activities. "External costs" that appear due to business activities of the regarded company are therefore not included. Measures on the grounds of legal regulations as well as voluntary measures or measures based on the self-commitment of individual branches belong to the environmental protection measures referring to this guideline. The guideline recommends a division into production-related, product-related and other measures, in end-of-the-pipe and system integrated, respectively process integrated measures and a division considering the areas waste management, water protection, noise reduction, air pollution control, nature conservation and landscape conservation (see Figure 2).

Figure 2: Structure of the industrial environmental protection measures according to VDI 3800



Source: Verein Deutscher Ingenieure, 2000

Broad definition

Even though the definition has changed over the years, in this textbook a further delimination then in the standards is being proposed: environmental investments are defined as all ecologically relevant investments, since it is the purpose of the investment decision process, to provide information on the existing action alternatives. These serve as a basis for investment decisions of the ones responible. When wanting to consider ecological consequences for all investment decisions, a broad interpretation has to be made. Environment protection investments may be made due to official regulations or, on top of that, voluntarily. They may, on one hand, display pure environmental protection measures and, on the other hand, be expansion investments, replacement investments, or rationalisation investments at the same time.

Investment decision process

An investment decision process consists of the four phases investment incentive, investment search, investment evaluation and investment selection (see Figure 3).

Figure 3: investment decision process

investment incentive phase	investment search phase	investment evaluation phase	investment selection phase
• selection of the stakeholder's demands • analysis of the former investment structure	• display of business alternatives - avoid - reduce - substitude - recycling - disposal • display of possibilities of passing on to - customers - suppliers - the state • display possible consequences in the case of non-performance - opportunity costs - sanctions - insurance contributions - pollution rights - negotiated solutions	• singling out alternatives, that do not meet the minimum requirements • conducting an investment appraisal with monetary rateability - determination of the revenues and expenditures that are connected with the alternatives - determination of the interest rate and the planning horizon - conducting the investment calculation method • application of non monetary decision instruments	• comparing the results • decision, whether and in what extent external effects are voluntarily internalised • selection of the optimal investment

Source: Günther, 1994

Investment incentive phase

During the investment incentive phase, all of the company's problems, that can be solved with the help of an adjustment, a replacement or an expansion of the former investment structure, are being systematically gathered and analysed. In doing so, all the relevant burdens of the ecological environment are considered aswell. The company can derive the problem areas from the demands of the stakeholders (analysis of the objectifying concernment). The subjective concernment, which is decisive for the actions of a company, can strengthen or weaken these demands by its own perception , depending on whether or not the ecology orientation displays an objective for the company.

Investment search phase

It is the objective of the investment search phase, to find alternative possibilities for action in order to solve problems. For this, appropriate measures for the avoidance, reduction, substitution, recycling and disposal of environmental burdens must be determined. They can emerge from environmental burdens, which internalisation is compulsory, as well as voluntarily internalised external effects. With every action alternative, the possibilities for passing on the arising costs on third parties are being analysed. For a complete comparison of alternatives, one must also consider the action possibilities for refraining from ecologicallyoriented measures.

Investment evaluation phase

In the investment evaluation phase, the alternatives, that do not meet the internally or externally determined minimum requirements, must be sorted out, first (k.o. criteria). If a monetary evaluation is possible, the revenues and expenditures, that are linked to the alternatives, must be determined. These can be based on costs to be internalised as well as external effects, while it is important to point out that the difference to the decision maker. Furthermore, a risk adequate calculated interest rate and a planning horizon are determined. This data then go through a suitable investment calculation. For this, the popular instruments in financial mathematics net present value, internal rate of return, payoff time, baldwin interest method (see additionally Perridon & Steiner, 2007) need to be analysed regarding their suitability for ecologicallyoriented questionings. This examination happens according to the procedure with every investment decision, while company specific guidelines need to be considered individually.

Investment selection phase

The investment selection phase, eventually, includes the decision between the alternatives. Ecological aspects may, on one hand, be considered exclusively in the context of internalised effects, and, on the other hand, be considered due to external effects, while the latter can also be considered step by step. When the result of the evaluation does not offer a definite decision, non-monetary aspects need to be considered for the selection of the ideal alternative as well.

Alteration of parameters

Beside the general procedure of an investment decisions, the changes in costs and profits need to be regarded and their impacts on the results of an investment calculation need to be revealed. In the following, the parameters revenues, expenditures, planning horizon and discount rate are presented. The terms disbursement, expenditure, expense, costs, as well as payment, revenue, proceeds, benefit refer to business accounting (cf. Haberstock, 1998).

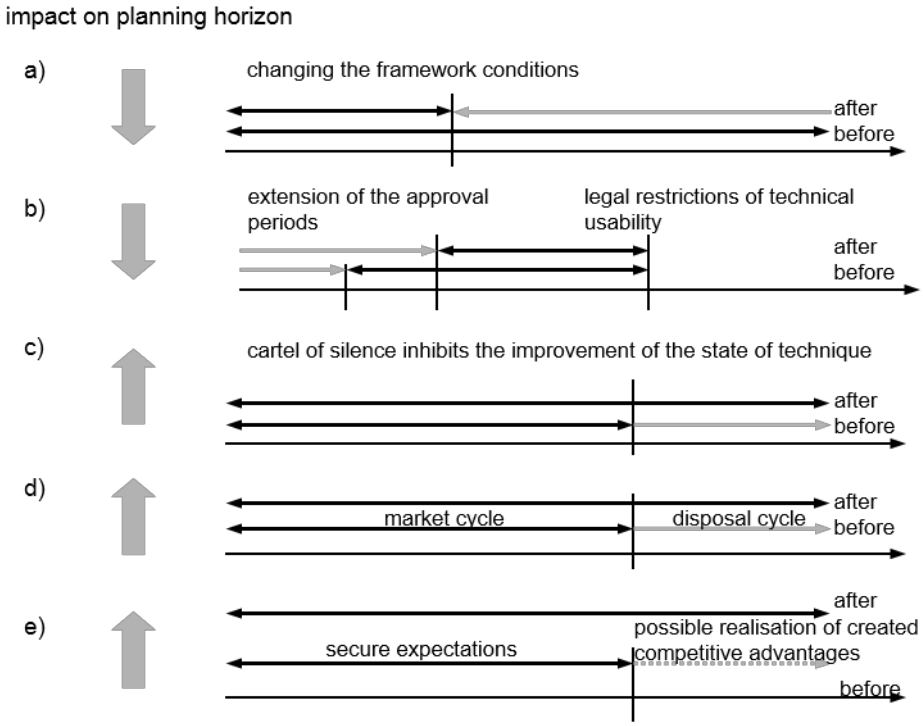
Revenues and expenditures

The already identified ecologically relevant entry parameters like revenues, expenditures, planning horizon and discount rate may directly enter the decision instruments of investment calculations. The evaluation of internalised effects is oriented towards existing market prices; the evaluation of the external effects can be carried out with the help of the evaluation methods mentioned above. The only peculiarity in investment accountings lies in the additional consideration of the timing of revenues and expenditures. The investment expenditures that are, as depreciations in cost accounting, allocated over the useful life, need to be considered as one-time-only expenditures. Furthermore, non-cash costs are not regarded. The second peculiarity lies in the consideration of internalised and external effects, that, however, need to be labeled seperatedy. Sunk costs, eventually, display expenditures, the cause for which lies in the past and that can therefore no longer be revised by the decision. For this reason, they can not be allocated to the evaluation of alternatives.

Planning horizon

Beside the determination of relevant calculation values, the relative permanency of investments is an important indicator for investment decisions. Here, a look at the aspects, that influence the planning horizon, that is to be chosen, is worth while. (see Figure 4):

Figure 4: impact on the planning horizon



Source: Günther, 1994

Altered framework conditions, for instance because of the claims of stakeholders, regarding the environment, require an early time for replacement. This leads to a shortage of the planning horizon. Thus, the legislator may make an earlier time for replacement necessary with stricter regulations. The consumers may also necessitate other production methods by changing their demand behaviour (e.g. fuel efficient compustion engines).

Long approval timescales shorten the planning horizon when there is a constant economic useful life. Since the technical parameters, that determine the state of technique, stay identical, the usage by an extended duration for authorisation may only occur later. Thus, the technolagy might already be technically outdated and economically suboptimal when being put into operation.
Companies can try to influence the planning horizon themselves. Since this planning horizon in principle needs to be adjusted to the economic useful life, they can, under certain conditions, keep the state of technique on a lower level than technically possible by *deliberately withholding innovation* (cartel of silence of the senior engineers). This way, adjustment requirements and therefore the time for replacement are delayed and the economic useful life accordingly extended.

By considering *disposal cycles*, the necessity to extend the planning horizon, because additional receipts of payments (e.g. by selling secondary raw materials) and especially disbursements (e.g. by disposal), that influence the advantageousness of the project, can arise.

By so called "*thinking in options*", a tendential long-term observation can be undertaken: This way, decisions can conciously be made in a way, that maneuvering rooms for decisions survive or expand. Especially in the context of the climate discussion, a flexible adjustment strategy and a systematic navigation are forward-looking. With shorter planning horizons, this thinking coud not be supported.

Discount rate

Time preferences of the decision makers enable the weighting of disbursements and receipts of payments, that occur at various times. The formation of these time preferences is seen as a typical task in investment theory. In investment accounting, the discount rate, that allows an eponymousness of disbursements and receipts of payments at different times, serves as a benchmark for. It reflects the time preference of an investment, meaning the remuneration for the investor for refraining from consumtion now and postponing it to another period. This means, that measures, that cause disbursements later on, are preferred due to discounting, since they are worth less.

When regarding ecological aspects, the following peculiarities for the selection of the discount rate arise:
When observing *reversible burdens* of the ecological environment, the elimination of which at this time or later on is subject to negotiation and brings the same result, a positive discount rate can be applied ($i > 0$).

In contrast, a discounting is not adequate, when the *damages are irreversible* and when there is an immediate need for action. A time preference for investors, that the discounting of future damages is based an, is not possible in this case ($i = 0$).

Possible *technical developments* can lead to an increase of the discount rate, because they contain the chance of a future expenditure cut by newer procedures. When these aspects are included in the weighting, the preference is shifted in favour of a later consideration ($i >> 0$).

In contrast, *expected intensifications of framework conditions* can even necessitate a compounding of interest, in order to assign the higher time preference to an immediate triggering off of an action. The discount rate is not to be interpreted as a monetary equivalent for the refraining from consumtion by the investor (premium to the investor). The investor rather pays a premium for refraining from consumption, in order to avoid later decreases of usevalue by immediate action ($i < 0$).

The *interests of future generations* are not sufficiently considered when discounting. Discounting also lowers the importance of the interests of the following generation. A suspension of the discounting or a compounding of interest would be the logical consequences of this postulation ($i = 0$ or $i < 0$).
For a summary of the explained impacts on the discount rate see Figure 5.

Figure 5: situative impact on the discount rate

case	reason	impact on discount rate
a)	reversible damages	$i > 0$
b)	irreversible ecological damages	$i = 0$
c)	technical progressions	$i >> 0$
d)	intensified framework conditions	$i \gtrless 0$
e)	interest of future generations	$i \overset{=}{<} 0$

Source: Günther, 1994

Financial Analysis

After the strategic analysis, in the ideal case, identified severel potential acquisition candidates, the financial evaluation oft these candidates follows. For this, the net asset value and earning capacity value can be determined. For the determination of the evaluation method, one can choose the perspective of the buyer or the perspective of the seller. The potential buyer has the alternatives of an identical-good reproduction (internal growth), acquisition of the company as well as investing on the capital market. The seller can lead the company on, seek to liquidise and sell the individual parts or sell the whole company and invest the proceeds on the capital market. For the identical-good reproduction, respectively the liquidation, the net asset value can be determined, while in the first case the term reproduction value and in the second, the term liquidation value is used. It consists of the sum of the values of the individual assets (single valuation method). The starting point for the net asset value determination is the company's balance of accounts, meaning the capital view and not the performance view or outlook for the future from a statistical point of view. For the recognition only capitalisable assets or, additionally, the immaterial values can be included. For the evaluation the replacement costs are being determined, while one can either start with the replacement costs for new assets or consider the age structure of the assets. The earning capacity value proceeds from the continuation, respectively the acquisition of the company. For the buyer's assessment of value the so called excess withdrawals are relevant. In the first stage, an objectifying company value is determined as a cash value of expected excess withdrawals on the basis of the accounting's data (revenuerelated figures from the integrated balance planning, performance planning and finance planning) (without synergies). This way, one gets the company value "as is". In the second stage, the subjective company value is determined by adding on synergies, meaning positive or negative effects, that solely lead back to the acquisition and are dependend on the acquireing company. These can, for example, result from an early market entry or an increase in know-how. The earning-capacity value is determined as a capital value of all surplus payments Der Ertragswert wird als Kapitalwert aller Einzahlungsüberschüsse ermittelt.

$$\text{company value} = \sum_{t=1}^{\infty} \frac{(P_t - D_t)}{(1+i)^t}$$

P_t - D_t = surplus payments (inpayment - disbursement)
t = consecutive number of observed years
i = discount rate

Shareholder value

With the concrete example of the shareholder value as an implementation of the earning-capacity value concept the ecological orientation shall be displayed in the following. The shareholder value represents the present value of the free cash flows in a company to be expected in the future, that can be brought up for the satisfaction of the lender of capital (value, that is due to the shareholder, respectively stockholder)

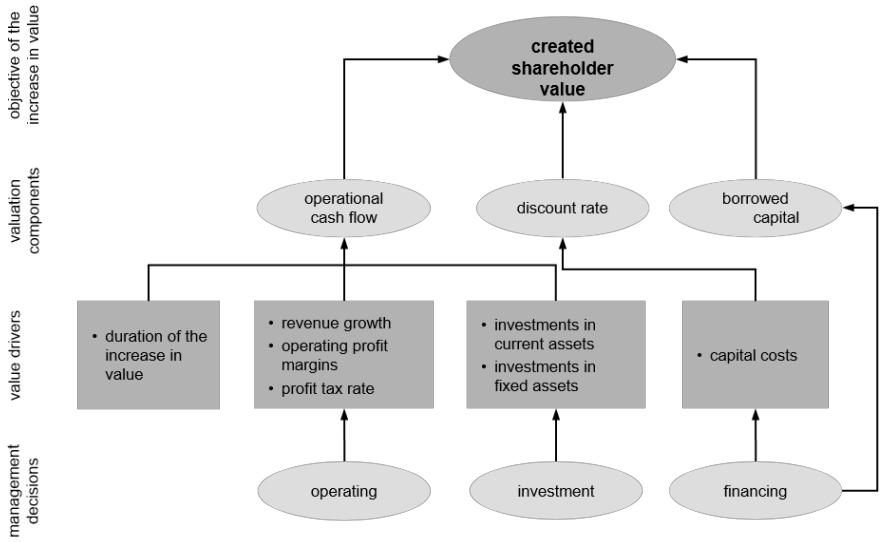
$$SHV = \sum_{n=1}^{\infty} \frac{FCF_n}{(1+i)^n} - BC$$

SHV = shareholder value
FCF = free cash flows (= cash flows minus investments minus alteration of the net working capital before interests and clearance)
n = consecutive number of observed years
i = discount rate (total capital cost)
BC = borrowed capital

But in what way is the shareholder calue ecologicallyoriented? It is forward-looking (future FCF) and therefore oriented towards a long term increase of the company value. Furthermore the shareholder value can be specifically raised by environmental management. Figure 6 displays the value drivers, that are exemplarily explained focussing on ecology orientation.

Duration of the increase in value:
Ecological innovations allow occasional price premiums or cost savings.
Increase in value: A return that is obtainable over the capital costs ("excess return") increases the shareholder value.
Awareness of the consumer: Ecologically alarming products can be connected with sales problems.
New legal regulations lead to cost increases, for instance due to increasing limit values.

Figure 6: shareholder value network



Source: based on Rappaport, 1995

Operating:
- Improvement of the competitive position by ecology orientation leads to revenue growth ("green" segmentation) and increases the shareholder value.
- Material costs or disposal costs drop due to more environment-friendly technologies and the shareholder value is increased.
- Tax benefits (special depreciations, subsidies) increase the shareholder value.
- As a result of government support programs the profit tax rate can sink.

Investments in fixed assets:
- Investments increase the shareholder value, when the returns exceed the capital costs.
- Investments in end-of-the-pipe-technologies are rather capital-intensive. Oftentimes, proceeds can not be assigned to them, instead, high operational costs arise, so that the

shareholder value tends to drop. Thus, environmental investments with a low capital intensity are to be preferred.

Investments in current assets:

- Ecologicallyoriented activities like material cost reductions, smaller flow rates or the process optimisation have a positive impact on the shareholder value, because free cash flows increase. Integrated environmental protection technologies show a similar effect.

Financing (discount rate, possibilities for borrowing capital):

- In the course of a lending, environmental aspects are considered; this way the value of the interest is affected, but also the general possibility of taking out a loan.
- Credit programs and funding programs that are subsidised by the state lead to lower interest charges.
- Environmental risks increase capital costs and lower the shareholder value.

Environment-due-diligence

In the context of an environmental evaluation the macro field and task field as well as all the takeover candidate's stages of creation of value, are investigated with regards to ecological concerns. Environment-due-diligence has become established as a term for the checking the (diligent) way of dealing with the ecological environment. The objective is, to determine and then avoid, respectively reduce the risks of aquireing a company regarding environmental aspects by detailed analyses of the potential object of purchase. Such an evaluation is not only relevant for environmentally sensitive industrial sectors, like the chemical industry, the oil and gas industry and the manufacturing industry, but also for trading companies or service companies as well as credit institutions or insurance companies due to indirect concernment.
In order to increase the degree of the creation of value, MOBILITY UNLIMITED acquires SPEED GMBH (SPEED LTD.), an automotive supplier. One year later, the pollution of the groundwater with chlorinated hydrocarbons is being discovered. Research shows, that the pollution originates from the terrain of SPEED GMBH. The cause for the damage was the improper handling with hazardous substances, that were used until the end of the 1980s. Public authorities obligate SPEED GMBH to refurbish the soil and groundwater. Resulting from this are high costs, but also image-related problems. Now it becomes apparent, that the contamination was not only caused by SPEED GMBH, but also by a company nearby. Research shows, that due to the preparation of solvents, vast amounts of solvents entered soil and groundwater. However, the company has, in the meantime, become bankrupt, so that public authoroties call on the land owner SPEED GMBH for the remediation.

Content of an environment-due-diligence

At stage 1 of an environment due diligence one covers the envrionmental risks in in the financial statements of the company. This takes place in the context of a financial analysis of the latest annual accounts (**net asset** value determination). At stage 2, a legal compliance audit, that covers the question, in what extentent environmental regulations are being satisfied, takes place. Stage 3 determines the financial impacts by environmental risks (earning capacity value determination). For this, all the current and, as long as foreseeable, future financial impacts on products, processes, investments, expenses and other commitments of the companyare being captured (e.g. outdated manufacturing processes, drops in demands, planned legislation, use of dangerous raw substances, disposal costs). Stage 4 addresses "good management practices". This concerns voluntary agreements (e.g. responsible care from the Chemical Industries

Association (VCI)), but also the analysis of these management practices. At stage 5, the environment-de-diligence is extended considering quality and occupational safety.

Progress of an environment-due-diligence

After the determination of objectives come the audit planning (information procurement and operation planning), the assembly of the audit team (combination of technical, scientific, environmental law and business knowledge), as well as the actual audit procedure with the help of check lists, that involves a site inspection, interviews with the employees, the employee representation, the production management, the environmental representative and the corporate management as well as a document analysis. Thus, the environment-due-diligence is effected by means of a system audit and function audit, during which the examiner assures himself of the tasks, the design and the efficiency of the system of regularisations and processes. In the context of the audit, the following sections of the company are being investigated: organisational structure and operational structure, approval management and condition management, environmental representation, waste management (internal waste management practices and disposal documentations), review access, reports of internal and external audits, reports of the environmental representative, a lawyers letter of confirmation on legal and environmentally legal procedures, the corporate managements decleration of completeness, investment and expense budgets, liability regimes in purchasing agreements and lease agreements and insurance coverage. Eventually, a connection with the financial due diligence takes place. The result ought to be well-founded statements on the environmental risks as well as the determination of further measures (detailed investigations).

MOBILITY UNLIMITED would like to take over another automotive company, that posesses a disassembly line and offers mainly small and mid-ranged cars. However, the complete liablility risks would be passed on to MOBILITY UNLIMITED as well. It is therefore in the interest of the corporation, to evaluate all of the potential financial risks, and also the environmental risks of the said firm. In doing this, not only soil and water contaminations or problems with the building substance need to be evaluated, but all of the environmentally relevant aspects need to be taken into account: environmental aspects in the manufacturing process and disassembly process, production facilities, emissions and immissions, substance and waste management, usage in the neighbourhood etc.. For this, an environment due diligence with the following points must be created: research on the parcel of land's history, research on the parcel of land's environment, examination of soil, soil vapout and groundwater, detailed inspection of the object regarding building substances that are hazardous for the environment and/or problematic, evaluation of the production process and the facilities used in these processes regarding environmental risks, evaluation of the materials and auxiliary materials in use including their storage space and evaluation of the waste management including disposal facilities. The final report with the results of the environment due diligence revealed all of the environmental risks and their financial assessment for MOBILITY UNLIMITED. Thus, the report served as a basis for the decision making in the takeover negotiations.

Thinking in costs and revenues – calculating prices and controlling costs

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In contrast to the investment calculation, that has a project-related, cross-period view the cost accounting refers to individual time slices (meaning usually month, quarter or year) and is more position oriented, respectively division oriented.

1 Ecology orientation of the classic cost accounting

Distinction

The subject of cost accounting is the support of operative management tasks of planning, steering and control that relate to processes, departments and products. Since environmental aspects do not only manifest themselves in definite projects, but also take effect in all reference objects of the cost accounting (processes, products), they need to be displayed in cost accounting. An ecologicallyoriented cost accounting captures and accounts costs, that emerge due to environmental impact of a company. Therefore it does not stand beside the "normal cost accounting", but occurs because of the further development of the existing cost accounting by systematically considering ecology-related costs.

Ecologicallyoriented cost concept

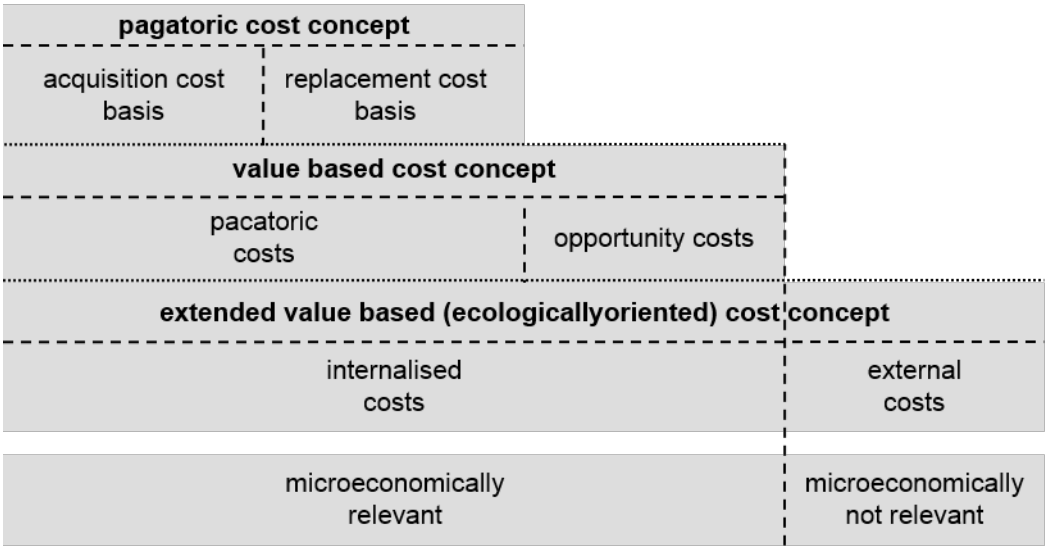
Ecology costs, respectively proceeds need to be determined, in order to be able to navigate the impacts of business ventures on the ecological environment. They express themselves in the form of environmental aspects, meaning in the form of completely quantifiable material and enery flows between the system and the environment. Resulting from the diversity of environmental aspects in a company, that become cost-effective or proceeds-effective, is the necessity to define "ecology costs", respectively "ecology proceeds" as a term and define their determination according to type and amount. Costs are generally defined as valuated consumption of goods and services for the creation of operational performances (cf. Coenenberg, Fischer, & Günther, 2007). Included in this is theoretically every use of environmental functions, meaning all costs and proceeds may be designated as ecology costs, respectively ecology proceeds. "Ecology costs, respectively ecology proceeds" can therefore in general be defined as all costs, respectively proceeds, that emerge by means of the environmental aspects of the company in the form of completely quantifiable material flows and energy flows between the system and the environment (see for the relation between environmental impacts and costs Umweltbundesamt (Hrsg.), 1996). According to other definitions, environmental protection costs are labelled as the "complete economic disadvantages, that are triggered by decisions in a company, that affect the ecological environment" (Wagner, 1992). ROTH differentiates valuated objective consumptions for measures of avoidance, reduction, recycling and disposal of company-induced environmental burdens as well as for surveillance measures (cf. Roth, 1992). FISCHER demarcates costs, that are relevant for the plant-related environmental management, as costs for the avoidance of waste materials, costs for the production of waste materials, costs for the disposal of waste materials and external costs of waste materials (cf. H. Fischer, Wucherer, & Wagner, 1997).

Demarcation

In order to analyse the ecology costs in practice, different cost concepts need to be considered:

Looking at the pagatoric cost concept, that can be affiliated to KOCH, the valuation is based on the "not compensated expenditures that are connected with the manufacturing and sales of a unit of the product, respectively a period" (Koch, 1958), meaning expenditure-equal costs. These can be determined on the basis of acquisition costs or replacement costs. Ecology costs are therefore only regarded in the extent that they are already internalised and that they bring about expenditures for the company. Because an overlapping of pagatoric and external costs is generally not given.
The value based cost concept's distinction relates to the "values of the consumed goods for performance" (Schmalenbach, 1963), meaning the monetary marginal benefit, that the company can derive from the consumption of environmental goods. The value based cost concept expands the pagatoric cost concept by the opportunity costs. These represent lost profits, that arise as a result of existing alternatives (opportunities) not being seized. Costs therefore comprise of a consumption of quantities as well as a depreciation. The quantity component requires a consumption of goods and a performance relation. Regarding the criterion of the consumption of goods, there is, on one hand, the question of the characteristics of goods, on the other, the question of the characteristics of the consumption of this good, meaning the consumption of economical (respectively economically scarce) goods. The performance relation of goods postulates, that without their use, production is not possible. Since the valuation happens in monetary units, a monetary rateability is required. Ecology costs are integrated in the cost concept in so far as they are microeconomically relevant and monetary rateable. External effects may also be included. Already in 1963, Schmalenbach advocated the principle of the public service profitability and did not restrict himself solely on the consideration of microeconomic aspects (Schmalenbach, 1963). Thus, the ecologicallyoriented cost concept can be understood as an extended value based cost concept.
For a summary of the different cost concepts see Figure 7.

Figure 7: Ecologicallyoriented cost concept



Source: Günther, 1994

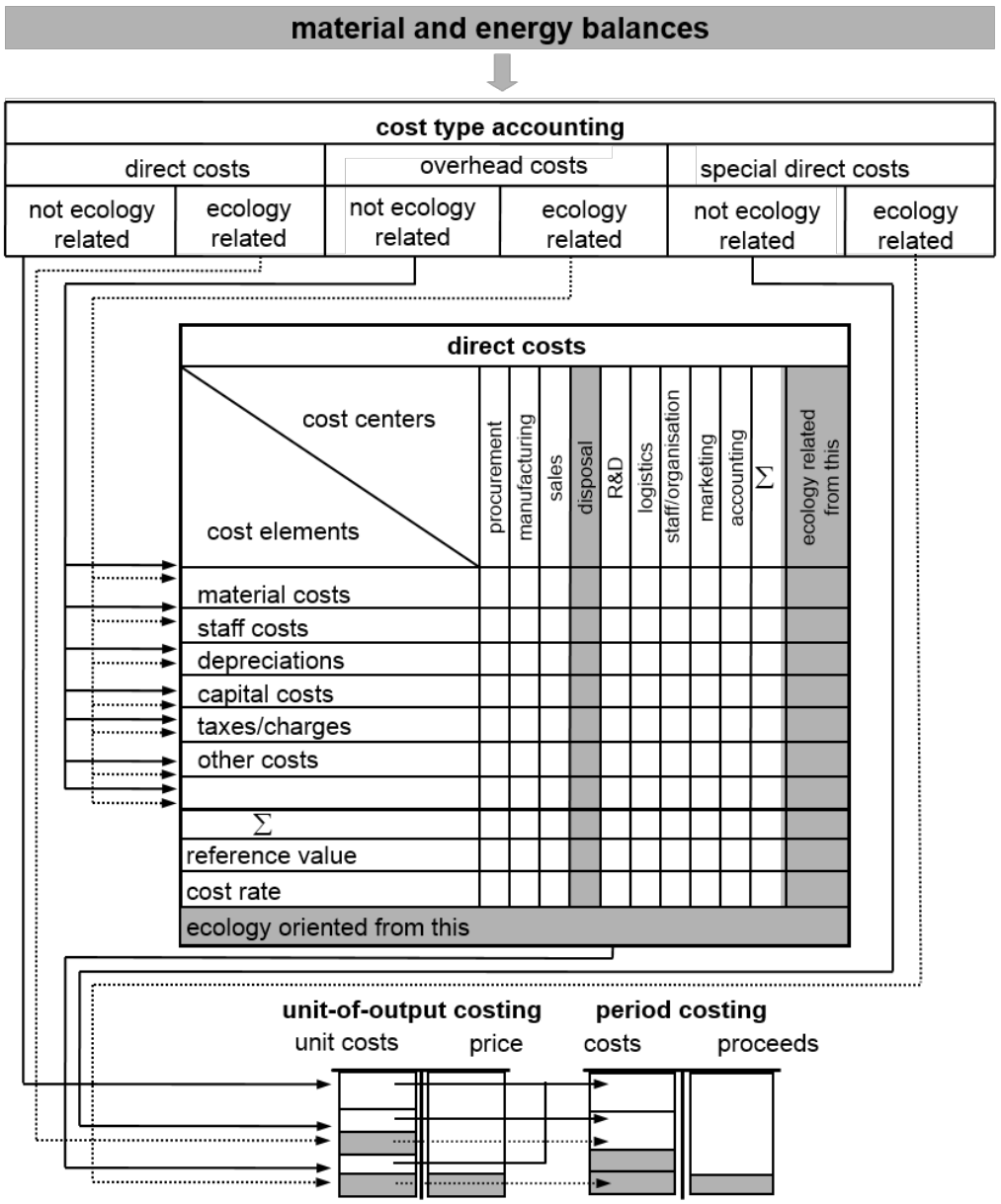
Components of cost accounting

An ecologicallyoriented cost accounting draws on the actual material flows and energy flows in a company, that are displayed in the operational material and energy balance. After the capturing and valuation of so called ecology costs and ecology performance types (cost type accounting) they need to be assigned to the planning, navigation and control of individual departments (cost center accounting) and products, respectively orders (cost unit accounting) (see Figure 8).

Starting point material and energy balances

These balances can relate to a firm at a certain site (firm or site balance), branches of activity within a firm (plant balance), individual machine and equipment groups, as well as aggregates (process balance) or a product (product balance). Prices, respectively costs (value component) are assigned to all of the partial flows of the operational material and energy balance (quantitiy component). For material and energy flows, that enter the company or originate from it, there are concrete market prices (e.g. costs per energy unit or disposal costs per ton of special waste). Internal activities are evaluated over an internal cost distribution, alternatively over market prices, e.g. enery deliveries from the block-type thermal power station or services from the internal waste management facility. Eventually, due to the connection between internalised and external effects displayed above, not every envrionmental aspect, that is documented in the operational material and energy balance also causes internal ecology costs. Especially the pollution of the air is normally accompanied by costs for third parties, but not for the polluter.

Figure 8: cost flow scheme



Source: Günther, 1994

The distribution of costs can be determined with the following reference values:

- *Quantity values* (m_3, m_2, m, etc.): for the cleaning, recycling or removal of waste, waste water, exhaust air, waste heat (example: for a sewage prufication plant, the amount of waste water, that is to be purified, can be indicated in m^3 or liters.)
- *Weight values* (t, kg): for the recycling or removal of waste or exhaust fumes (example: amount of waste, amount of emitted CO_2)
- *Time values* (h, Tage): Usage intensity of equipment (example: time of utilisation of recycling equipment for the waste of certain cost centers in hours)
- *Technical values* (kWh, kJ) (example: regained electrical energy from a heat exchanging device and its feeding beack to a primary cost center in kWh)
- *Ratios*: When appears to complex, to exactly determine the amount of hazardous substances and waste, one can allocate according to estimated ratios (example: amount of waste water in three production centers in the ratio 1:2:5)

Cost type accounting

The task of the cost type accounting is to comprehensively capture and valuate all costs, that occurred in an accounting period for the entrepreneurial performance. For the ecoloy orientation, all stages of the creation of value need to be regarded, while costs are to be demarcated by time and objectively. Costs in environmental protection, that are either not accounted at all, or at least not in the period need to be demarcated by time. Ecology costs and environmental protection investments need to be objectively demarcated. (case 1): Environmental protection measures are normally connected with investments. These, however, do noot display costs (yet), but are captured in the depreciations. Furthermore, the question of the practical differentiation, when a product fully or partly serves the protection of the environment, arises (case 2). Since substance-related envrionmental risks are always a question of occupational safety, as well, the respective cost types are to be considered, too (case 3). Eventually, ecology costs and process related costs for integrated technologies need to be demarcated (case 4). Because measures can serve environmental protection as well as efficiency and quality enhancement. At this point, calculations of the ecology-related enhancement towards former technologies or alternative solutions with the help of a difference or marginal observation are done. For the capturing, one needs to distinguish between primary and secondary ecology costs: primary costs are directly assignable to a cost center, while secondary costs are distributed over the internal cost allocation from preliminary cost centers to final cost centers. Furthermore, in the cost-type accounting direct costs (directly assignable to a cost unit/product) and overhead costs (not directly assignable to cost units) need to be seperated, while ecology costs normally have the character of overhead costs. This means, that they indirectly enter the calculation over the cost center accounting: They can be directly assigned to cost centers (cost center direct costs) or divided onto cost centers (cost center overhead costs). Eventually, a seperation into fixed and occupation-proportional costs according to the cost accounting system needs to be done.

Cost center accounting

The cost center accounting asks, where costs emerged and in what height they emerged. For this, the internal service interconnections between the cost centers are considered. Thus, the cost center accounting prepares the calculation. Cost centers can, according to a computational viewpoint, be divided into preliminary cost centers (do not work directly for the final product) and final cost centers (perform work directly for the cost unit). According to a production-related viewpoint, direct cost centers (serve the production of the main products (according to a computational viewpoint: final cost centers)), indirect cost centers (production of saleable side products or joint products or the recycling of waste-products) as well as non-productive cost

centers (only indirectly serve the manufacturing of products, meaning rather a supportive function – they deliver all of their performance to primary cost centers). Cost centers can be exclusively, partly or not ecology-related: the company owned sewage purification plant, for instance, exclusively serves environmental protection. In many cases, however, there are cost centers, that do not solely serve environmental protection. This requires techniques of cost seperation within the cost centers. Only then, ecology costs can stay visible after a further accounting (e.g. of the repair shop's service or the plant security). Since a complete and detailed demarcation is oftentimes not possible, the following procedures can be recommended:

- Calculation of the ecology costs by detailed *subtracting* of the ecology-related part from the existing cost data (for instance calculatory depreciations for environmental protection investments, operational costs of the environmental protection equipment, production costs for environment-friendly products etc.),
- written *inverviews* with the persons responsible for the cost center once a year with the help of a questionnaire,
- *Seperation* e.g. proportional to the amount of environmental investments in the complete investments.

Cost unit accouting

In the context of the cost unit accounting, ecology costs per cost unit are determined. Direct costs can directly be assigned to the cost unit from the cost type accounting, overhead costs over the cost center accounting. An ecologicallyoriented breakdown requires a seperation of the overhead rates according to cost centers. For a cause-oriented calculation (unit of output costing), the ecological overhead costs need to be distributed onto the costing object. The calcuation determines the manufacturing costs of a product and thus also serves the finding of price limits. It must be perceptible from the period costing, in what amount ecology costs and ecology services occur in the accounting period. This operating statement shows, how economically successful the practice of a company was in a period (profit/period).

Actual costs or planned costs

Ecology costs are treated according to the logic of the traditional cost accounting and do not make special demands to the design of the system. However, the question arises, how cost accounting is generally formed. One one hand one must decide, whether the system shall stay limited to an actual cost perspective, or whether it should be extended by a planned cost calculation, that supports anticipated decisions and enables a meaningful controlling. On the other hand, cost accounting systems can be formed on the basis of marginal costs or full costs, which is dependend on whether the cost accounting supports short-tearm decisions or whether it is meant for long-term objectives.

Instruments of the cost management

Due to specific requirements, the demand for the extension of the traditional cost accounting in terms of a cost management became vital. This shall link the strategic objectives of the company and cost oriented considerations to the realisation in operative decisions (cf. T. M. Fischer, 1993). Out of the three tasks planning, navigation and control, the navigation aspect deserves special attention, since the more restrictive surrounding field's conditions require the specific implementation of success potentials. In the following, chosen instruments of the cost accounting and cost management are briefly displayed in the form of business cards. For a detailled description see the works of MAHLENDORF (CF. MAHLENDORF, 2005) and LOEW, FICHTER und MÜLLER (Loew, Fichter, Müller, Schulz, & Strobel, 2003).

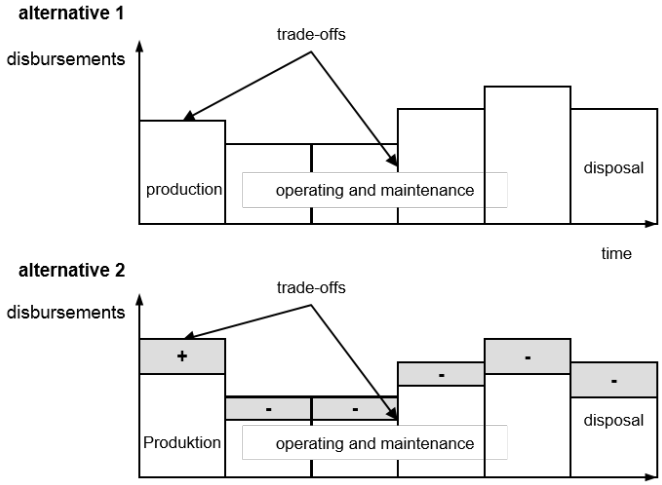
In order to make the selection of an ecologicallyoriented cost management system, MOBILITY UNLIMITED invites a few companies to a workshop, in which every company presents the instrument of its choice.

2 Life cycle costing

The instrument of life cycle costing displays a procedure of a lifecycle-oriented evaluation of investment alternatives, meaning from the production to the use to the disposal. The term costs in the labelling of the instrument is misleading in so far as the procedure should in principle regard cash flows. Thus, the user purposely evaluates the subsequent payments for the firm, that are necessary beyond the pure acquisition disbursements, and the disposal of the products to be evaluated. By regarding the different disbursements and receipts of payments during the life cycle, their trade-offs are identified. Therefore, it may very well pay off, to pay a higher cost price for a product, when by that the continuous disbursements, respectively disposal disbursements are accordingly reduced. The relevance of this approach becomes apparent for instance in the area of pumps and with buildings.

Table 3: business card life cycle costing

feature	description
origin	The method, that is used for investment decisions, originated in the 1930s in the USA for the procurement of tractors. Since then it was specified and developed further in multiple variations. The life cycle costing (LCC) starts from the thought, that acquisition costs only make for a minimal part of the costs, that occur during the entire life cycle. For the producers, the demand for optimisation of the cost structure, that is incurred over the life cycle, arises.
scope	worldwide
system boundary	cradle-to-grave
evaluation object	projects, products or services
evaluation value	material flows and energy flows, that cause disbursements and receipts of payments later on
objective	planning, evaluation and comparison of different investment alternatives from a procurement perspective as well as a development perspective according to the principle of a total cost orientation
assumptions	evaluated alternatives offer the same functionality
procedure/ method	*Definition of objective* Determination, which functions/services shall be acquired *Identification of possible alternatives* Identification of alternatives, that fulfill the demands that were determined in the first step *Capturing necessary information* Discount rate, date and height of the disbursements and receipts of payments occuring during the life cycle, duration of the life cycle Recommendation of applying a cost-break-down structure plan for a systematic overview over all disbursements and receipts of payments In this context still a separate consideration of environmentally relevant costs *Determination of target costs* Determination of acceptable costs in the individual phases of the life cycle *Profit analysis* Different methods for the calculation of the total life cycle costs possible, in principle the discounting is done with the following formula:

	$$C_0 = \sum_{t=0}^{T} \frac{P_t - D_t}{(1+i)^t}$$ P_t = receipts of payments in year t D_t = disbursements in year t t = consecutive number of regarded years T = planning horizon i = discount rate Furthermore one can create a cost profile for the visual comparison of several alternatives.  *Source: based on Burstein, 1988*
result	deduction of accrued interests of the identified disbursements and receipts of payments via discounting at the time of acquisition (for this, consideration of finance effects and inflation impacts, as well) selection of the alternatives with the lower life cycle costs
critical appraisal	consideration of the entire life cycle and the consequences for producer and buyer showing consequences of decisions via the displaying of trade-offs compinability of the LCC as a monetary instrument with the method of a life cycle assessment (LCA) difficult acquisition of data and prognosis uncertainty of the used data liquidity bottlenecks impede the implementation of the results of the LCC
literature	BLANCHARD, B. S. (1978): Design and Manage to Life Cycle Cost. Portland 1978. WÜBBENHORST, K. L. (1984): Konzept der Lebenszykluskosten – Grundlagen, Problemstellung und technolgische Zusammenhänge, Darmstadt 1984. GÜNTHER, T.; KRIEGBAUM, C. (1999): Life Cycle Costing, In: Baum, H.-G.; Coenenberg, A. G.; Günther, E. (1999): Betriebliche Umweltökonomie in Fällen, Band 1, München 1999, S. 232-266. COENENBERG, A. G.; FISCHER, T. M.; GÜNTHER, T. (2007): Kostenrechnung und Kostenanalyse. Stuttgart, 2007, S. 569 – 577. HUNKELER, D.; LICHTENVORT, K.; REBITZER, G. (Hrsg.) (2008): Environmental Life Cycle Costing. Boca Raton, Fla., 2008.

Sample calculation life cycle costing

The illumination for a factory hall belonging to REIFEN FRISCH needs to be renewed. In order to decide, whether incandescent lightbulbs or energy-saving lightbulbs come into use, a comparison of the life cycle costs shall be made. For this, the procedure of the life cycle costing is used. In total, the factory hall needs to be equipped with 50 lightbulbs. One incandescent lightbulb with a power of 75 W and a life span of 1000 hours costs 0.99€, a comparable energy-saving lightbulb (15 W) costs 9.55€ and has a life expectancy of 10 000 hours. For the energy-saving lightbulb disposal costs of 0.625€ per lamp emerge. The energy costs are currently at 0.139 € per kWh. The lamps are turned on 12 hours a day on average on 21 working days a month. At the moment the interest rates for risk-free German government securities lie at 3.2 % and the average interest payed on the capital market is 4 %. The systematic risk of the branch lies at 1,2. At the moment REIFEN FRISCH pays 8 % in interests for borrowed capital. The equity ratio accounts for 40 %. The examining period of time is set on n=40. The income tax (s) lies at 50 %.
Solution:

<u>Step 1: Calculation of the effective interest rate</u>
Calculation of the equity interest rate and borrowed capital interest rate:

$$i_{EQ} = i_{risk\text{-}free} + \beta\,(i_{market} - i_{risk\text{-}free})$$
$$i_{EQ} = 3{,}2\,\% + 1{,}2\,(4\,\% - 3{,}2\,\%) = \underline{\underline{4{,}16\,\%}}$$
$$i_{BC} = \underline{\underline{8\,\%}}$$

Calculation of the WACC (annually):

$$\text{WACC} = \text{equity ratio} \times i_{EQ} + \text{borrowed capital ratio} \times (1 - s) \times i_{BC}$$
$$= 0{,}4 \times 4{,}16\,\% + 0{,}6 \times (1 - 0{,}5) \times 8\,\% = \underline{\underline{4{,}1\,\%}}$$

Calculation of the WACC (monthly):

$$\text{WACC}_{month} = (1 + \text{WACC})^{\frac{1}{12}} - 1 = 1{,}041^{\frac{1}{12}} - 1 = \underline{\underline{0{,}34\,\%}}$$

Calculation of the present value factor (PVF):

$$PVF_{month} = \frac{1}{WACC_{month}} \times (1 - (1 + WACC_{month})^{-n}) = \frac{1}{0{,}0034} \times (1 - (1 + 0{,}0034)^{-40}) = 37{,}3383$$

Step 2: Calculation of the acquisition costs, energy costs and disposal costs:

Example life cycle costing

	calculation	incandescent lightbulbs	energy-saving lightbulbs
acquisition costs			
acquisition costs [€]	price per lightbulb x amount of lightbulbs	-49.50 €	-477.50 €
amount of replacement lightbulbs [pc.]	$\frac{\text{period * working days a month}}{\text{life span}}$	10.08	1.01
replacement interval [months]	$\frac{\text{life span}}{\text{Betriebszeit pro Monat}}$	3.9683	39.6825
$WACC_{replacement}$	$(WACC_{month} + 1)^{\text{replacement interval}} - 1$	0.0136	0.1443
$PVF_{replacement}$	$\frac{1}{WACC_{Ersatz}} \times (1 - (1 + WACC_{Ersatz})^{-(\text{Anzahl Ersatzl.} -1)})$	8.4889	0.0075
capital value of the initial purchase [€]	acquisition costs	-49.50 €	-477.50 €
capital value of the following purchases [€]	acquisition costs x $PVF_{replacement}$	-420.20 €	-3.57 €
total capital value of acquisition costs [€]	$CV_{AC} + CV_{\text{following purchases}}$	**-469.70 €**	**-481.07 €**
energy consumption			
energy consumption [kWh/month]	power x monthly working hours x amount of lightbulbs	945	189
energy savings [kWh/month]	energy $\text{consumption}_{\text{incandescent lightbulb}}$ – energy $\text{consumption}_{\text{energy-saving lightbulub}}$		756
energy costs [€/month]	energy consumpzion x energy costs per kWh	-131.36 €	-26.27 €
capital value of energy costs [€]	monthly energy costs x PVF_{month}	**-4.904.57 €**	**-980.92 €**
disposal			
disposal costs [€]	disposal costs per lightbulb x amount of lightbulbs	0	-31.25 €
$PVF_{disposal}$		9.3619	0.8804
capital value of disposal costs [€]	disposal costs x $PVF_{disposal}$	**0**	**-27.51 €**
total capital value [€]	$CV_{energye} + CV_{AC} + CV_{disposal}$	**-5.374.27 €**	**-1.489.50 €**
savings			
			-3.884.78 €

Result:

The acquisition of the energy-saving lamps is to be preferred, because it involves savings of 3884.78 € towards the use of incandescent lightbulbs in the observed period.

3 Process-based cost accounting

This approach will rectify the imperfections, that partly occur in other procedures of the cost accounting, which have emerged due to changes in the cost structure in the last decades. The main objective of the process-based costing is the causal allocation of overhead costs of the indirect areas to the cost units in a company. The approach is well suited for the extension of the life cycle costing since it provides for a direct determination of the disbursements and receipts of payments, that occur in the use and disposal phase. Furthermore, with the help of a process consideration ecology costs and proceeds can be direcly determined and regarded.

Table 4: business card process-based cost accounting

feature	description
origin	In 1975 SIEMENS employed a workgroup for the process-based cost accounting, that, however, stayed limited to the company. For ten years J.G. MILLER and T.E. VOLLMANN occupied themselves with the problem of increasing overhead rates in the USA. In 1988 hinterfragten R. COOPER und R.S. KAPLAN questioned the conventional cost accounting systems and got significantly involved in the development of the activity based costing (ABC). In the 1990s P. HORVATH and R. MAYER picked up the idea of the ABC and developed a system, that is fitted to the peculiarities in Germany.
scope	worldwide (with regards to regional peculiarities)
system boundary	cradle-to-gate
evaluation object	operational sub-processes
evaluation value	activities on all stages of the creation of value
objective	The process-based cost accounting allocates the overhead costs in a company according to the actual use.
assumptions	no percental overhead rates, but assigning of overhead costs to the sub-processes
procedure/ method	*process analysis* seperation of all ecologically relevant activities in every stage of the creation of value in primary and secondary activities *process determination* summarisation of the activities in sub and main processes on the basis of mutual cost drivers *process cost drivers/ process values* determination of the crucial values for the increase in process costs *process costs* break down of overhead costs, determination of the process cost rate as well as assignment of the overhead costs to the sub processes => statements on costs for ecologicallyoriented measures according to type and scope
result	process-based calculation for the individual cost units
critical appraisal	long term view transparence of ecology costs product calculation according to cost-by-cause consideration of external effects possible focus on consideration of ecological problems process quantity useable as benchmarks ecologicallyoriented navigation also for make-or-buy-decisions

	endangerment of the operating profit due to an application of the results without reflection, since processes, that seem unprofitable tighten customer localty overproportionally, secure purchasing benefits, create employee satisfaction or other interdependencies, that would not be be captured in a purely monetary analysis
literature	COOPER, R.; KAPLAN, R.S. (1988): Measure Costs Right. Make the Right decisions. In: Harvard Business Review. September/October 1988, S. 96-103. HORVATH & PARTNERS (Hrsg.) (2005): Prozessmanagement umsetzen. Durch nachhaltige Prozessperformance Umsatz steigern und Kosten senken, Stuttgart 2005. MAYER, R.; KAUFMANN, L. (2000): Prozesskostenrechnung – Einordnung, Aufbau, Anwendungen. In: Fischer, T.M. (Hrsg.) Kostencontrolling – Neue Methoden und Inhalte, Stuttgart 2000. MILLER, J. G.; VOLLMAN, T.E. (1985): The hidden factory. In: Harvard Business Review, Vol. 63, No. 5, 1985, S. 142–150.

Example process-based cost accounting

The company SCHLAUCHTECHNIK GMBH specialises in the manufacture of hoses. Especially for vehicle manufacturing, the company supplies brake hoses and fuel hoses. SCHLAUCHTECHNIK GMBH has developed a new model for a brake hose. However, for its manufacture there are two different alternatives. Alternative 1 causes 2 kg of steel waste, 4.5 kg of plastic waste and 240 litres of waste water, whereas alternative 2 causes 3 kg of steel waste, 3 kg of plastic waste and 300 litres of waste water. In our case, 100 kg of plastic waste are equivalent to 100 m³. For the decision making, the company makes use of the activity based costing. A placement of the processes can be found in the following table.

Example process-based cost accounting

activity	cost drivers	total costs [€]	process quantity
storage steel waste	mass	20.000	5t
storage plastic waste	volume	23.000	110 m³
transport steel waste	mass	16.000	5 t
dewatering fees for wastewater	amount of wastewater	22.000	600 m³
disposal fees for plastic waste	volume	54.000	110 m³
disposal fees steel waste	mass	19.000	5 t
cleaning fees wastewater	amount of wastewater	26.000	600 m³

<u>Solution:</u>

<u>step 1: creation of main processes on the basis of similar cost drivers</u>

steel waste: storage, transport, disposal fee
plastic waste: storage, disposal fee
wastewater: dewatering fee, cleaning fee

<u>step 2: determination of process cost rates</u>

$$\text{steel waste}: \frac{20\,000\,€ + 16\,000\,€ + 19\,000\,€}{5\,000\,\text{kg}} = \underline{\underline{11\,\frac{€}{\text{kg}}}}$$

$$\text{plastic waste}: \frac{23\,000\,€ + 54\,000\,€}{(110\ \text{m}^3 \times 100\,\frac{\text{kg}}{\text{m}^3})} = \underline{\underline{7\,\frac{€}{\text{kg}}}}$$

$$\text{wastewater}: \frac{22\,000\,€ + 26\,000\,€}{600\ \text{m}^3 \times 1\,000\,\frac{\text{l}}{\text{m}^3}} = \underline{\underline{0.08}}\,\frac{€}{\text{l}}$$

<u>step 3: calculation of process costs</u>

alternative 1:

$$\text{steel waste}: 11\,\frac{€}{\text{kg}} \times 2\,\frac{\text{kg}}{\text{pc}} = \underline{\underline{22\,\frac{€}{\text{pc}}}}$$

$$\text{plastic waste}: 7\,\frac{€}{\text{kg}} \times 4.5\,\frac{\text{kg}}{\text{pc}} = \underline{\underline{31.50\,\frac{€}{\text{pc}}}}$$

$$\text{wastewater}: 0.08\,\frac{€}{\text{l}} \times 240\,\frac{\text{l}}{\text{pc}} = 19.20\,\frac{€}{\text{pc}}$$

sum process costs $= \underline{\underline{72.70\,\frac{€}{\text{pc}}}}$

alternative 2:

$$\text{steel waste}: 11\,\frac{€}{\text{kg}} \times 3\,\frac{\text{kg}}{\text{pc}} = \underline{\underline{33\,\frac{€}{\text{pc}}}}$$

$$\text{plastic waste}\ 7\,\frac{€}{\text{kg}} \times 3\,\frac{\text{kg}}{\text{pc}} = \underline{\underline{21\,\frac{€}{\text{pc}}}}$$

$$\text{wastewater}: 0.08\,\frac{€}{\text{l}} \times 300\,\frac{\text{l}}{\text{pc}} = \underline{\underline{24\,\frac{€}{\text{pc}}}}$$

sum process costs $= \underline{\underline{78\,\frac{€}{\text{pc}}}}$

<u>Result:</u>
The process-based calculation reveals, that alternative 1 is to be preferred, since the ecology related process costs at 72.70€ per piece are lower than with alternative 2, with 78€ per piece.

4 Target costing

Starting point for this instrument is the question, what a product may cost, in order to meet the demands of the market and still be profitable. For this, there is particular attention given to the fact, that the predominant part of the costs is already determined in the planning and development phase. The instrument is well suited for mass production as well as for the production of long life, highly specialised products. Furthermore, internal as well as external ecology costs can be included. The consideration and proper assignment of internal ecology costs increases the planned production costs (drifting costs). Ideally, meaning when the conservation of the environment is intended, the external effects need to be party or fully included in the calculation. However, since external costs are only actually internalised, when this seems reasonable from a market perspective, legal obligations or moral-ethical considerations, they initially display a calculatoric part of the drifting costs. It is the task of the management, to determine the optimal degree of internalisation.

Table 5: business card target costing

feature	description
origin	This concept of cost management was developed in japanese companies and is based on the thought, that ca. 70% of production costs are determined before production. It is the objective of the instrument, to determine cost targets, coming from a target price, therefore answering the question: "How much is the product allowed to cost?"
scope	worldwide
system boundary	products and servicese
evaluation object	cradle-to-gate
evaluation value	components of a product or service
objective	Target costing stands for a consequent, customer value oriented and therefore market-driven direction for the product, respectively service offer within the price range accepted by the customer.
assumptions	in the development and construction phase future costs are comparatively easier to be influenced then in later phases determination of cost targets for manufacturing costs already in the development and construction phase
procedure/ method	*determination of the function/ feature structure* (e.g. by means of a conjoint measurement) and the customers willingness to pay *determination of the target price,* respectively the demand function *deduction of allowable costs,* meaning the permitted costs allowable costs = target price – target profit *development of a raw draft of the product* compilation of components, that meet the demands from step 1 *calculation of drifting costs*, meaning the planned production costs with consistent technology and consistent process operations determination of full costs of the individual components, when the status quo stays the way it is *weighting of the components* Bestimmung des Beitrags der Komponenten zu den Funktionen *determination of target costs, induced by a product* For this, the allowable costs are confronted with the drifting costs. With the objective of the cost leadership, for instance, the target costs should be identical with the allowable costs *target cost distribution on functions* distribution of target costs on the individual components (e.g. with the help of the benefit provided by the components) *target cost analysis* comparison of target costs (respectively simplified proportional to the share of benefits) and the drifting costs of the components; among other things the creation of a target cost control scheme with measures for the achievement of target costs descripancies between target costs, respectively shares of benefits and drifting costs *ecologicallyoriented extension* disclosure of already internalised environmental costs internalisation of external costs by:

	prospective shifting forgoing of profit reducing the allowable costs
result	Comparison of the existing/planned costs of products/services with the customers willingness to pay as well as navigating adjustment of costs in the direction of a target price for more marketable, customer-oriented products/services
critical appraisal	clear market orientation possibility to integrate ecology costs static character, thus difficult dynamic adjustment of costs and target prices for the application on products, respectively services with short lifecycles only a small inaccuracy of forecasting relatively high expenses for the determination of the target prices and drifting costs (application of the instrument is only sensible starting from a certain sales volume)
literature	BAUM, H.-G.; COENENBERG, A. G.; GÜNTHER, E. (1999): Betriebliche Umweltökonomie in Fällen. Band I: Anwendung betriebswirtschaftlicher Instrumente, München 1999, S. 166-196. COENENBERG, A. G.; FISCHER, T. M.; GÜNTHER, T. (2007): Kostenrechnung und Kostenanalyse, 6., überarbeitete und erweiterte Auflage, Stuttgart, 2007, S. 527-567. HERBST, S. (2001): Umweltorientiertes Kostenmanagement durch Target Costing und Prozesskostenrechnung in der Automobilindustrie, Köln 2001. SEIDENSCHWARZ, W. (1993): Target costing: marktorientiertes Zielkostenmanagement. München 1993.

Example target costing

Mrs Schmidt, employee in the accounting department of the bicycle manufacturer BIKE AG presents the application of a target costing for the evaluation of the ecological aspects of products. Mrs Schmidt has used this procedure for the assessment of the newest model, the MOUNTAINBIKE BERGAUF. The new model causes, according to internal estimations, especially due to the utilisation of water and air, external ecology costs of 90 000 €. A market price of 1000€ is aimed for the new model. The return on sales shall amount to 10 %. It is being estimated, that 500 models per year leave the factory. Furthermore, a contract with a new supplier was made for the rims, which led to a 5% drop of target costs fore the unit costs. In a market analyses, it was determined, that customers are willing to pay 10% more of the market price, when this additional price is utilised ecologicallyoriented. Mrs Schmidt shows, how the ecological aspects can be considered in target costing.

Solution:

For a more detailed example on target costing see COENENBERG/FISCHER/SCHILL u. a. 1999, S. 170 ff.

step 1: Determination of the target price

$$\text{target price}_{\text{new}} = \text{target price}_{\text{old}} \times (1 + \text{additional price}) = 1\,000\,\frac{€}{\text{pc}} \times (1 + 10\,\%) = 1100\,\frac{€}{\text{pc}}$$

Increase of the ecology orientation by prospectively passing on costs to customers:

$$\text{internalised ecology costs} = (1100\,\frac{€}{pc} - 1000\,\frac{€}{pc}) \times 500\ pc = 50\,000\ €$$

By passing on the costs to customers 50 000€ of the external costs can be internalised.

<u>step 2: determination of allowable costs</u>

$$\text{allowable costs} = \text{target price}_{\text{old}} \times (1 - \text{return on sales}) = 1\,000\,\frac{€}{pc} \times (1 - 10\,\%) = 900\,\frac{€}{pc}$$

<u>step 3: determination of drifting costs</u>

There is no internal cost reduction potential, but merely the possibility to pass on costs to the supplier.

$$\text{cost savings by 5\% of target costs} = 900\,\frac{€}{pc} \times 5\,\% = 45\,\frac{€}{pc}$$

$$\text{internalised costs} = 45\,\frac{€}{pc} \times 500\ pc = 22\,500\ €$$

A reduction of target costs by 22 500€ can therefore be made by a retrospective passing on to the supplier.

<u>Result:</u>
In total, 72 500€ of external costs can by internalised by the company. For the difference amount of 17 500 other solutions need to be found. This could, for instance, be achieved by abstaining from profit, since, in general, there already is an ecology orientation in the company.

5 Least Cost Planning

The scope of Least Cost Planning is to provide energy services both at minimum social cost and at appropriate economic profit (The costumer does not require primary energy carriers but energy services, such as light, heat, power.). Least Cost Planning is based on the assumption that the necessary energy, water and mobility requirements may be covered by an increased efficiency in consumption. The method allows a direct comparison between measures to promote an increased efficiency in consumption and a possible expansion of production capacity. The approach guarantees cost minimization and the same time reduces environmental impacts by increasing the overall efficiency.

Table 6: Characteristics Least Cost Planning

attribute	description
origin	Least cost planning has been developed and put into practice during the 1970s and 1980s in the US-American energy industry. The first scientific treatise of the method can be attributed to SANT (SANT, 1979).
scope of application	worldwide
system border	cradle-to-grave
object of valuation	services linked to the infrastructure

measure of valuation	energy, water and mobility with step costs
scope	Least Planning identifies the most favorable combination of extended service offered by the provider and savings made by the costumer. It is worthwhile to apply the method if the potential savings achieved by the customer are less expensive than the additional provision of the service by the provider.
assumptions	savings that do not restrict the benefit of the service in question Infrastructure has reached its capacity barrier; production faces a fluctuating demand. possible measures linked to the saving potential are exhausted (e.g. different consumer behavior or systematic deactivation)
approach/method	*Analysis of framework conditions,* e.g. regulation and price control *Analysis and projection of demand* *Identification of capacity barrier* and rise in costs related to infrastructure provided by supply side *Cost comparison* of possible demand and supply options *Implementation* of most cost efficient option
result	integration of saving potential on demand side into resource planning of service provider supply management and control: e.g. during peak load major customers can be cut off from the grid.
critical assessment	saving potential on demand side can be considered an additional energy source limited predictability and reliability of costumer behavior
literature	BRACHER, T.; BACKES, T.; URICHER, A. (2002): Möglichkeiten der Umweltentlastung und Kostenreduzierung im Verkehr durch Verkehrsplanung – mit Leitfaden für die LCTP-Anwendung in Kommunen. In: Umweltbundesamt (Eds.): UBA-Texte 23/02, Berlin 2002. HASSE, H. (1997): Least-Cost Planning, Ein Managementkonzept für Energieversorgungsunternehmen. In: Wirtschaftswissenschaftliches Studium, Volume 6, 1997. SANT, R. W. (1979) The Least-Cost Energy Strategy: Minimizing Consumer Costs through Competition, Report 55, Mellon Institute Energy Productivity Center, VA, USA, 1979. TURNER, A.; WHITE, S.; BICKFORD, G. (2005): The Canberra Least Cost Planning Case Study. In: Water Science and Technology: Water Supply, Vol. 5, No. 3-4, 2005, p. 257-263.

Example calculation Least Cost Transportation Planning (LCTP)

An employee of the municipal department for town and traffic planning presents the LCTP method. The approach has been applied to analyze the public transport connection to a newly built industrial park in the south of the town. The scope of the method is to ensure a precise cost and environmental assessment of the project. There are two possible options to connect the industrial park: a bus line, or new tramway line. The investment costs for the bus line are 2.7 Mio. €. The construction of the tram way line will cost 25.2 Mio €. The depreciation period of the bus line is 26 years; the depreciation period of the tramway line is 36 years. The overhead expenses (indirect expenses, esp. administrative expenditure) are estimated at 25 % of the direct costs (current expenditure and depreciation). The new bus line would be 30 km long and circulate 90 times a day. The resulting cost per kilometer is 3.50 €. The tram way line would be 22 km long and circulate 80 times a day with resulting costs per kilometer of 4.20 €. Both bus

and tramway are operating 300 days a year. The tramway line would increase the overall traveling time. Due to its routing, 30 % of all employees would have to face a longer walk to work.

This increases the number of km operated by private motor vehicle by approximately 3000 km a day. It also results in a greater land use owing to moving and stationary traffic of 2500 m²h/day and 15.000 m²h/day. Additionally, the number of seats available according to the different means of transport is taken into account. In comparison to the tramway, the bus offers 30.000.000 more seat kilometers. The bus line also offers a higher density of stops (by 30.000 departures * stops). Furthermore, the following data concerning pollutant and noise emissions is taken into consideration.

Example calculation Least Cost Planning – options

	option bus	**option tramway**
noise (noise indicator)	218.233,00	217.595,00
CO_2 [t/year]	691.200,00	691.100,00
particulate [t/year]	90,20	90,00
HC [t/year]	930,00	930,00
NO_x [t/year]	2.230,00	2.224,00

Approach according to UBA-guideline **(Bracher, Backes, & Uricher, 2002):**
The following table presents only the difference between both options so as to gain a clear overview over the results. All absolute values of the bus line option are zeroed. Table below shows the differences between tramway and bus option.

Calculation of current expenditure per year:

$$\text{Option}_{\text{bus}} = 30\,\text{km} \times 90\,\frac{\text{circulation}}{\text{day}} \times 3.50\,\frac{€}{\text{km}} \times 300\,\frac{\text{days}}{\text{year}} = 2.835.000\,\frac{€}{\text{year}}$$

$$\text{Option}_{\text{tramway}} = 22\,\text{km} \times 80\,\frac{\text{circulation}}{\text{day}} \times 4{,}20\,\frac{€}{\text{km}} \times 300\,\frac{\text{days}}{\text{year}} = 2.217.600\,\frac{€}{\text{year}}$$

Example calculation Least Cost Planning – derivation

parameter	unity	difference tramway option
capital expenditure	€	22.500.000,00
direct expenditure		
fixed expenses	€/year	-617.400,00
depreciation of capital	€/year	+596.153,85
subtotal	€/year	-21.246,15
indirect expenditure		
amount of indirect expenditure	€/year	-5.311,54
traffic volume		
vehicle kilometers	KFZ-km/day	+3.000,00
immissions		
noise	noise emission indicator	-638,00
air pollutant emissions		
CO_2	t/year	-100,00
particulate	t/year	-0,20
HC	t/year	0,00
NO_x	t/year	-6,00

parameter	unity	difference tramway option
land use		
moving traffic	m²h/day	+2.500,00
stationary traffic	m²h/day	+15.000,00
social impact		
number of seats available in public transport	Mio. seat kilometer	-30.000.000,00
density of stops in public transport	(departures*stops)/year	-30.000,00

Results:
The table illustrates that the tramway is preferable concerning direct and indirect expenditure. Furthermore, the tramway option results in lower noise and pollutant emissions. However, traffic volume and land use are more significant; as the tramway serves a lower number of stops, some people might prefer to take their own car. In addition, the bus offers a higher number of seats available and a higher number of daily departures. The results do not show clearly which option is preferable. The tramway line has disadvantages concerning its routing, which increases the walking distance and might provoke an increase in private car traffic. At this point, possible modifications concerning the routing that could compensate for these disadvantages should be taken into consideration. Finally, some attention may be paid to the fact that the chosen period of depreciation exerts a strong influence on the expenditure. A possible alteration of the period of depreciation can therefore change the expenditure considerably.

6 Residual Material Accounting

Residual Material Accounting focuses on the residual materials that arise during the value creation process. This includes waste, waste water and defective products. Residual Material Accounting also covers expenses that are connected to residual materials (e.g. hazardous material depot, environmental manager). The approach identifies specific costs that can be reduced by avoiding the production residual material.

Table 7: Characteristics Residual Material Accounting

attribute	description
origin	The term Residual Material Accounting dates back to FICHTER/LOEW/SEIDEL (Fichter, Loew, & Seidel, 1997). Residual Material Accounting allocates the expenses for raw materials, material processing, transport, etc. not only to the product itself, but also to the residual materials. Thus the approach shows which expenses can be saved throughout the complete system.
scope of application	worldwide
system border	cradle-to-gate
object of valuation	company
measure of valuation	material and energy flows that are included into the „production" of residual materials
scope	Residual Material Accounting shows how the company can reduce its costs and lessen its environmental impact through the regulation of residual material.
assumptions	Non-value-added raw material causes expenses for the company at three different levels of the value chain: during the purchasing process, during the production phase and during the waste disposal phase.
approach/method	*calculation of residual materials* *classification of residual materials* *distinction between residual material expenditure* and remaining costs *allocation of residual material expenditure* to residual materials that drive costs up and input material that is included into the residual materials *implementation of results* into the operational definition of goals, planning, managing and controlling process
result	residual materials and connected expenditure are allocated according to the causative principle
critical assessment	transparency of operational processes and exposure of potential economic and ecologic weak spots during the transformation process due to the registration of material and energy flows allocation of residual material expenditure to cost centers and cost units by means of the registered material and energy flows identification of weak spots in cost accounting by means of implicit plausibility checks on the available data benefit to the continuous process of improvement improvement of information for product development and cost accounting additional data entry work

literature	FISCHER, H. (2001): Reststoff-Controlling. Ein neues Tool zur Steigerung der Material- und Energieeffizienz, Berlin, 2001. FISCHER, H.; BLASIUS, R. (1995): Umweltkostenrechnung. In: Bundesumweltministerium; Umweltbundesamt (Eds.): Handbuch Umweltcontrolling, München 1995, p. 439-457. FICHTER, K.; LOEW, T.; SEIDEL, E. (1997): Betriebliche Umweltkostenrechnung - Methoden und praxisgerechte Weiterentwicklung, Berlin 1997. LOEW, T.; FICHTER, K.; MÜLLER, U. (2003): Ansätze der Umweltkostenrechnung im Vergleich. In: Umweltbundesamt (Hrgs.): UBA Texte 78/03, Berlin 2003. Available from: www.umweltdaten.de/publikationen/fpdf-l/2428.pdf, Stand: 2003, Retrieved [01.06.2008]. LUTZ, U.; NEHLS-SAHABANDU, M. (2005): Fachbibliothek nachhaltiges Management, Neidlingen, 2005. SCHMIDT, M.; KEIL, R. (2003): Kostentransparenz und Umweltwirkung betrieblicher Stoffströme und ihre systematische Analyse mittels Software-Einsatz. In: Kramer, M.; Eifler, P. (Eds.): Umwelt- und kostenorientierte Unternehmensführung – Zur Identifikation von Win-win-Potentialen, Wiesbaden 2003, p. 131-154.

Residual Material Accounting can be applied parallel to Flow Cost Accounting and is integrated into the example calculation for Flow Cost Accounting in the following paragraph.

7 Flow Cost Accounting

The Flow Cost Accounting approach aims at a consistent presentation of all material and energy flows that occur in the company. The traditional cost accounting system does not focus on material and energy flows; therefore, they cannot be retraced completely. Flow Cost Accounting also permits to evaluate the overall resource efficiency. The method not only allows the retracing of product related flows but also of residual material related flows. Flow Cost Accounting is based on Residual Material Accounting; however, it expands the latter by the explicit product focus. Therefore, Flow Material Accounting falls under the category of material and energy flow oriented approaches.

Table 8: Characteristics Flow Cost Accounting

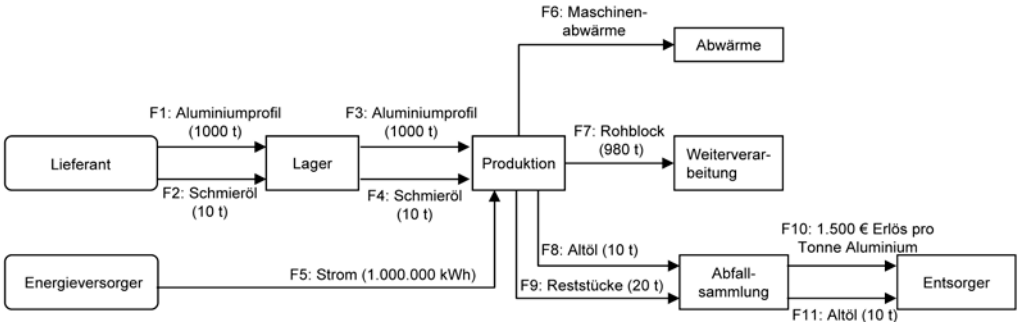
attribute	description
origin	The Flow Cost Accounting method has been developed from Residual Material Accounting in the 1990s with the significant participation of the INSTITUT FÜR MANAGEMENT UND UMWELT (INSTITUTE FOR MANAGEMENT AND ENVIRONMENT) and the INSTITUT FÜR ÖKOLOGISCHE WIRTSCHAFTSFORSCHUNG (INSTITUTE FOR ECOLOGICAL ECONOMY RESEARCH). First pilot project were carried out at CIBA GEIGY PHARMA-DEUTSCHLAND GMBH, ITT AUTOMOTIVE GMBH and the company group MERCKLE / RATIOPHARM.
scope of application	worldwide
system border	cradle-to-gate
object of valuation	company
measure of valuation	internal material flows

scope	Flow Cost Accounting aims at a reduced and efficient use of materials and energy through the identification and evaluation of improvement measures and the identification of ecological efficiency potentials.
assumptions	underlying cost concept of flow cost as sum of material costs, system costs and costs for delivering and disposal material costs are caused by the "consumption" of materials system costs include all costs that occur during the operational value creation costs for delivery and disposal are costs that arise in connection with the receipt and handing of material
approach/method	On the basis of a material flow model, Material Flow Accounting and System Cost Accounting are being conducted. *Material Flow Accounting* Material Flow Amount Accounting Material Flow Value Accounting Material Flow Cost Accounting *System Cost Accounting* System Cost Delineation > System Cost Classification> System Cost Allocation The method is applied mainly in the form of a special account.
result	material flow related consistency check of information system material flow related clarification of structures and allocation methods within the cost accounting method development of ecologic and economic measures
critical assessment	suitable for companies with high material and energy costs and currently no existing or only low level Environmental Management high practical relevance due to the innovative approach to material costs Environmental Management based on Flow Cost Accounting show s a high degree of accordance with economic corporate goals. This increases the chances of promotion.
literature	HESSISCHES MINISTERIUM FÜR WIRTSCHAFT, VERKEHR UND LANDESENTWICKLUNG (Eds.) (1999): Flusskostenmanagement. Kostensenkung und Öko-Effizienz durch eine Materialflussorientierung in der Kostenrechnung, Wiesbaden 1999. LANG, C.; STEINFELDT, M.; LOEW,T.; BEUCKER, S.; HEUBACH, D.; KEIL, M.. (2004): Konzepte zur Einführung und Anwendung von Umweltcontrollinginstrumenten in Unternehmen. Available from: http://www.bum.iao.fraunhofer.de/downloads/EndberichtForschungsprojektINTUS.pdf, Stand: 2007, Retrieved [01.06.2008]. UMWELTBUNDESAMT (Eds.) (2003b): Ansätze der Umweltkostenrechnung im Vergleich. Available from: http://www.umweltdaten.de/publikationen/fpdf-l/2428.pdf, Stand 23.11.2007, Retrieved [01.06.2008].

Example calculation Flow Cost Accounting and Residual Material Accounting

PROFIL GMBH & CO. KG is a mechanical engineering company that produces aluminum parts i.a. for plant construction. Ms Bauer, who works in the controlling department, demonstrates Flow Cost Accounting on the basis of the production process. The approach includes a separate examination of residual materials; therefore there will be no additional example for Residual Material Accounting. Aluminum profiles are being transformed into ingots and fed into the production process. This production step shall be examined with the Flow Cost Accounting method. The exact process is depicted in figure below One metric ton of aluminum costs 6 000 €, one metric ton of lubricating oil costs 800 €. The local energy supplier charges 0.20 €/kWh for

electricity. The established costs for each cost center include storage costs of 200 000 €, production costs of 1 100 000 € and disposal costs of 220 000 €.



Example Flow Cost Accounting

Derivation

<u>Step 1: Material Flow Accounting</u>

Example calculation Flow Cost Accounting – Material Flow Accounting

flow-no. (F)	material		amount		material costs in €		disposal costs in €	
	material group	description			per t	total	per t	total
1;3	product materials	aluminum	1.000	t	6.000	6.000.000		
2;4	operating materials	lubricating oil	10	t	800	8.000		
5	operating materials	electricity	1.000.000	kWh	0,2	200.000		
flow-no. (F)	material		amount		material costs in €		disposal costs in €	
	material group	description			per t	total	per t	total
6	residual products	waste heat	1.000.000	kWh	0,2	200.000		
7	product materials	ingot	980	t	6.000	5.880.000		
8	residual products	used oil	10	t	800	8.000		
9	product materials	cut-off piece	20	t	6.000	120.000		
10	product materials	cut-off piece	20	t	6.000	120.000	-1.500	-30.000
11	residual products	used oil	10	t	800	8.000		

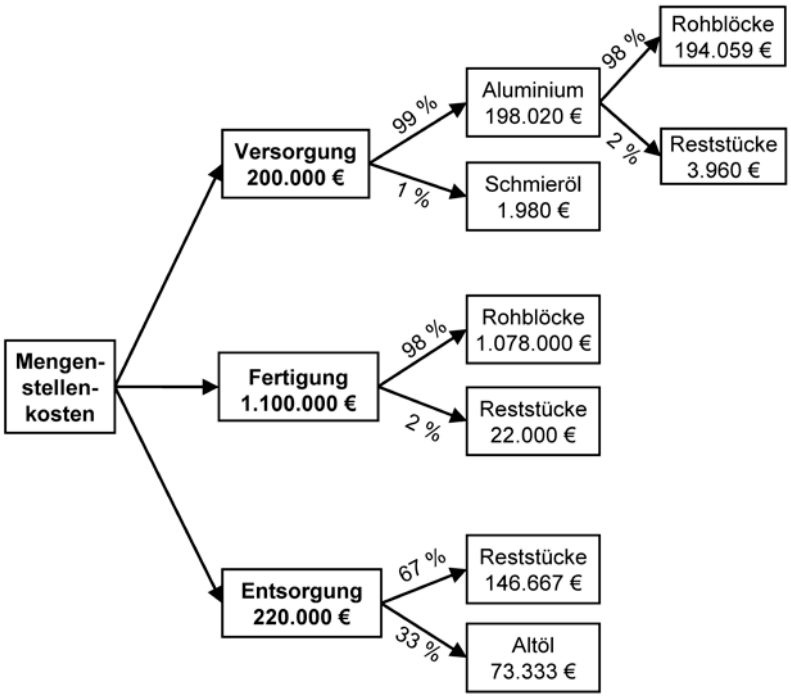
<u>Step 2: System Cost Accounting</u>

Example calculation Flow Cost Accounting –System Cost Accounting

amount unit	flow-no.	material		allocation			amount unit costs [€]		
		material group	description	relevance	amount [t]	key	pre-stage	production	post-stage
supply amount units	1	production material	aluminum	yes	1.000				
	2	operating materials	lubricating oil	yes	10				
	allocation relationship:		**storage costs**		**1.010**	**100 %**		**200.000**	
	3	product materials	aluminum	yes	1.000	99 %		198.020	
	4	operating materials	lubricating oil	yes	10	1 %		1.980	
production amount units	3	product materials	aluminum	yes	1.000		198.020	198.020	
	4	operating materials	lubricating oil	no	10		1.980		
	5	operating materials	electricity	no					198.000
	allocation relationship:		**production costs+ product material**		**1.000**	**100 %**		**1.298.020**	
	6	residual products	waste heat	no					
	7	product materials	profile	yes	980	98 %		1.272.060	
	8	residual products	used oil	no	10		1.980		
	9	product materials	cut-off piece	yes	20	2 %		25.960	25.960

amount unit	flow-no.	material		allocation			amount unit costs[€]		
		material group	description	relevance	amount [t]	key	pre-stage	production	post-stage
disposal amount unit	8	residual material	used oil	yes	10		1.980		
	9	production material	cut-off pieces	yes	20		25.960		
	allocation relation:		**disposal costs**		**30**	**100 %**		**220.000**	
	10	operational material	used oil	yes	10	33 %	1.980	73.333	75.313
	11	production material	cut-off pieces	yes	20	67 %	25.960	146.667	172.627

Step 3: Formation of Flow Cost Matrix



Proportional amount unit costs

Example calculation Flow Cost Accounting – Flow Cost Matrix

flow	material costs in €	proportional amount unit costs in €			disposal costs in €	flow costs in €
		supply	production	disposal		
ignot	**5.880.000**	**194.059**	**1.078.000**	**0**	**0**	**7.152.059**
cut-off pieces	120.000	3.960	22.000	146.667	-30.000	262.627
hydraulic oil	8.000	1.980	0	73.333	0	83.314
sum residual materials	**128.000**	**5.941**	**22.000**	**220.000**	**0**	**375.941**
energy	**200.000**	**0**	**0**	**0**	**0**	**200.000**
sum costs in €	**6.208.000**	**200.000**	**1.100.000**	**220.000**	**-30.000**	**7.728.000**

Results:
The flow costs for the examined production step amount to a total sum of 7.728 Mio. €. Residual materials amount to about 376 000 €. Consequently, 92.5 % of the total flow costs are related to the product „ingot“. Residual materials and energy demand cause 4.9 % and 2.6 % of the overall flow costs. Operational materials, in this case hydraulic oil, only account for 1 % of overall costs. Mrs. Bauer also finds that the major share of the flow costs (about 80 %) can be assigned to the material costs.

8 Resource Cost Accounting

Resource Cost Accounting is a method that includes material and energy flows into the examination of processes. The underlying principle of the approach is to focus on resource efficiency. The method is based on the expense distribution sheet from traditional cost accounting but also respects the material and energy flow accounting approach.

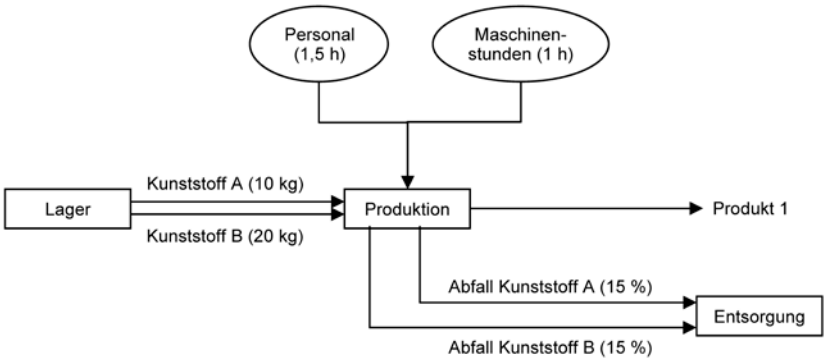
Table 9: Characteristics Resource Cost Accounting

attribute	description
origin	EFFIZIENZAGENTUR NRW developed this method in the early 2000s.
scope of application	worldwide
system border	cradle-to-gate
object of valuation	processes within the company, especially SME, with low level cost accounting
measure of valuation	operational material and energy flows that exert an influence on the environment
scope	Resource Cost Accounting includes environmental aspects into the traditional decision-making process
assumptions	The Company already applies the traditional cost accounting concept through the expense distribution sheet.
approach/method	*traditional expense distribution sheet* *registration of materials that are allocated to the cost center* (=> well functioning stock accounting is necessary) *assignment of material flows* (material usage and residual materials) to products, intermediate products and semi-finished products that are being produced in the cost center *process-based recording of material flows and energy consumption* *process-based recording of material flows and energy consumption with percentage allocation of corresponding overall production costs* *process-based recording of material flows and energy consumption with process-related allocation of corresponding overall production costs*
result	amount and value presented separately
critical assessment	low requirements for cost accounting high acceptance level by controlling department function-neutral basic accounting less appropriate for large firms with existing cost accounting system
literature	STÜRZNICKEL, B.; LETMATHE, P. (2003): Ressourcenkostenrechnung. In: Tschandl, M. (Eds.): Integriertes Umweltcontrolling: von der Stoffstromanalyse zum integrierten Bewertungs- und Informationssystem. Wiesbaden 2003, p. 137-154. LETMATHE, P.; STÜRZNICKEL, B. ; TSCHESCHE, J. (2002): Ressourcenkostenrechnung . In: Umweltwirtschaftsforum 2002, Volume. 10, p. 52-57. LETMATHE, P. ; WAGNER, G. (2002): Umweltkostenrechnung . In: Küpper, H.-U. ; Wagenhofer, A. (Eds.) : Handwörterbuch Unternehmensrechnung und Controlling. Stuttgart 2002, p. 1988-1997. DIE EFFIZIENZ-AGENTUR NRW (2008): Ressourcenkostenrechnung. 2008. Available from: www.efanrw.de/rkr-cd/material/einleitung/start.html, Stand 2008, Retrieved [01.06.2008].

Example calculation Resource Cost Accounting (cf. Die Effizienz-Agentur NRW, 2008)

POLYMER1000 GMBH is a leading manufacturer of plastic casing, plastic cladding and plastic trim strips. The company places special emphasis on the efficient use of resources; therefore, Resource Cost Accounting is applied. The production of an engine cowling requires 20 kg of plastic A and 10 kg of plastic B. The purchase price is 20 € for plastic A and 15 € for plastic B, the disposal of 1 kg of plastic costs 2 €. Throughout the production process, 15 % of the used material (relative to the mass) will be turned into waste. The production process also requires 1

machine hour at 100€/h and 1.5 man hours at 100€/h. So as to demonstrate the difference between Resource Cost Accounting and Traditional Cost Accounting, both methods shall be considered.



Example Resource Cost Accountin

Derivation:

1. Traditional Cost Accounting

Example calculation Resource Cost Accounting -
Traditional Cost Accounting

costs for	material			material costs in €		disposal costs in €		production costs			sum
	description	amount		per kg	total	per kg	total	amount in h	costs per h	total	
product 1	plastic A	10	kg	20	200						**500**
	plastic B	20	kg	15	300						
disposal	disposal	4,5	kg			2	9				**9**
personnel								1,5	100	150	**150**
machines								1	100	100	**100**
sum											**759**

The manufacturing costs for one product amount to 759 €, of which 500 € are for materials, 150 € are for personnel, and 100 € are for machines. Only 9 € are for the disposal of waste.

2. Resource Cost Accounting

Example calculation Resource Cost Accounting – Joint Cost Accounting

cost center	cost unit	material		material costs in €		disposal costs in €		production costs			sum
		description	amount	per kg	total	per kg	total	amount in h	costs per h	total	
product 1	**product 1**	plastic A	8,5 kg	20	170						**170,00**
	waste	waste	1,5 kg	20	30	2	3				**30,00**
	product 1	plastic B	17 kg	15	255						**255,00**
	waste	waste	3 kg	15	45	2	6				**45,00**
disposal	**disposal**	waste	4,5 kg			2	9				**9,00**

cost center	cost unit	material		material costs in €		disposal costs in €		production costs			sum
		description	amount	per kg	total	per kg	total	amount in h	costs per h	total	
personnel	**product 1**							1,275	100	127,50	**127,50**
	waste							0,225	100	22,50	**22,50**
machine hours	**product 1**							0,850	100	85,00	**85,00**
	waste							0,150	100	15,00	**15,00**
sum					**500**		**9**			**250**	**759,00**

Resource Cost Accounting shows that a total of 121.50 € do not relate to the product itself but are to be allocated to the waste produced in the process.

Example calculation Resource Cost Accounting – Result

cost unit	costs in €
material	**500,00**
of that product	425,00
of that waste	75,00
disposal	**9,00**
personnel	**150,00**
of that product	127,50
of that waste	22,50
machine hours	**100,00**
of that product	85,00
of that waste	15,00
sum	**759,00**
sum disposal	**121,50**

Results:

Resource Cost Accounting shows that not only losses of material, but also overhead expenses are to be allocated to the cost unit waste. Consequently, saving potentials can be determined. Those potentials, apart from permitting a more efficient use of raw materials, also reduce overhead expenses.

9 Japanese Guideline for Environmental Accounting

The Japanese Guideline for Environmental Accounting constitutes a special from of Environmental Accounting. The method connects elements of the traditional cost accounting with a reduction of environmental aspects and economic savings obtained in the process. The guideline's objective is to improve efficiency and environmental protection in the company. The instrument also serves the purpose of informing the public.

Table 10: Characteristics Japanese guideline

attribute	description
origin	The first version of the guideline concerning the introduction of environmental accounting has been published in 2000 by the „Study Group for Developing a System for Environmental Accounting"of ENVIRONMENT AGENCY JAPAN. An updated version has been published in 2005.
scope of application	Japan (although international application is envisaged by the authors)
system border	cradle-to-gate
object of valuation	company
measure of valuation	comparison of costs for operational environmental protection measures and physical environmental impacts as well as the economic effects due to costs savings and higher returns
scope	The Japanese Guideline strives for an increase of internal efficiency and effectiveness of environmental measures. The collected data may also be used by external persons for statistical and scientific purposes. This allows environmental benchmarking and other forms of environmentally orientated evaluation of companies. The envisaged application on international level shall permit comparisons of companies beyond national borders.
assumptions	Underlying cost concept "environmental protection costs": Investments and current expenses for the environmental protection (including costs caused by environmental damage)
approach/method	*periodic determination of environmental protection costs,* in doing so separate classification of investment and current expenses (including depreciation) *Creation of corresponding environmental protection cost centers* *Aggregation of costs* on site and company level *Separation of integrated measures* – four general ways of proceeding: calculation of difference; calculation of shares: "calculation by using the simple method", consideration of the overall costs of the integrated measure The choice of the method is up to the entrepreneur. *Determination of physical reduction of environmental aspects* measured by environmental indicators in the areas of resource use, waste, products and services as well as other (e.g. transport) referring to a comparison period *Determination of actual or estimated returns or cost savings due to environmental protection referring to a comparison period* or directly derived from the statement of loss and gain
result	control of downstream environmental protection measures identification of cost reducing potentials from end-of-pipe measures

critical assessment	important and good attempt to create an overall system for operational environmental accounting extern costs are included through reinstatement expenses and avoidance costs determination of environmental protection costs for the company: individual choice concerning integrated measures reduces comparability of data advantages of integrated measures might not be recognized material and energy flows are not transparent
literature	STUDY GROUP FOR DEVELOPING A SYSTEM FOR ENVIRONMENTAL ACCOUNTING (2000): Developing an Environmental Accounting System, Available from: http://www.env.go.jp/policy/kaikei/report00e.pdf, Stand 2000, Retrieved [01.06.2008]. UMWELTBUNDESAMT (Eds.) (2003). Ansätze der Umweltkostenrechnung im Vergleich (Forschungsbericht 299 15 156; Texte 78/03). Berlin. MINISTRY OF THE ENVIRONMENT JAPAN (2005): Environmental Accounting Guideline 2005, Available from: http://www.env.go.jp/en/policy/ssee/eag05.pdf, Stand 2005, Retrieved [01.06.2008].

Example calculation Japanese Guideline for Environmental Accounting

The Dresden branch of MOBILITY UNLIMITED operates a car wash facility that is characterized by high water consumption. Mrs. Reinhart has collected information about the possible installation of a waste-water treatment plant by means of a bioreactor. During the process organic substances in the waste water are degraded and the water can therefore be reused as industrial water. The investment costs of the plant are at 35 000 €; the period of use is 20 years. Furthermore, the plant causes additional annual maintenance and service costs of 2 000 € as well as higher current costs of 350 €. For each wash or vehicle, the existing plant consumes about 150 liter of water of which the company disposes as waste water. The new plant with bioreactor would keep 80 % of the water in the cycle and require only 20 % of fresh water (about 5 % of the used water is lost due to evaporation or remains on the vehicle). The branch operates averagely 3 650 washes a year. The supply of one m³ of fresh water costs 2.15 € and the disposal of one m³ of waste water costs 1.49 €. Mrs. Reinhart chose to apply the Japanese Guideline so as to calculate saving potentials and to identify environmental protection costs and resulting effects.

Derivation:

<u>Calculation of saving potentials:</u>

Example calculation Japanese Guideline

washes per year	3.650			
fresh water use per wash old	150 l		=	0,15 m³
fresh water use per year old	= 3.650*150 l =	547.500 l	=	547,5 m³
fresh water use per wash new	30 l		=	0,03 m³
fresh water use per year new	=3.650*30 l=	109.500 l	=	109,5 m³
savings on freshwater per year	=547.500l - 109.500 l =	438.000 l	=	438 m³
waste water discharge per year old	=0,95*547.500 l =	520.125 l	=	520,1 m³
waste water discharge per year new	=0,95*109.500 l=	104.025 l	=	104 m³
savings on waste water per year	=520.125l-104.025 l=	416.100 l	=	416,1 m³
cost per m³ freshwater	2,15 €/m³			
cost savings freshwater	=438 m³*2,15 €/m³=	941,70 €		
cost per m³ waste water	1,49 €/m³			
cost savings wastewater	=416,1 m³*1,49 €/m³=	619,99 €		
sum savings	**=941,70 €+619,99 €=**	**1.561,69 €**		

Result:

Umweltschutzkosten

Investitionskosten	35.000 €
Wartung/Instandhaltung	2.000 €
Laufende Kosten	350 €
Summe	37.350 €

Effekte

Ökologisch	
Reduzierung Frischwasserverbrauch	438,0 m³
Reduzierung Abwassereinleitung	416,1 m³
Summe	854,1 m³
Ökonomisch	
Kosteneinsparung geringerer Wasserverbrauch	941,70 €
Kostenreduzierung geringere Abwassereinleitung	619,99 €
Summe	1.561,69 €

Example Japanese Guideline

The installation of a waste-water treatment plant with bioreactor causes environmental costs of 37 350 €. On the other hand, the new plant can reduce fresh water use by 438 m³ and waste water use by 416.1 m³. These reductions lead to an annual cost saving of 1 561.69 €.

10 Cost Utility Analysis

Cost Utility Analysis constitutes a method to compare and evaluate different options; therefore, it can improve the decision making process concerning investments. The Costs Utility Analysis method does not only take monetary criteria into consideration, but also focuses on non-monetary evaluation and qualitative aspects. Monetary criteria are included into the method as separate utility category. The method may be applied if an exclusively monetary evaluation of different options is neither possible nor appropriate.

Table 11: Characteristics Cost Utility Analysis

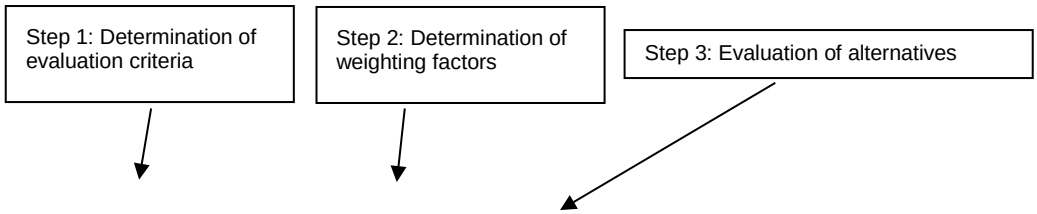
attribute	description
origin	The method has been developed in the 1960s in the USA and has acquired a wider reputation in Germany thanks to ZANGEMEISTER (ZANGEMEISTER, 1976).
scope of application	worldwide
system border	gate-to-gate
object of valuation	several complex alternatives, including those that cannot be evaluated in monetary terms

measure of valuation	to be determined individually
scope	Cost Utility Analysis supports multi-criteria decisions
assumptions	utility of the alternative does not depend on set goals Addition of utility values is possible constant weighting factors (e.g. over the course of time)
approach/method	*determination of goal system* *elaboration of evaluation criteria* *weighting of evaluation criteria according to the degree of target achievement* *Evaluation of alternatives according to the degree of target achievement* (target revenue) *Calculation of utility value* through multiplication of weighted evaluation criteria and target revenue
result	overall utility value of all alternatives
critical assessment	clear presentation of decisions concerning multiple objectives decision process and subjective decision criteria are presented in a transparent and comprehensible way combination of qualitative and quantitative criteria is possible results are neither universally valid nor transferable
literature	ZANGEMEISTER, C. (1976): Nutzwertanalyse in der Systemtechnik – Eine Methodik zur multidimensionalen Bewertung und Auswahl von Projektalternativen, Verlag Wittemann, 1976, München. WITTMAN, R. G.; LEIMBECK, A.; TOMP, E. (2006): Innovationen erfolgreich steuern, Heidelberg 2006. JÄGER, T.; KARGER, C. R. (2006): Instrumente zur Nachhaltigkeitsbewertung: Eine Synopse. Available from: www.fz-juelich.de/inb/inb-mut/projekte/pdf /bewertungsinstrumente_synopse.pdf, Stand: 2006, Retrieved [01.06.2008]. BÖHM, E.; HILLENBRAND, T.; LIEBERT, J.; SCHLEICH, J.; WALZ, R. (2002): Kosten-Wirksamkeitsanalyse von nachhaltigen Maßnahmen im Gewässerschutz. In: Umweltbundesamt (Eds.): UBA Texte 12/02, Berlin 2002.

Example calculation: Cost utility analysis

MOBILITY UNLIMITED considers purchasing a new lacquering plant for automotive coatings. The plant that is currently used applies liquid coatings. Lately, leading car manufacturers have increasingly been using powder coating. Mrs. Reinhart would like to apply Cost Utility Analysis to test whether powder coating is preferable to liquid coating in terms of ecological aspects. The degree of target achievement is measured with a scale extending from 0 to 10. The number 10 stands for a degree of target achievement of 100 %.

Derivation:



Example calculation Cost Utility Analysis

criterion	weighting	liquid coating		powder coating	
		degree of target achieve-ment	partial utility value	degree of target achie-vement	partial uti-lity value
CO_2 emissions	15 %	3	45	5	75
NMVOC emissions (from solvents)	25 %	5	125	10	250

criterion	weighting	liquid coating		powder coating	
		degree of target achieve-ment	partial utility value	degree of target achie-vementq	partial uti-lity value
energy consumpti-on	10 %	7	70	3	30
coating consump-tion	20 %	2	40	6	120
waste	15 %	3	45	7	105
waste water	15 %	3	45	6	90
utility value	**100 %**		**370**		**670**

Step 4: calculation of utility values

Result:

The Cost Utility Analysis method shows that powder coating generates a higher utility value and therefore is clearly preferable to liquid coating in terms of ecological aspects. Nevertheless, additional criteria should be included into the investment decision; economic criteria, such as acquisition and maintenance costs play a crucial role. Furthermore, technical aspects are to be taken into consideration. Minimum quality requirements must be fulfilled and the coating process has to be suitable for different materials.

The implementation of environmentally oriented controlling

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The environmental management mechanism is a set of tools on the impact of economic entities to ensure the consideration of environmental factors at all stages of activity.

The basic tools of environmental management are:

- environmental assessment and the procedure of evaluation of the impact of activities on the environment;
- environmental control;
- ecological examination;
- environmental audit;
- environmental certification;
- environmental accounting and reporting;
- environmental monitoring;
- environmental labelling and advertising.

Environmental regulation is carried out at various stages of economic activity. The legal basis of such regulation are Federal Laws "On environmental protection", "On ecological expertise" and other legislative acts.

1 Environmental assessment and process evaluation of the impact of activities on the environment

In the first stage economic activity - preparation of economic decisions is the impact assessment of the proposed activities on the environment (EIA) to determine the extent and nature of exposure and select the most preferred option for the project. Data obtained from the EIA are included in the environmental sections of pre-project and project documentation, subject to mandatory environmental impact assessment.

Environmental assessment is a procedure to establish compliance of planned economic and other activities with environmental requirements and determine the admissibility of its implementation in order to prevent possible negative impacts on the natural environment.

The state ecological expert examination is conducted by a Commission established by the specially authorized state body in the field of environmental assessment for a particular object.

Planned activities can be implemented only in case of positive conclusion of the State ecological expertise.

During reconstruction, diversification, technical re-equipment of the enterprise environmental regulation is implemented in the form of procedures for the assessment of impacts on the natural environment and the state environmental expertise.

Modernization and diversification of existing enterprises Pets if there is a positive conclusion of the state ecological expertise.

At the stage of liquidation (termination of economic activities) environmental regulation is to assess the impact of the facility on the natural environment (post-project analysis) and the state ecological expertise (liquidation of the company should not cause negative consequences for natural objects).

2 Environmental control

In the second stage of economic activity - construction - environmental regulation is made by the local environmental authorities and sanitary-and-epidemiologic supervision in accordance with environmental, sanitary and building codes.

The state environmental monitoring is carried out in the form of:

- inspections to ensure compliance with requirements for the protection of water and air in the process of construction;
- control the removal and storage of topsoil, preservation of green space during construction;
- control of the reclamation of the land upon completion of construction, pre-commissioning and commissioning of environmental facilities.

3 Environmental monitoring

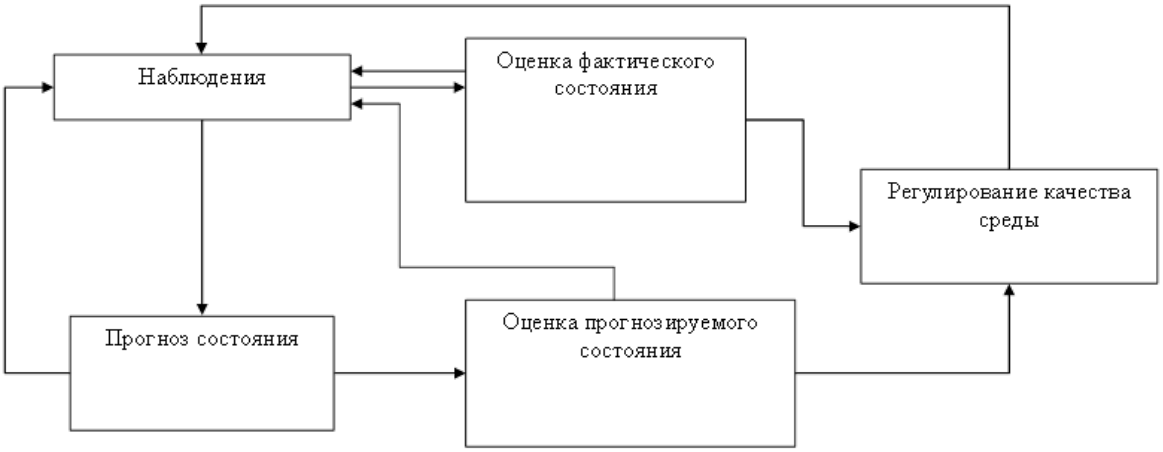
During the operational phase of the economic object (in normal mode) measures of environmental regulation include environmental monitoring (EM). Environmental monitoring - periodic or continuous measurement, evaluation, and determination of environmental parameters and contamination levels with the aim of preventing negative or destructive impact on the environment. Also includes forecasting of possible changes in ecosystems and the biosphere as a whole. Scheme monitoring is presented in figure 10.1.

Features environmental monitoringagent observation of natural objects and sources of anthropogenic pollution.

Monitoring of the natural environment forms the in-formational ensuring environmental management as at the enterprise level and at the regional and Federal levels.

The collection, storage, processing and transmission of data is carried out thanks to the Unified state system of environmental monitoring (ЕГСЭМ).

Figure 9: Diagram of the monitoring



The environmental monitoring for the oil and gas industry allows you to:

- evaluate the negative impacts on natural systems;
- to identify the causes of negative impacts and their sources who incurred;
- to decide on the adjustment of technological processes.

For assessment of the ecological environment and the impact of oil and gas objects on all components of the enviromental, you need to monitor and control their condition, which conducted a comprehensive environmental monitoring in accordance with environmental law is divided into public and industrial. Exposes industrial and social infrastructure, trends in the status of the components and operating system objects depending on the scale of industrial activity. With this aim, methods and apparatus in accordance with the RF law "On ensuring the uniformity of measurements", which allows to obtain results with the required accuracy of measurements.

For monitoring oil and gas production, specially organized and equipped environmental polygons and areas for scientific and technological research in the area of anthropogenic impact.

Integrated system monitoring includes monitoring of the atmosphere, aquatic environments, locomonitor (monitoring of subsoil), the monitoring of landscape and exogenous geological processes.

Local environmental monitoring (LEM) on the hydrocarbon is carried out in three areas: aerospace, ground and forecast.

Aerospace monitoring based on remote sensing data site to identify objective situations by comparing materials control surveys, 1 year, basic landscape-ecological map of the territory, in the process of engineering and environmental studies.

Ground monitoring comprises: monitoring air pollution, radiation, monitoring of surface and groundwater, geotechnical, soil, biological.

Predictive monitoring is an integral part of terrestrial and aerospace monitoring. The goal of predictive monitoring - a comprehensive analysis, modeling and prediction of the impact on the natural environment.

Holding LEM fields includes:

1. Preparatory stage:

- the formation of goals, objectives and monitoring objects;
- select the location and number of monitoring points;
- choice of equipment and methods of analysis;
- the choice of methods of sampling, preservation and storage of samples;
- analysis and interpretation of results available observations on the state of environmental components. The selection of background values;
- analysis of pre-established environmental standards of the EM objects;
- preparation of preliminary maps of key areas of field work (observation posts), technogenic load.

2. The field phase ground investigation:

- sampling, preservation and storage of samples, their transportation to the place of stationary measurements (chemical analytical laboratory, biological laboratory, and others);
- conducting field measurements, their documentation.

  Step ensures that the execution of the works, taking into account the stages of field development.

3. The stage of post-processing of the collected field data and drafting of the report:

- laboratory work, the implementation of quantitative chemical analysis (QHA) of samples of air, water, sediments, soils, identification of the species composition of aquatic organisms;
- statistical processing of the results of laboratory work and metrological measurements; off-site hydrological, geo-Botanical, soil studies;
- presentation (report, tables, protocols, QHA, updated map parcel of land degradation, vegetation). Final report on the LEM up to 1 times per year, analytical reports every 3 and 5 years.

An integrated approach in the implementation of the LEM on the territory of oil and gas fields found a practical application for making fully informed management decisions of the company in the field of environmental protection.

Among the main problems to ensure the required level of industrial safety at hazardous production facilities of oil and gas complex are the following:

- the extremely low level of security of oil and gas facilities from accidents with serious consequences;
- the systematic violations of the companies of the requirements for the safe use of subsoil in the oil fields;
- the unsatisfactory state of exploration wells for oil.

Therefore, a special place in the EM system is the monitoring of possible emergencies. Given this, it is necessary:

1. A detailed analysis of emergency situations and complications during drilling to assess the likelihood and extent of exposure that will allow you to identify approaches to ecological risk assessment, to assess the real economic damage and, finally, to optimize the search for technological solutions that ensure the ecological safety of production and reduction of capital investment in the operation field.
2. The creation of a system of monitoring and, in the first place, monitoring of the chemical composition of groundwater and hydrological characteristics and water pollution in major hydrological periods: winter and summer low-water period in the spring and autumn floods.
3. Control the tightness of sludge pits with the following activities:

- careful monitoring of the integrity of membrane screen and elimination of violations of insulation;
- organization of the mine workings (at least trackway) around the perimeter of the barn - two of them the meter deeper than the bottom and one at the nearest aquifer;
- are developing in the direction of groundwater flow;
- well equipped with a casing and a filter mouth are cemented or isolated;
- before operating the barn are level measurements and water sampling for chemical analysis to obtain background data;
- after filling the pits once in ten days, and after three months of operation once a month to analyze the composition of the water in the workings and compare with background data;
- in case of depressurization impervious screen carry out the repair or construction of a new barn.

4. Quantitative and qualitative assessment of the consequences of accidents should include calculations of the volume of spilled oil, water, gases in the separation pipe, including information about the change of pressure, temperature, flow under different conditions of expiration, as well as data on the distribution of emissions and the possible consequences for the population and components of the enviromental. Assessment of the extent of involvement of personnel, the public, and monitoring the consequences of accidents.

In accordance with applicable regulations at the expense of the perpetrator of the accident after the spill of oil must be provided with environmental monitoring of water bodies, soil, atmospheric air.

4 Environmental audit

During the operation of an object as a tool of environmental security are environmental audit. Environmental audit means periodic analysis of the various aspects of the enterprise from the point of view of compliance with the requirements of environmental protection.

Environmental audit is carried out:

- when real estate transactions;
- privatization;
- when environmental rationale of the investment project to determine the extent of environmental risk of the enterprise;

- for a contract to environmental insurance;
- when an object is expanded without technical re-equipment;
- to assess compliance of the environmental management systems at the enterprise regulatory requirements;
- in the analysis of financial indicators of the environmental activities of the company.

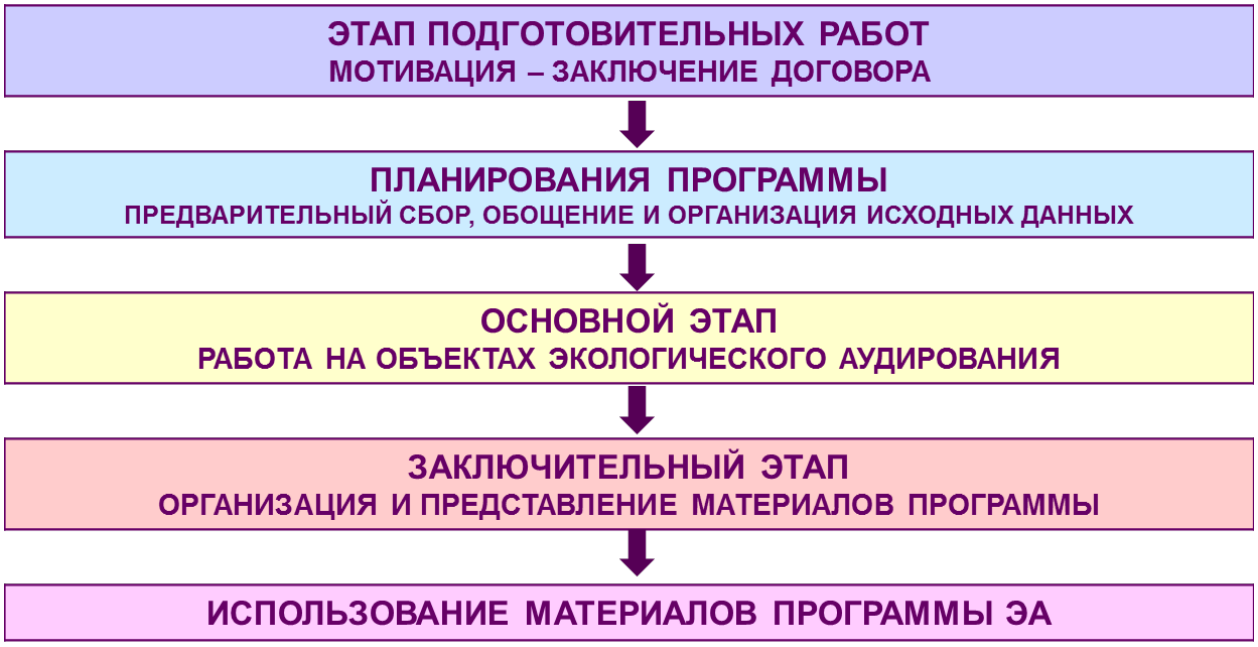
Environmental auditing environmental management systems in accordance with ISO 14001 is defined as a systematic and documented process for obtaining objective evidence to determine whether the environmental management system of the enterprise criteria that apply to such systems.

The company must develop and maintain periodic audits of environmental management systems. During carrying out of environmental audits is determined that corresponds to the current environmental management system to the requirements of the International standard ISO 14001 (or its national equivalent), and to the extent provided and maintained its functioning.

Environmental audit the environmental management system should be based on the present environmental activities of the company and the results of previous audits.

Procedure programs the environmental audit is shown in figure 10.

Figure 10: Procedure programs the environmental audit



Environmental auditing should be beneficial to the management of the enterprise, as the results of audits infiniroute whether the environmental management system and management the way it should work in accordance with its stated environmental policy and objectives.

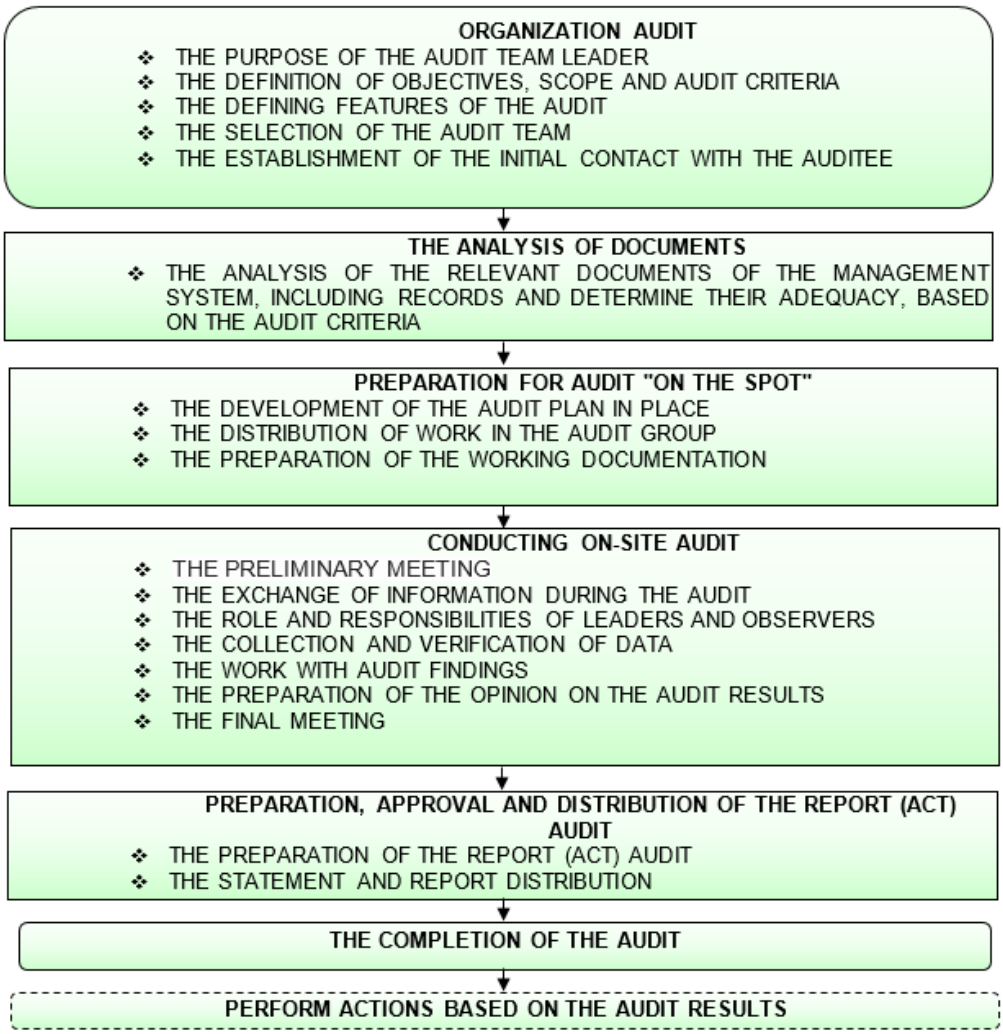
The company may also conduct an environmental audit for other purposes, for example, for the purpose of certification of the environmental management system by a third party in accordance with national or international standards.

Programs and procedures for environmental auditing should consider:

- priority environmental aspects of activities of the company;
- the periodicity of the audit;
- effective planning and efficient organization of work of the audit team;
- active use of the results of the audit;
- the competence of the auditors;
- the General methodology of environmental auditing and methodology of audits.

The outline of the environmental audit of the oil and gas industry is presented in figure 11.

Figure 11: Scheme of environmental audit



Environmental audit environmental management systems can be internal and/or external. In the case of internal audit, the company's management directs the responsible specialists on the staff of the formation of the audit team, which may include experts from outside. In the case of external audit contract with a specialized firm or specialist has a license for this activity and forming audit "team", which may include representatives of the enterprise. In any case, the specialists carrying out an environmental audit must be qualified, impartial and objective.

To create and ensure the effective functioning of the environmental management system is not easy, so you can conduct environmental auditing in order to identify those areas and aspects which are not yet developed. Conclusion environmental auditing should include advice on the development of environmental management at the enterprise and to be directed on creation of an effective environmental management system.

The audit firm may be held to provide information to the state bodies of environmental monitoring and control for the official certification of the environmental management system. This audit is conducted by external independent auditors or audit firms that have a license for this activity. Also is always external environmental audit, which is conducted for banks or investors.

5 Environmental certification

Monitoring of compliance with environmental safety of the current object by periodic procedures environmental certification.

Environmental certification - the procedure for the identification of the object compliance with certification requirements environmental requirements.

The purpose of the procedures for environmental certification similar goals environmental review to confirm compliance with environmental legislation. The difference lies in the objects to be assessed: in the first case (environmental certification) is a valid object, finished products; in the second case (ecological expertise) - development (pre-design, design documentation).

Objects certification are:

- environmental management system;
- products;
- technological processes;
- wastes of production and consumption;
- the environmental objects;
- environmental services.

Certification of EMS according to GOST R ISO 14001 is a process of formal confirmation of conformity of environmental management system in an enterprise environment this standard specifically accredited for the provision of such services by the organization.

International certification companies have approximately the same conditions of certification for environmental management systems, at the same time, their requirements for an environmental management system can to some extent be different.

A generalized procedure for certification is as follows:

- the company submits an application for certification;

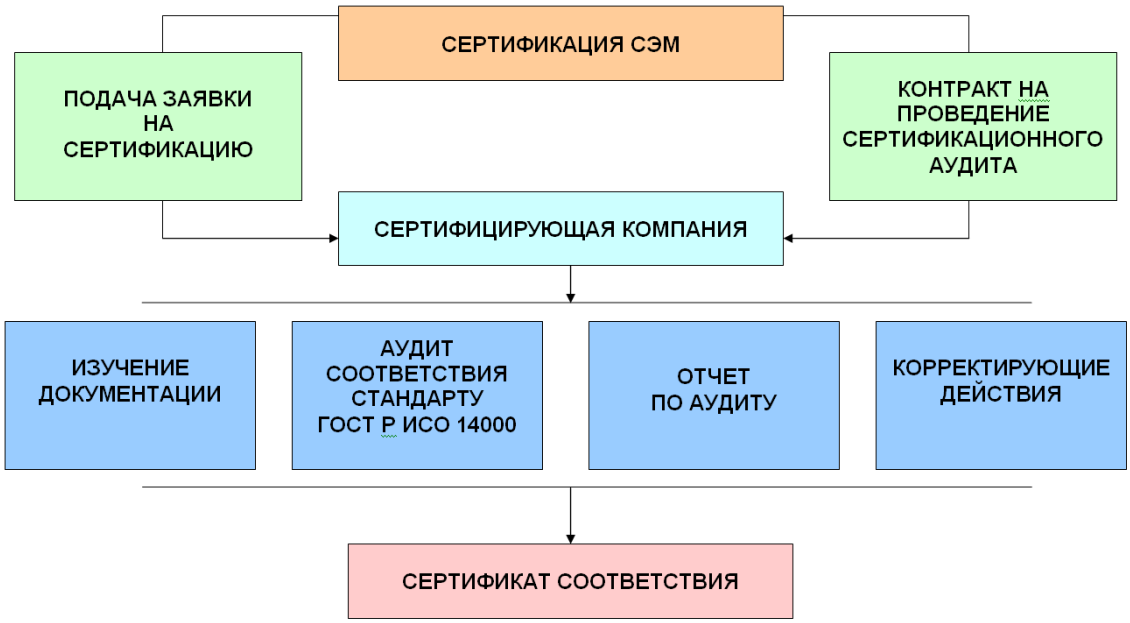
- settled between the company and the certifying company signed a contract to conduct the certification audit.
- the representatives of certifying companies conduct the first study visit with the purpose of planning the audit;
- the auditors certifying the company's study documentation EMS enterprises (primarily manual on environmental management);
- what is a compliance audit (certification audit) of the company requirements of GOST R ISO 14001;
- the auditors' certification company prepares an audit report;
- what if irregularities are found, the audit criteria, the company performs corrective actions;
- the company is awarded the certificate of conformity to GOST R ISO 14001;
- the conducted periodic audits of the environmental management system of the enterprise.

Scheme of the procedure for certification work is shown in figure 12.

After 2 to 3 years after the issue occurs confirmation certificate, for which specialists' certification company is the next audit.

The process of certification of the environmental management system takes on average about the same as the introduction of EMS, i.e. 1 - 1.5 years.

Figure 12: Diagram of the procedure for certification work



6 Environmental assessments of oil and gas projects

Environmental assessment is a process of systematic analysis and evaluation of environmental impact of planned activities, consultations with stakeholders, and consideration of the results of

this analysis and consultation in the planning, design, approval and implementation of this activity.

According to this definition:

- environmental assessment is a process, not just the data or documents obtained as a result of this process;
- environmental assessment - a systematic process, that is, following certain rules;
- environmental assessment is not limited to the planning stage, but it also covers the implementation of planned activities.

The environmental assessment process includes the following main components:

- analysis (forecast) potential impacts of the proposed activity on the environment and assessment of their significance;
- consultations with stakeholders with the aim of finding a mutually acceptable solution;
- using the results of the forecast impacts and consultation in the decision making process related to the proposed activity.

Procedures for environmental assessment in different countries differ in many aspects: for what activities you performed an environmental assessment of who conducts it, in any decisions and how to count the results.

An effective system of environmental assessment, time-tested, correspond to three basic principles: precautionary, complexity and democracy.

The precautionary principle means that the environmental assessment is conducted before making major decisions on the implementation of planned activities, and that its results are used in making and decision making. The analysis of consequences of decision environmental assessment in fact is not.

Environmental assessment should be carried out not only before adoption the decisions about the implementation of planned activities (for example, issuing a permit), but before making critical design decisions.

One of the important tools of the precautionary principle is the analysis of alternatives. Review and comparison of several alternatives to achieve the objectives planned activities and options for its implementation provides the freedom to make decisions depending on the results of the environmental assessment.

The principle of complexity involves the joint consideration of the impacts of the planned activity and associated changes in all environments, but also in the social environment. This principle is based on the idea that the division of environmental components (air, water, soil) is a simplification of the real situation. Actually we are dealing with a single natural system, closely connected with the society. The objective of environmental assessment is not only to trace, as far as respected the "standards and regulations" for the individual components of the natural environment, but also to understand how the natural-social system as a whole will respond to the impact of the intended activity.

The principle of democracy reflects the fact that environmental assessment is not limited to scientific and technical research, and is a tool for making mutually acceptable solutions.

Expected impact of planned activities on the environment affects the interests of a potentially unlimited number of individuals and organizations. Most of them do not have any formal

authority in relation to this activity. Tool for protecting the interests of these parties can serve as a different kind of system permissions and licensing, design standards. However, the principle of democracy implies the recognition for these parties the right to direct participation in the decision-making process. Thus, stakeholders should have the opportunity to participate in the environmental assessment process, and their opinion should be taken into account along with expert opinions in the formulation of conclusions and the results of the environmental assessment process.

The absence of democracy, secrecy and lack of transparency in the decision-making process often leads to the fact that, in practice, decisions in such systems are accepted on the basis of informal negotiations and agreements involving the individual, the most influential stakeholders. Often results in suffering the objectivity of the environmental assessment.

Subject to environmental assessment, in particular, is intended activities project level - project-specific business objects. The main efforts should be focused on those projects that involve a significant environmental impact. Therefore, conducting a full environmental assessment for all projects, it would hardly be expedient, and from the outset, this mechanism has been focused primarily on large projects.

Subject to environmental assessment can be not only individual projects but initiatives higher level - different plans and programmes, sectoral development, the draft regulations, which can have significant environmental consequences.

Before the project, the last stage of the environmental assessment must submit the results of its assessment on ecological expertise.

Scheme of the process of environmental assessment of oil and gas projects is shown in figure 10.5.

Figure 13: General scheme of the process of environmental assessment of projects

For the effective development of environmental assessment required organization "feedback", giving an opportunity to assess compliance or noncompliance made predictions real impact on the environment and, if necessary, to implement measures to adjust activities. This goal is achieved by developing the results of the ecological assessment, environmental management plans and programs after project analysis.

7 Analysis of environmental risks as part of the environmental management and audit

The overall steady trend to increase the impact naikruteyshy environment and, consequently, to the increase of environmental risk. Increased exposure can be uniform, and may be sharp, associated with the implementation of certain environmental events or the emergence of a significant emergency situations.

The levels of risk of the pollution of the natural environment when oil and gas are shown in Table 12.

Table 12: Risk Levels of environmental contamination from pollution sources

Type of pollution source	The risk of contamination		
	ground	water	atmosphere
Wells and wellhead equipment	low	low	low
Prefabricated piping and pipelines for water injection into the well	high	high	low
Separation plants and field processing of oil	medium	medium	high
Oil storage	medium	high	high
Equipment for injection compressor equipment and equipment used for the transfer of products to the consumer	low	low	medium

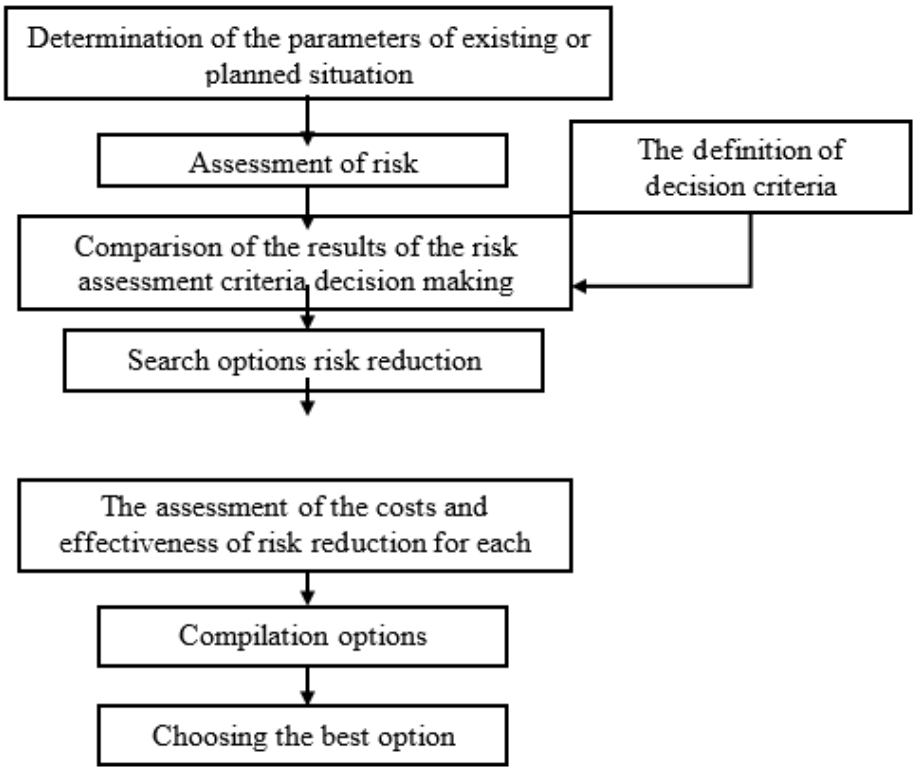
An effective way of ensuring environmental safety in oil and gas development - risk management of production.

The risk management process is based on the results of quantitative risk assessment, which allows you to:

- to compare alternative projects potentially dangerous objects and technologies;
- to identify the most dangerous risk factors acting on the object;
- create a database and a knowledge base for expert systems decision support technical solutions and the development of regulatory documents;
- to identify priority areas of investment in risk reduction and risk reduction.

Scheme of the process of managing environmental risks is presented in Figure 14.

Figure 14: scheme of the risk management process



As can be seen from figure 10.6, first by comparing the results of risk assessment to consider the situation and the relevant criteria. After this comparison are ways to reduce the risk, each of which is evaluated by considering the cost of its implementation. Assessment of options is an iterative operation is repeated until then, until you reach the optimal solution.

A significant stage in the search options for risk reduction (see Fig. 10.6) is the prediction of changes of parameters of the existing situation and the simulation of the behavior of the object in question. Under the scientific forecast understand the statement in the form of probabilistic assertions depend on uncertain or unknown factors the behavior of a specific system in the future, made under study and generalization of the experience of the past with the use of intuitive ideas about the development of this system in the future. Scientific predictions made by the experts - specialists in the oil and gas industry. Often, instead of the term "scientific Outlook" use the term "expert assessment".

The essence of the method of expert estimations is that the offer to answer questions about the future behavior of objects or systems characterized by uncertain parameters or unexplored properties. Expert estimates are expressed in qualitative or quantitative characteristics of the probabilities of these events or processes, related to a specific period of time. The importance attributed to the formation of rating scales used by the experts. Grading grading scale should be accompanied by a brief qualitative description (verbal or linguistic explanation).

STAKEHOLDERS

Thinking in target audiences– using impulses from competitive constraints and stakeholders

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1 Stakeholders as triggers

The impulse for an ecologically oriented management oftentimes does not take place due to a direct recognition of ecological scarcities, it is more often the case, that triggers and amplifiers of sensibilisation are interconnected, so called stakeholders in the closer and broader taskfield and global framework conditions in the macro field. The more groups take responsibility for the condition of our environment, the higher are the demands, companies experience.

2 Stakeholders as impulse providers

Interdependences with the company surroundings

Companies can not act isolated, economic processes are bound to a set of interactions that unites ecological, economic, technical as well as social and political, respectively legal aspects. Between this system and the company as individual economies are several interdependences, that demand adjustment processes. On a long term, companies can only secure their existence, when they meet the expectations of the closer and broader company surroundings. This means, that knowledge on the elements of the surroundings as well as possible and resulting consequences in a situation marked by dynamics, discontinuity, complexity, internationalisation and globalisation, gains importance

Macro field

In order to determine, which parts of the surroundings of a company are relevant, one should examine, to which corporate goals there is a reference. The macro field is understood as "the general conditions in a geographical space, that apply to a large amount of companies with various factual targets and the possibility to influence the establishment of certain factual targets and the implementation of strategic ways of behaving in the individual case" (Kubicek & Thom, 1976). The ecological, economic, technological, social and political, respectively legal framework conditions belong to the macro field. Thus, the macro field sets up the general framework conditions, in which economic activities take place.

Task field

The task field includes stakeholders, that are able to demand concrete requirements for the companies. They include as branch specific groups suppliers, customers and competitors. Shareholders and finance providers as well as the staff, the state and the public as regulative groups belong to the broader task field.

Stakeholders FREEMAN *defines stakeholders as „... any group or individual who can affect or is affected by the achievement of a corporation`s objectives" (Freeman, 1984)*. The two directions in the definition make it clear, that impacts can come from the stakeholder groups as well as the

company itself. When stakeholders are able to influence the company, the concerns for ecology of that company are changed as well.

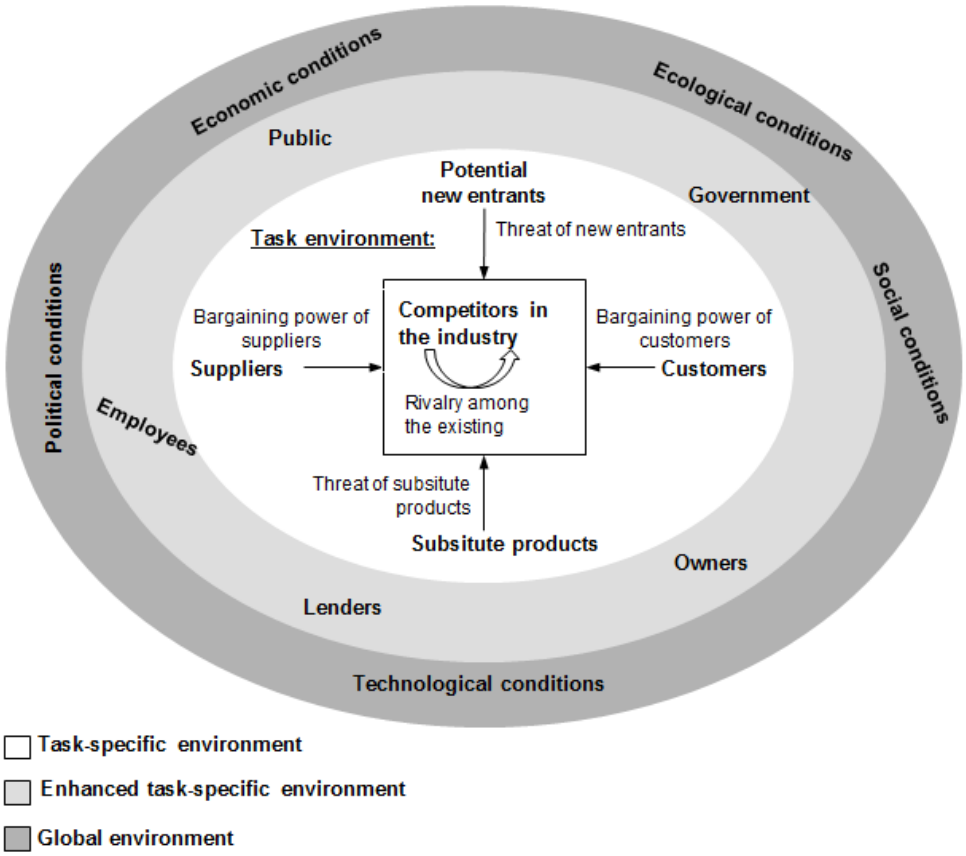
Stakeholder concept

The stakeholder concept originates from the coalition theory, which was represented the first time in 1938 by BARNARD (BARNARD, 1938) and formed the basis for the theory of the firm by CYERT/MARCH (CYERT & MARCH, 1963) in 1963. These thoughts on decision-making principles of the coalition members formed the foundation for the incentive-performance-theory, according to which the participants can decide for or against an organisation as well as for or against making a contribution. The coalition members appear to the company as individual incentive givers, by supporting (positive incentives) and punishing (negative incentives) the behaviour of a company. Due to the further development of demands placed on companies, the view on external participants, meaning all stakeholders, was extended. Therefore the stakeholder concept addresses the behaviour model of the homo reciprocans.

Interdependencies

Thus, all components of the macro field and the task field are to be examined with regards to possible impacts on the ecological orientation of the company. The technological framework conditions may prevent ecological aspects or enable them in the first place (e.g. renewable energies). Economic framework conditions like growth or the competitive situation in a branch create or limit free spaces for taking measures concerning ecology. Aside the societal (e.g. climate discussions or disposal crisis) and the ecological field (e.g. precipitation), there were, over the last years, notable changes in the environmental law in particular, that intend to prompt companies to extend their ecological orientation. Likewise, the groups of the task field influence managerial decisions.

Figure 15: Macro surroundings and task surroundings of the company



Source: based on Freeman, 1984; Kubicek & Thom, 1976; Porter, 1999

Stakeholder Identification

Stakeholders are broadly defined as actors who are affected by the firm or have the potential to affect it (Donaldson & Preston, 1995; Fassin, 2009; Freeman, 1984; Freeman, 2004; Mitchell, Agle, & Wood, 1997). In contrast, human decision-making is constrained by resources, the state of the art, norms and values as well as knowledge about alternatives (Frey & Foppa, 1986). Consequently, managers "simply cannot attend to all actual or potential claims" (Mitchell et al., 1997) and hence focus on salient stakeholders. They narrow the analysis by identifying stakeholders according to their power to affect the firm, the legitimacy and urgency of their stake (Mitchell et al., 1997). A stakeholder has power when it can "impose its will in the relationship" (Mitchell et al., 1997). Legitimacy is defined as *"a generalised perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions" (Mitchell et al., 1997; Suchman, 1995). The* stake is urgent if the relationship or claim is time-sensitive and "important or critical to the stakeholder" (Mitchell et al., 1997). Urgency adds a dynamic dimension to stakeholder identification.

Stakeholders are identified and classified based on the occurrence of one or more of these attributes (see Table 13). For example, dormant stakeholders have power but have no urgent or legitimate claim. They are thus less salient and are less likely to use their power until their claim gains urgency or legitimacy (Mitchell et al., 1997). Stakeholders with legitimate claims but

neither power nor urgency are called discretionary. Managers may engage with them but there is no pressure to do so (Mitchell et al., 1997).

Table 13: Identification of stakeholders

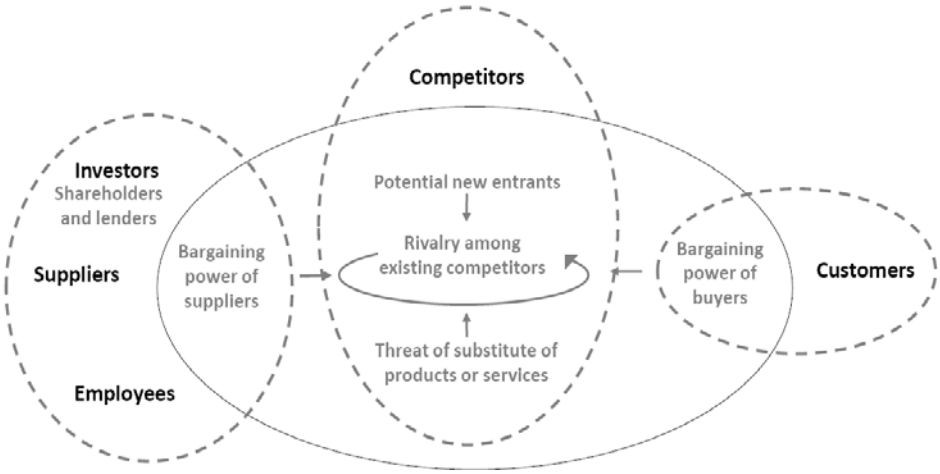
Stakeholder		Power	Legitimacy	Urgency
Non stakeholders				
Latent	dormant	X		
	discretionary		X	
	demanding			X
Expectant	dominant	X	X	
	dependent		X	X
	dangerous	X		X
Definitive		X	X	X

Source: based on Mitchell et al., 1997

Once stakeholders fulfil two of the three attributes the responsiveness of the organisation increases (Mitchell et al., 1997). Dominant stakeholders "matter" because they are legitimate and powerful (Mitchell et al., 1997). Dependent stakeholders lack power but have claims that are both urgent and legitimate. They depend upon others' power to achieve their will (Mitchell et al., 1997). For instance, the natural environment depends on the regulative power of the state for its protection. Dangerous stakeholders must also be taken into account (Mitchell et al., 1997). Although they lack legitimacy, they are dangerous because they are characterised by power and urgency. Though dealing with this type of stakeholder is uncomfortable, identifying them allows for the opportunity to counteract and mitigate their dangerous potential (Mitchell et al., 1997). If a stakeholder fulfils all three attributes he/she becomes a definitive stakeholder (Mitchell et al., 1997).

This widely used classification scheme (Achterkamp & Vos, 2007) will guide us to identify and understand the roles of the stakeholders involved in biotechnology firms.

Figure 16: Stakeholders identified through the five competitive forces



Source: Guenther & Hueske, 2014

3 Macro-environment

Different demands

Since the specific task area as well as the macro-environment consist of different components, they must be examined seperately, regarding their effect on managerial decisions. The analysis of the influencing framework conditions has to have the aim to identify possible chances and risks, in order to confront them with the entrepeneurial strengths and weaknesses.

Ecological framework conditions

Perspective of the textbook: Deriving from the impairment of the supply, reception and regulation function of the environment as well as the resulting ecological and increasingly economical scarcity – thus the condition of our planet – is, from an entrepreneurial perspective, the necessity to consider the ecological framework conditions of the entrepreneurial performance proactively. Therefore the textbook is to be understood from the perspective of the ecological framework conditions, being explained in this chapter.

Components of the ecological framework conditions: The ecological environment can, on one hand, be seperated in the environmental media ground, water and air, the scarcity of which as a supply or reception medion composes the the basis for economic activity. On the other hand, a more detailed systematisation of the environmental impact categories greenhouse effect, depletion of the stratospheric ozone (ozone hole), photochemical oxidant production (summer smog), eutrophication, acidification, utilization of fossil resources , land use, damage to health and damage to ecosystems etc. can make sense, when companies intend to implement environmental reliefs in a certain area.

Strategic relevance: The ecological framework conditions are important for the strategic development for two reasons: The company has to be oriented towards regulations, that became necessary due to the environmental situation (reactive flexibility) and can, simultaniously, use the in every situation immanent potential opportunities for its own business ventures (proactive flexibility), by only developing products and production factors that present themselves as necessary in the future, regarding the ecological environmental circumstances. The perception of the ecological environment is inevitably, when a company has to overcome the ecological scarcity, an ecological crisis, or, in an extreme case, an ecological catastrophe.

Economic framework conditions

Meaning: The economic conditions, that present themselves in macroeconomic indicators such as the economic growth, display basic information, that are relevant for the corporate management. However, experience shows, that the development of a certain procurement market or sales market can proceed different from the respective macroeconomic aggregates.

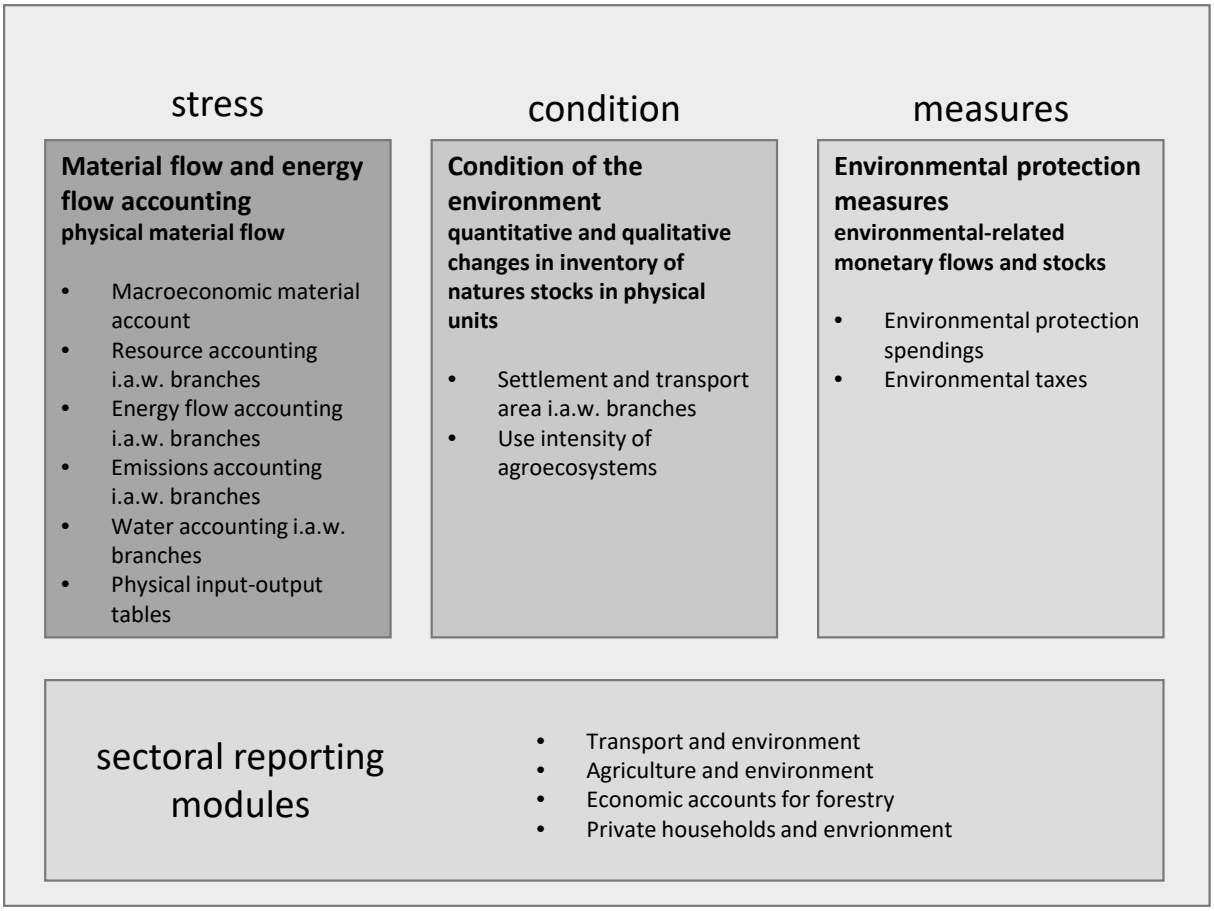
Components of the economic framework conditions: Within the economic framework conditions, general growth and development indicators, certain competitive constellations, the affiliation with a branch as well as the international developments are to be observed. General growth figures influence – depending on branche and size of the company – the corporate management and the maneuvering room of an ecologicallyoriented management. Population growth influences this aswell (see IPAT-equation in chapter 1). Aside from the general situation, the respective competitive situation of a company or business area is of importance. According to PORTER, on can differentiate between the following strategies for the determination of the competitive position (cf. Porter, 1999; Porter, 2000): For standartised products in the low price segment, a broad cost leadership is preferable, a differentiation strategy is preferable, when, due to specific advantages in quality, service or image, a higher price can be achieved. A specialisation strategy is expedient, when a concentration on a certain market segment (product-related, but also region-related) seems beneficial. Different impacts of the branch appear, for instance, also with the economic impacts of emissions trade, which, depending on the energy demands of a branch and the inclusion of the branch in emissions trade, can turn out very diverse. Furthermore the sensibilisation of the public for the environmental relevance of companies is also branch-dependent. Thus, the chemical industry, for instance, is more in the interest of the public eye. Ultimately, international developments, especially in the environmental field, are relevant because of the global importance of the topic, as well as e.g. the climate debate.

Strategic relevance: For each of the components of the economic framework conditions, implications for the strategic development can be derived. For instance the population growth, even just for one demographic group, e.g. seniors, can cause an alteration of the pattern of demand. The assignment of additive environment protection measures leads to cost increases, that can, depending on the competitive strategy, be passed on to the customer or not. If these measures accomplished voluntarily or anticipative, then, at least on a short term-basis, competitive cost advantages emerge. When a pollutive substance is being substituted, it can perhaps reduce the serviceability from the perspective of the customer. Ultimately, added benefit resulting from ecology, e.g. in form of lower susceptability to repairs or a longer product lifecycle can not only mean an image improvement, but, with the presence of willingness to pay by the customers, also enable a higher profit margin.

Environmental-economic accounting system: A first approach to show these interdependences on a macroeconomic level is given by the environmental-economic accounting system: in the context of the three large areas pressure, state and response, the interdependences are displayed with the help of material flow calculation and energy flow calculation, information on the use of surface and space, indicators of the environmental status, measures of the environmental protection and the associated abatement costs. Thus, the environmental-economic accounting system is to be understood as a satellite system to the national accounts. The monetary evaluated transactions and stocks are displayed in physical quantities in the material flow calculation and the energy flow calculation. This way, e.g. with increasing energy costs, consumption and price developments can be considered seperately. The environmental status is, especially over time, of interest from a national economic perspective, since the total burden by all companies is expressed. The measures, that are taken for dealing with the environmental stress, show on one hand, where actions were already taken, but on the other

hand also, where action still is demanded. The sectoral reporting tools for the areas transport, agriculture, forests and private households address certain political priority questions. The construction of the environmental-economical accounting system is done by the Federal Office of Statistics (see www.destatis.de).

Figure 17: Components of the environmental-economic accounting system



Source: Statistisches Bundesamt, 2007b

Technological framework conditions

Technique vs. technology: The term technique describes procedures, measures and operation modes to achieve specific goals. The term “technologies” describes the amount of potential, not necessarily techniques, that are already put into practice. For the ecologicallyoriented management already installed procedures as well as the procedures still being developed are decisive.

Components of the technological framework conditions: The technological framework conditions can open up new possibilites for action or set restrictions for planned projects. In doing so, they do not only cover the technological developments in the narrower sense, but in a wider sense also the local research facilities and the local technological and scientific standard, the transport system, communication systems and possibilities, educational and cultural establishments as well as the acceptance of technique and technology in the public.

Stages of technology development: Furthermore, the technological framework conditions are also part of the legal framework. The different steps of technology development are therefore laid down in legislation:

The “state of scientific knowledge” refers to the most advanced environmental and safety techniques and is also termed the “state of scientific insight” or “state of science and technique (e.g. section 4 subsection 2 sentence 3 AtG).

Example: Using this on MOBILITY UNLIMITED, fuel cell vehicles could be assigned here. However, the technology still has to be tested in everyday situations and extreme situations. Furthermore, a comprehensive hydrogen supply is not yet possible and the processing methods and storing methods for hydrogen are not yet satisfying.

The term “state of technique” stands for the stage of development in advanced procedures, establishments or operating modes, that make the practical application of measures seem secured and were already tested in the company with success (e.g. section 3 subsection 6 BImSchG). Here principles of proportionality and profitability are taken into consideration.

Example: Using this on MOBILITY UNLIMITED, hybrid cars and the use of alternative fuels, for instance biodiesel, could be assigned here. Both are advanced developments, that are already in successful use.

The term “generally accepted rules of technique” (e.g. section 4 subsection 2 sentence 1 VOB/B) is used, when the majority of operators already uses a procedure. The different legal requirements also support the so called “cartel of silence of the senior engineers”, meaning knowledge on new environment-friendly processes being withdrawn from the public, in order to ease the enforcement of the law.

Example: Using this on MOBILITY UNLIMITED, the 3-way-catalyser can be assigned here. It transforms the harmful substances CO, HC and NO_X into water, CO_2 and N_2 and is built into every new vehicle in Germany since 1989.

<u>Strategic relevance:</u> Companies have to include the technological framework conditions, that could have a great importance for the future of the company, into their corporate governance, since they can open up new possibilities for action or set restrictions for planned projects. Especially the dynamics of technical product innocation and procedure innovation force the companies into doing this, since they can have impacts on the individual range of services. On the market for environmental technology itself, the relative technological advantage has priority. According to a study by ROLAND BERGER the environmental technology will supersede the mechanical engineering and automotive industry as the leading industry in Germany in the year 2020 (cf. Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit, 2007). This competition is, however, supplimented by the qualitative competition in the area of need-based, meaning function-oriented technical procedures. From the perspective of an environmental technology company, a high state of technique secures demand, while a missing technology basis in form of workforces and research facilities can act as a barrier.

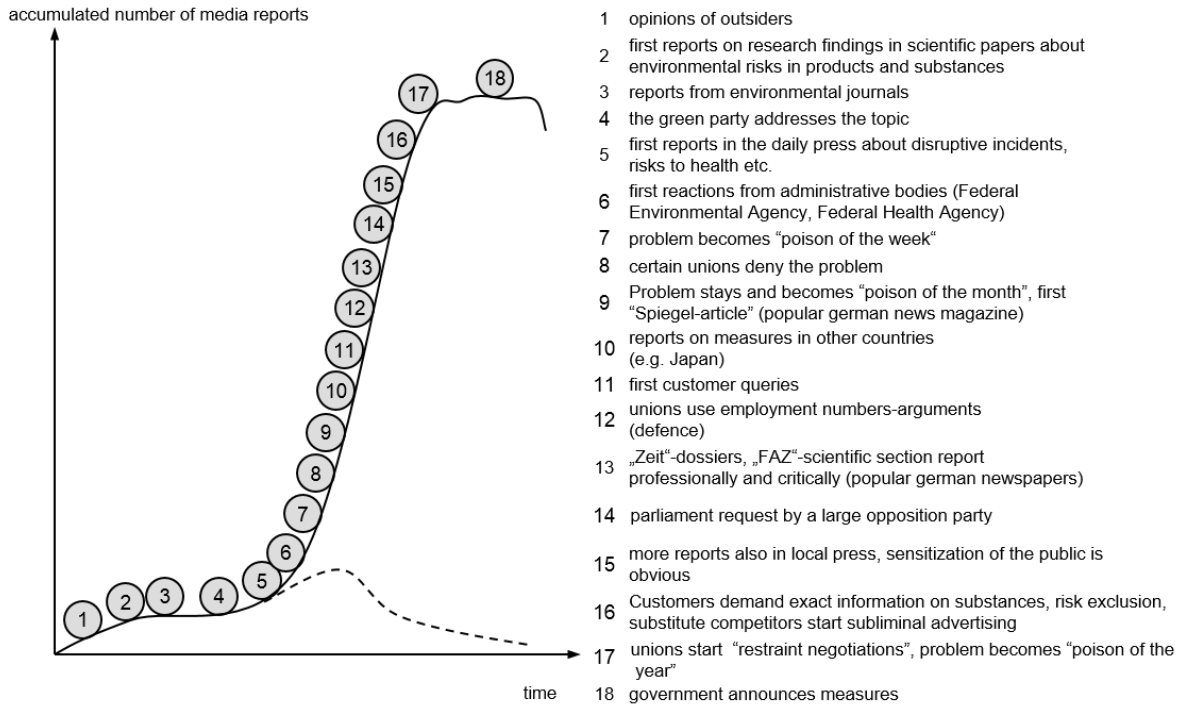
Framework conditions of society

<u>Public exposure</u>: Companies see themselves as being confronted with demands, that are not directly related to the actual object of the production of goods and services. DYLLICK calls this the “public exposure” of a company (Dyllick, 1989). The ability, to also adequatly deal with unfamiliar stakeholders in the context of a public exposure, is for many companies a big challenge. The increasing influence of external stakeholders lead to a stronger recognition of social ambitions during the strategy formulation. In addition to this come the increasingly detailed and mostly subject-related environmental reportings of the media. The analysis of the social sphere aims to enable forestalling a potential pressure by timely capturing and analysing the emerging change in values, in order to draw concrete consequences.

Components of the framework conditions of society: When analysing the social environment, the four groups residents, local initiatives and organisations, media and the broad public are to be considered, while the transition to the task field is smooth. By considering the interests of the residents in the context of the ecologicallyoriented management, conflicts, that above all influence the acceptance of a company in its immediate environment (e.g. by odour nuisance) , are evitable. Instead of avoiding contact, there should be a dispute with the residents, creating trust. Local initiatives and organisations intend to anticipate dangers and report great successes in doing so. This way, a constructive relationship can lead to synergy effects on both sides. Especially with acute dangers for the environment, the media captures relevant issues and activates a process of attaining conscience and forming an opinion among the general population. This way, the general population itself can be motivated to change its behaviour.

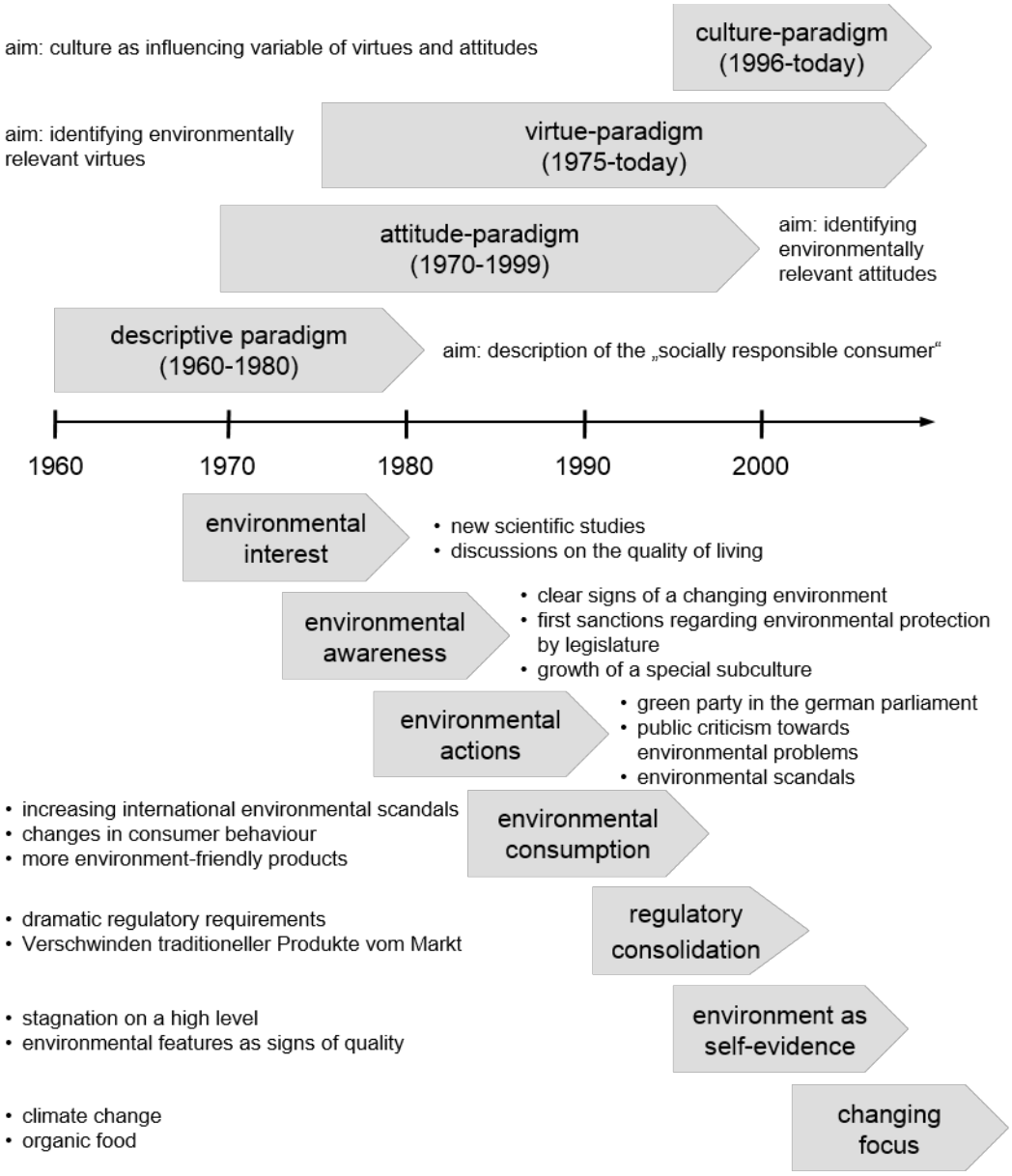
Diffusion curve: The process of the spreading of environmental knowledge can be displayed using a diffusion curve (see Steger, 1993). On the abscissa one can find the time, on the ordinate the amount of reports in the media on a certain topic. As seen exemplarily in the following illustration and its key, the process takes place in different stages and captures various stakeholder goups as time passes.

Figure 18: Diffusion curve



Source: Steger, 1993

Figure 19: Development of environmental awareness



Source: Meffert & Kirchgeorg, 1998; Michael, 1990; based on Müller, Wünschmann, Wittig, & Hoffmann, 2007

Environmental awareness of the public: The development of an environmental awareness can be regarded from two perspectives – from the perspective of the population and from the perspective of researchers. The environmental awareness of the german population is captured every two years by the study "environmental awareness in Germany" and can look back upon six captures since 1999 (see www.umweltbewusstsein.de). If one goes back to the beginning of the environmental movement, one can identify in the further development by KIRCHGEORG/MEFFERT (MEFFERT & KIRCHGEORG, 1998) seven stages of development in the german population: Scientific studies and discussions on the quality of life initiated an environmental interest. In succession of the perception of environmental problems and legal bases, this interest evolved to an actual environmental awareness. With the green party entering the german parliaments, but also due to activities by environmental organisations, more and more often environmental actions took a centre stage. The eventually lead to behavioural changes of the consumer and a consolidation of legal regulations. The protection of the environment has become self-evident by now, whilst certain topics were able to attain a broad impact (e.g. climate protection). From the perspective of researchers, four paradigms concerning environmental awareness can be identified: First of all, the responsible consumer is being described (descriptive paradigm). After that his attitudes are being identified (attitude paradigm). The question, which values underlie these attitudes, is considered by the value paradigm. Finally, the culture paradigm analyses culture as an influencing variable for values and attitudes (cf. Müller et al., 2007) (Figure 5).

Strategic relevance: For the strategic development of companies, the framework conditions of society are relevant, as they influence the behaviour, meaning the purchasing behaviour as well. However the increasing transparency also causes the company to become a corporate citizen and lose its identity. The responsibility, companies have towards society, called corporate social responsibility, is an inherent part of a corporate strategy by now. In order to fix understanding, the EUROPEAN MULTISTAKEHOLDER FORUM on CSR 2004 created the following definition: „Corporate Social Responsibility is the voluntary integration of environmental and social considerations into business operations, over and above legal requirements and contractual obligations. CSR is about going beyond these, not replacing or avoiding them" (European Multistakeholder Forum on CSR, 2004). Studies like the MCKINSEY-survey from fall 2007 (cf. Bonini, Greeney, & Mendonca, 2007) show, that the public exposure is being noticed by companies. In the survey „Assessing the impacts of societal issues" by the business consultancy MCKINSEY, which is done every two years, the effects of the framework conditions of society are being reflected: When in 2005 environmental aspects were only ratet rank 3 with 28% of entries, in 2007 48% of 2,687 managers named environmental aspects, especially climate change, the most important influencing variable of "social issues" regarding shareholder value.

Political and legal framework condition

Significance: The necessity of governmental intervention arises whenever political decision makers consider enterprises not taking ecological framework conditions adequately into account. While ecological framework conditions shape the perspective of this textbook, political and legal framework conditions represent the main drivers/main incentives for enterprises to incorporate an ecological perspective in their policies. This also explains the extent of explanations in this subchapter. Companies can, on one hand, be governed through regulative, non-fiscal instruments – which do not directly affect cash flows between state and company, such as charges/stipulations. On the other hand, legal framework conditions for fiscal instruments can lead to company's expenditures, which flow back to the state, e.g. in terms of a charge (green tax) or as an income, for instance through financial aids from the state.

Environmental principles: Environmental politics, which has been anchored in the environmental program of the German government from 1971 as a discrete

function/assignment of the state and which has been strengthened through later government declarations and environmental reports, is concretised by the principles of environmental law.

The classical eco-political three-part principle in Germany consists of the precaution, the cooperation and the polluter-pays principle, while the latter has been expanded by the principle of the common-burden and the usufructuary principle. Finally, economic efficiency was incorporated by the emphasis principle. Table 2 depicts the six principles by means of the criteria objective, approach and evaluation.

Table 14: Environmental Principles

Principle	Goal	Approach	Evaluation
Precaution Principle	Preventative Protection, i.e. prevention of environmental pollution, dangers and risks as well as developments which could possibly lead to environmental pollution Environmental politics independent from dangers: continuous improvement of environmental condition through hypothetical rejection of dangers Approach at the source of environmental pollution (no „end-of-pipe "-solution)	Optional, existential and legacy value of the environment (sustainable development) plays an important role Instruments: prohibitions and commandments, environmental planning, funding of research and development, environmental education, information, moral suasion Examples: Integrated environmental protection technology instead of „end-of-the-pipe "- solutions	Protection of the environment from potential impacts (+) Consideration of multi-media and long-term aspects (+) Appropriate for the implementation of a more sustainable development (+) Applicability on entrepreneurial level (economic and technical restrictions) (-) Term "precaution" as an undefined concept of law (no concrete action rule) (-) Unclear boarder of reasonableness of means (-) Prognosis of risks as well as weighing of various consequences is difficult (-)

Polluter-pays-principle	Initiator of environmental pollution should be held responsible fot the consequences, i.e. in terms of equivalent compensation payments Internalization of environmental damages though usage of natural resources Increase of the interest in conserve the environment on the part of decision-makers Incorporation of external costs in decision-making General right to averting of danger (fault clearance) Legal maxim of justice	Listing of polluters (principle of material imputation) Recording of all costs from ecological damages (planning, avoidance, waste removal, compensation costs etc.) Incentive to solving the environmental problem through the polluter himself/herself Instruments: Process and product norms, rules and prohibitions, charges, environment licences, environmental insurances, environmental accountability, consumer advantages Examples: Emission trading, dewatering charge	Incentive to avoidance of the environmental problem (+) Polluter is difficult to identify (Distance, long-term, cumulative effects etc.) and shifting of costs to the community (-) Monetary quantification of damages difficult (health costs) (-) Past causes without present polluter (-) Inadequate detection of responsibilities for production (i.e. demand for pharmaceutical products: companies or patient) (-) Highly complex internalization of external effects (-) Conflicting interests (Environmental protection vs. security of employment, financial burden) (-) High administration and monitoring costs (-) Question of distribution of polluter-pays-income and undesirable distribution effects (-) International application difficult (-) Acute emergencies (-) Environmental pollution cannot be compensated by payments (-) Consequences of inadequate enforcement of polluter-pays-principle:

Principle	Goal	Approach	Evaluation
			1. no optimal allocation 2. unproportional costs of damages through externalisation 3. amplifying of the injustice of distribution 4. Repairing of damages more expensive than avoidance
Principle of the common-burden	Addition to the polluter-pays principle; not applicable independently Conditions of applicability: Application of polluter-pays principle is difficult (i.e. because the polluter is unknown) or danger of decrease of outcome through polluter-pays principle Deficit of execution Acute emergencies	Makeshift whenever polluter-pays principle is not applicable Not only polluter takes care of the reduction of environmental damage but public authority carries the costs Instruments: Charges and fees, ecological tax Abatement of pollution legacy Example: Subsidies in case of contaminated production areas of bankrupt companies	No change in behaviour (-) Freerider problem (-) Exception turns from transitional to permanent solution (-) Perception abates (-) Constitution of governmental bureaucracy (for cost accounting and allocation) (-) Windfall gain for polluters (-) Cost fairness (common burden principle) (-)
Usufructuary principle	Addition to the polluter-pays principle; not applicable independently Subtype of the common-burden principle Solution alternatives when accounting of environmental damage is difficult	Claimant is "usufructuary" of an environmental measurement; he pays the polluter for avoiding the damage (buying the right to environmental damage) Instruments: Rights of disposal „public goods "	Wish for a cleaner environment induces costs for reducing damages. The originator of macroeconomic costs, in this case the damaged party, has to pay the costs because he wishes to reduce the damage (+) High economic efficiency because of

Principle	Goal	Approach	Evaluation
		Example: "Wasserpfennig" in Baden-Württemberg (charge for withdrawal of ground water); developed countries paying for the conservation of tropical forest	the controls through the damaged party (+) Inequitable implementation of the polluter-pays principle because of shifting to third parties (-) Abuse: Strength of companies can lead to charging the claimant with paying the damage (-)
Cooperation principle Cooperation principle (continued)	Commitment to self-monitoring Promotion of the acceptance of environmental policies and environmental conscience in different social groups Better operationalization of environmental policies Better implementation of environmental goals Better level of information of the participating institutions	All participants (polluters and claimants) should participate in solving environmental problems as soon as possible while the state releases no sovereign power Hearings of unions and experts during law propositions/legislative proposals Demand for environmental officer Instruments: all so-called indirect instruments like examinations of compatibility with environmental concerns, cooperative solutions in environmental policies (target-setting, self-commitments, branch and union treaties), non-fiscal, non-obligatory instruments (environmental education/raising of	Solution finding by experts (+) Raise of acceptance and ecological awareness among the population (+) Well-founded soluting finding (+) Generally, more flexible and easier to reverse (+) Costs of negotiations very high (-) "lazy compromise" (-) High time requirement (-) Question of decision competency (-) Question of representativeness (-) Level of information varies a lot (-) Danger of lobbyism (Influence of mighty interest groups at the expense of third parties) (-) Self-monitoring mechanisms hardly limited (+)

Principle	Goal	Approach	Evaluation
		ecological awareness through customer and danger information), environmental reporting, key data, support programs, environmental negotiations Example: Roundtable, Eco-Audit	Support programs possibly distort competition (-) Depth of regulation is low which requires acceptance (+) Ecological efficiency not necessarily high (-) Economic efficiency of support programs low (-)
Key aspect principle	Optimal (ecological and economic) enhancement of the environment with limited means Implementation of economic efficiency thinking	Exoneration from one charge, connected with the obligation of becoming eco-politically active in another area Requirement: Environmental relief of measurement one is achieved (while only a part of the operational costs is invested for measurement two) Example.: Joint Implementation, Clean Development Mechanism (regulated in project-mechanism law "ProMechG")	Economic/technical advantage of focus principle International comparison reasonable (developed countries vs. developing countries) (+) Weighing up of different measurements necessary (i.e. water + air) (-) Problem of quantification, especially relevant when weighing up (-) Strict governmental regulation necessary (-)

Source: Jänicke, Kunig, & Stitzel, 2003; Rogall, 2000; Wicke, 1993

4 Development of environmental policy

The implementation of these environmental principles in the Federal Republic of Germany began in 1971. In their environmental program the federal government stated goals concerning the „protection of the natural environment of mankind as health and human existence require the environment to be, prevention of negative human interventions/interferences as well as abatement of damaging behaviour".

In 1974 the ADVISORY COUNCIL OF THE ENVIRONMENT (Sachverständigenrat der Umwelt, SRU) concretized instrumental goals of long term environmental planning, polluter-pays principle,

environmentally friendly techniques, environmental consciousness and international cooperation. Finally the protection of the environment was added to the German constitution as a national objective in 1994 ((Anonymous,)([42. Law of the amendment of the constitution from the 27th of October 1994, BGBl I 3146]). Article 20 of the German constitution [Natural livelihoods] reads as follows: "The state protects natural livelihoods in responsibility of future generations according to the constitutional order of legislation and of proportion of law and right the executive power and jurisdiction". This means that there is an increased duty of the legislator to wit an assignment for legislative and executive, to take into account environmental protection as well as aid in interpretation in administration regarding i.e. undefined/unascertained legal terms. Environmental protection, however, has not been given the status of a basic right, in terms of a subjectively enforceable right for each single citizen. Hence, no individual-judicial protecting claim for governmental protection can be derived from the constitution.

Development of environmental legislation

The development of environmental legislation reflects the development in environmental policy. It can be divided in four phases:

1970 – 1980: 1st legislative phase, e.g. Leaded fuel act (1971) [Benzinbleigesetz (1971)], Waste act (1972) [Abfallgesetz (1972)], foundation of the Advisory council on the environment (1972) [Gründung des Rates von Sachverständigen für Umweltfragen (1972)], Federal control of pollution act (1974) [Bundesimmissionsschutzgesetz (1974)], establishment of the Federal environmental agency (1974) [Einrichtung des Umweltbundesamtes (1974)], Federal water act (1976) [Wasserhaushaltsgesetz (1976)], Federal nature conservation act (1976) [Bundesnaturschutzgesetz (1976)], Energy Conservation act [Energieeinspargesetz (1976)], law on the use of fertilizers (1977) [Düngemittelgesetz (1977)]

1980-1990: administrative phase in terms of an implementation/enforcement of existing laws and orders as well as

1990 – today: 2nd legislative phase after the German reunion with three focal points:

- *management oriented approaches:* i.e. Environmental Framework Act (1990), law on the assessment of environmental effect (UVPG) (1990), regulation on packaging (1992), law on environmental audit (1994) to implement the EG act on eco-auditing (EMAS), recycling economy and waste disposal act (1996), EG framework directive on water use (2000), act on end-of-life-vehicles (2002), act on electric devices (2005), act on environmental damages (2007)
- *fiscal approaches*: Ecological fiscal reform (1999), Renewable Energy law (EEG) (2000), law on greenhouse gas emission trading (2004)
- *information based approaches*: i.e. Environmental information act (UIG) (2004), law on environmental statistics (UStatG) (2005)

  There is, however, no clear boundary between the administrative phase and the 2nd legislative phase.

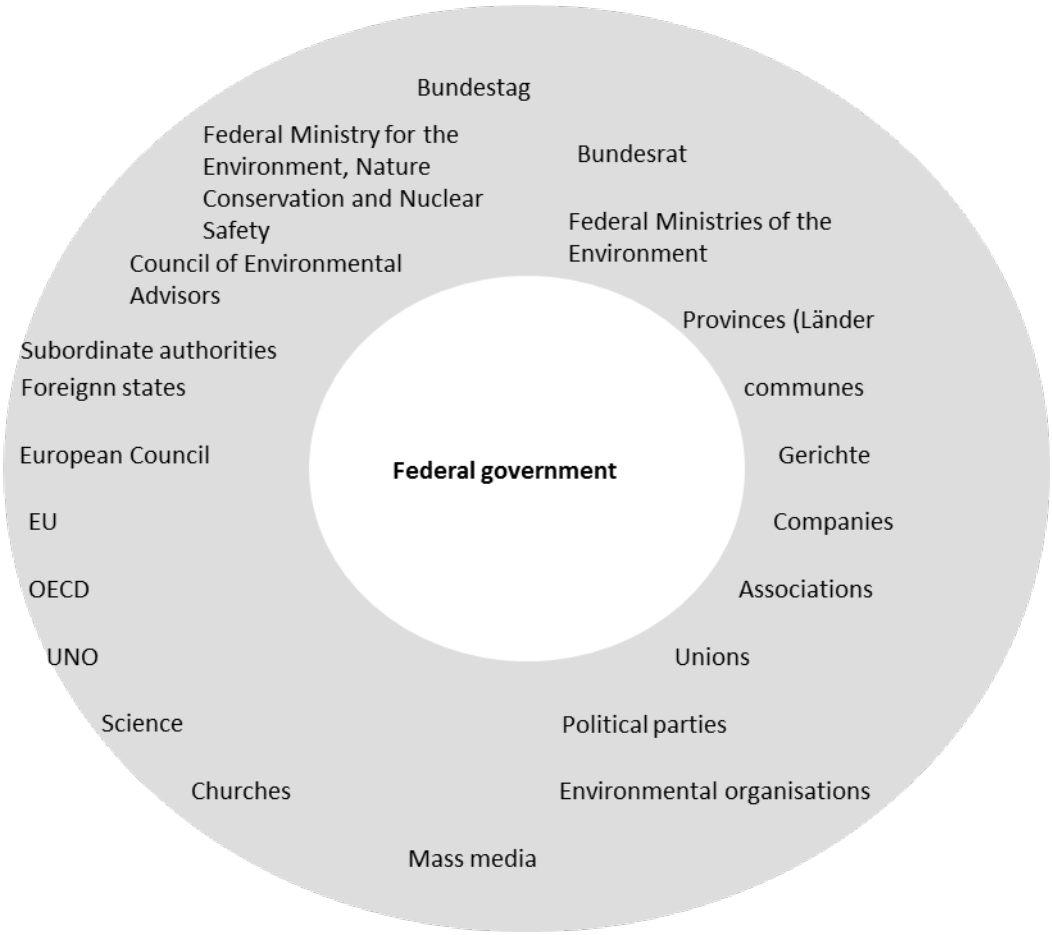
Overlapping since 1992: consolidating phase: Development of a consistent environmental code (UGB), which combines many single acts of the German environmental law: 1st draft (1997), 2nd draft (2007).

Stakeholder in environmental policy

The institutions Federal government are instigators and driving forces of environmental policy in Germany, its formation, though, is influenced by many governmental, societal and

international actors. Environmental policy, hence, is the outcome of relations between these protagonists. In the following, selected stakeholders on international, EU, federal and regional level are presented (see Figure 6).

Figure 20: Stakeholders in environmental policy



Source: Günther & Krebs, 2000

European Environmental Policy

As the development of environmental policy already revealed, German and European environmental policies are closely connected. The contractual fundament of a common environmental policy of the EU member states was built in 1987 by reforming the Treaty of Rome, the Single European act. The community was given explicit competence/sovereignty in environmental policy in Art. 130 r to 130 t. Its functions include the conservation and protection of the environment as well as the improvement of its quality, the protection of human health and the careful and rational usage of natural resources. In the Treaty of Amsterdam from 1999 supporting a sustainable development was explicitly determined a goal of the EU. In 2001 the European Council resolved the European Strategy for Sustainable Development (cf. Europäische Kommission, 2001) as a starting point for ecological, economic and social development. It shall also strengthen the integration of environmental protection in other policy areas. The development of the European environmental policy is reflected by the development of environmental action programs which define medium-term and long-term framework conditions of single/specific political areas. They are elaborated by the EUROPEAN COMISSION,

discussed by the EUROPEAN PARLIAMENT and enacted by the EUROPEAN COUNCIL pursuant to Article 189 b EC Treaty (co-decision-procedure).

They are executed and implemented by legal provisions, as i.e. orders which are valid in a specific member state or guidelines which shall be implemented in national legislation. In the following table environmental action programs are shown ordered by their validity period, their title, the proposed instruments and their flying range (cf. Table 15).

Table 15 : Environmental action programs of the EU

Features / Environ-mental action program	Year	Title	Instruments	Flying range
1.	1973 - 1975	none	Emphasis on the necessity of a comprehensive evaluation of the influence of other policy areas on the environment Gradual formulation of quality targets in environmental policy: research on evaluation of de facto interferences, their cause and criteria on environmental objectives/goals First product standards and boundary values of environmental quality Approach to protection of single environmental areas (priority on water protection and waste) Concepts on specific sectorial approaches (agriculture, land use planning)	Containment and abatement of environmental burden (precautionary and polluter-pays principle) International Collaboration/Cooperation Protection of the natural environment Problems regarding the scarcity of various natural resources Urban development and land use planning Improvement of the working environment

Features / Environ-mental action program	Year	Title	Instruments	Flying range
			Preparing measurements for emission control on air polluting contaminants European Foundation for the improvement of life and working conditions	
2.	1977 - 1981	none	Quality goals and boundary values in the context of directives for protection of water and air quality Waste framework guideline Bird protection guideline Analysis of the macro und micro economic impacts of environmental policy Examinations of the efficacy of economic instruments (cost application based on the polluter-pays principle, interventions of the public authority, regulation of charges/tax code?	Continuity with 1. Environmental program Assessment of impacts on the environment Economic aspects Spreading of knowledge in the area of environmental protection Research action in the area of environmental protection Elucidation and education in environmental issues Enhancement of the working environment Campaigns on complying with environmental protection regulations
3.	1982 - 1986	none	Integration of the protection of the environment in other policy areas	Follow-up of hitherto existing objectives European harmonization of environmental policy

Features / Environ-mental action program	Year	Title	Instruments	Flying range
			Quality specifications for air and water as well as flanking/additional measurements on the implementation of emission cadastres Harmonization of emission standards and product regulations Waste avoidance Resource efficiency: Financial instruments for the development of resource-conserving technologies Integrated environmental technologies Implementation of Environmental Impact Assessments	protection of natural resources Emphasis of economic advantages/benefits of environmental policy Strategies on a sustainable development Integration of environmental protection in the entire manufacturing process
4.	1987 - 1992	none	Analysis of single sectors of industry (Sectorial approach) Development of trans sectoral and intermedia instruments Examination of potential impacts of incentive oriented instruments (Taxes, subsidies, certificates)	As in 3. Environmental action program, Emphasis on economic dimensions of environmental policy Animal and plant protection Integration of environmental protection in the entire manufacturing process Analysis of strategies promoting win-win situations for the environment and companies

Features / Environ-mental action program	Year	Title	Instruments	Flying range
			Surveillance of risky/high risk industries	Integration of environmental protection in Development politics Information and education
5.	1992 - 2000	„Towards Sustainability“	Legislative instruments, i.e. determination of minimum norms on environmental protection Economic instruments, i.e. fiscal measurements, legal accountability in the environmental sector Horizontal and accompanying instruments, i.e. environmental statistics, research funding, land use planning Financial aids, i.e. LIFE-Program, structural funds	Permanent and environmentally sound husbandry of natural resources: Soil, water, natural landscapes and coastal areas Integrated environmental protection and measurements on waste avoidance Decline in the consumption on non-regenerative energies Enhanced mobility management with more efficient and environmentally sound modes of transport/carriers Consistent packages of measures to enhance environmental quality in urban areas Improvement of health and safety with particular consideration of industrial risk analysis respectively industrial risk management, nuclear safety and radiation protection
6.	2001 -	„Environment 2010: Our	Improvement in the implementation of	Climate change Biological diversity

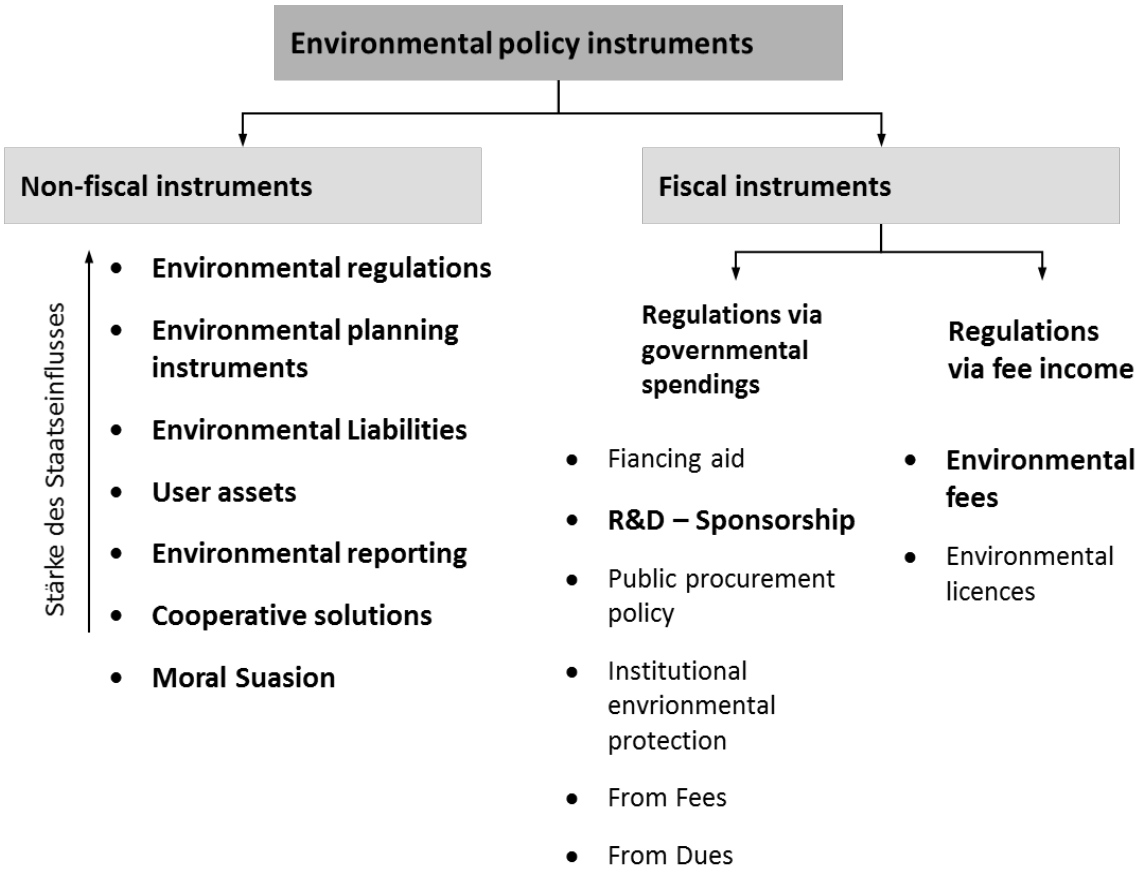
Features / Environ-mental action program	Year	Title	Instruments	Flying range
	2010	Future, Our Choice”	existing legal regulations Inclusion/Integration of environmental objectives in other policy areas Collaboration with the market, integration of citizens and stimulation of behavioural changes/changes in behaviour Consideration of environmental matters in land use planning and spatial structure	Environment and health More sustainable management of natural resources and wastes
7.	2013-2020	Living well, within the limits of our planet	better implementation of legislation better information by improving the knowledge base more and wiser investment for environment and climate policy full integration of environmental requirements and considerations into other policies	It identifies three key objectives: to protect, conserve and enhance the Union’s natural capital to turn the Union into a resource-efficient, green, and competitive low-carbon economy to safeguard the Union's citizens from environment-related pressures and risks to health and wellbeing

Source: Rat der Europäischen Gemeinschaften, 1973; Rat der Europäischen Gemeinschaften, 1977; Rat der Europäischen Gemeinschaften, 1983; Rat der Europäischen Gemeinschaften, 1987; Rat der Europäischen Gemeinschaften, 1993

Eco-political instruments

The German and European environmental policy is concretised in eco-political/environmental instruments. The major part of environmental regulations belongs to the administrative law and is based on the roots of environmental legislation in general police and security laws. Federal regulatory policy has its tradition in policy and trade law. This led to an early and strong permeation of all areas of the environment by laws legal rules. Main focus is the immediate control of environmental dangers and the avoidance of environmental damages. Second emphasis lies on fiscal environmental instruments which do directly influence the national budget as earnings or spending. Ideally, the incentives of cash flows shall impact entrepreneurial decisions. More than that, earnings have an effect on financing of the national budget. In the following figure conveys an overview of the main environmental instruments.

Figure 21: Instruments of environmental policy



Source: based on Wicke, 1993; Günther, 1994

Environmental regulations

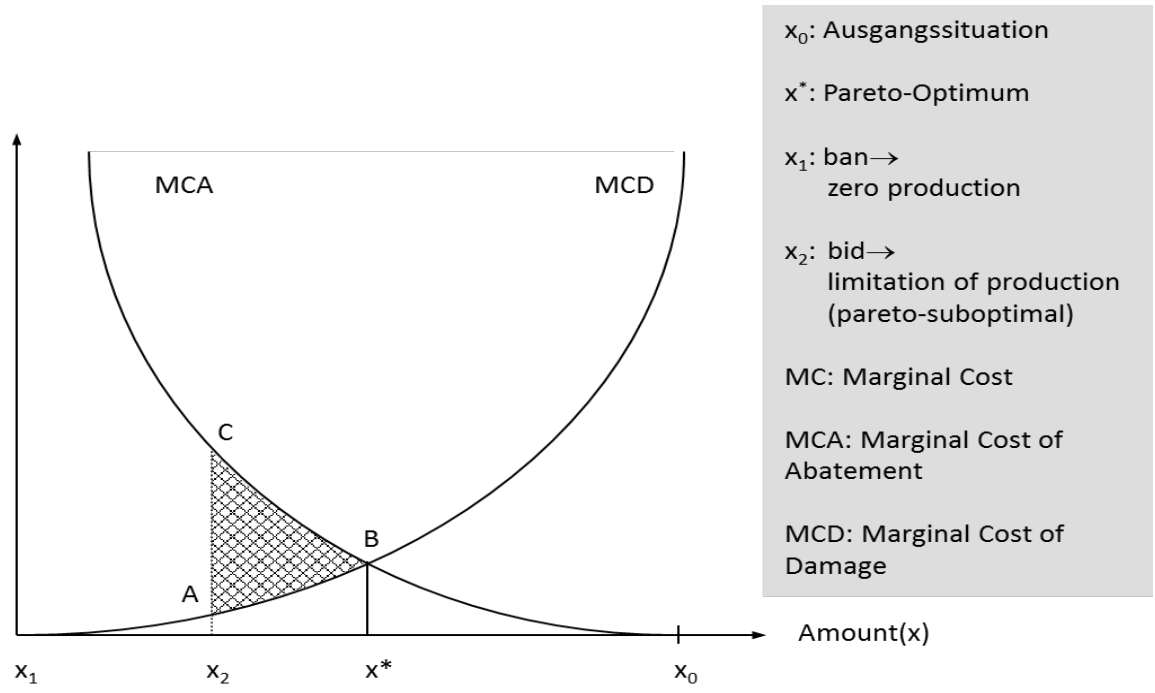
Environmental regulations are direct codes of behaviour for the implementation of political goals occurring as interdictions/bans and orders/commands. As environmental specifications originate in police law they are the basis for potential sanctioning and therefore put companies under pressure/represent coercion for companies. If they immediately aim at avoiding environmental dangers and damage, the precaution principle plays the major role. If they explicitly focus on users of environmental resources they realize/enact the polluter-pays principle. Environmental regulations can occur as general, absolute prohibitions/bans (i.e. production of DDT), preventive prohibitions (existence of a permit obligatory), repressive prohibitions (exoneration from this prohibition possible) or provisions of the administration

(revocation of the permit for an approved facility or order on an individual case). Environmental regulations can refer to input (quantity and quality of the deployed commodities, adjuvants and operating materials), processes (building class norms, operating norms, required standard of technology), products (requirements on assets invested and consumer goods), conducts (quota on recycling, boundary values, emission regulations, waste separation) or production itself (limitation of output, prohibition of industrial settlement, close-downs). They are geared to the so-called Norm Principle, (norm principle) developed by KAPP aiming at the attainment of a particular environmental standard (see Kapp & Vilmar, 1972). The state defines existential minima which must not be undershot or exceeded (physical or economic unities). Existential minima designate the limit of environmental conditions; a further deterioration would entail existential threats. The state has the task to define the environmentally optimal situation. While commands still allow environmental burdens, prohibitions shall entirely eliminate environmental burdens.

Graphic solution of environmental regulations

A regulation has to be set such that only the amount x_2 (with the entailed environmental damage) is produced. This instrument therefore is an eco-political command (in contrast to a ban). Setting x_1 a regulation would represent a ban of the environmentally harmful behaviour (complete prohibition of the damage). In comparison to the pareto-optimal equilibrium in x*, the regulation and setting of x_2 causes a deadweight loss to the amount of ABC (cf. Figure 8). Hence, producing x_2 is a pareto-suboptimal solution but results in a smaller environmental damage than the Pareto-Optimum. It needs to be taken into account that the marginal costs of abatement and damage can also be negative; to wit can be a marginal revenue.

Figure 22: Graphic solution of environmental regulations



Environmental planning instruments

By planning systematically and ecology oriented environmental damages can be avoided and the precaution principle can be implemented. Environmental planning shall capture complex cause and problem interrelations and coordinate conflicting goals and interests of in

environmental issues/concerns. Areas of responsibility comprise Nature protection, conservation of the countryside, protection and control of countryside related recreation system, the disposition of green areas, the control of eco systems and the creation/design of building areas. Environmental planning takes into account the systematic character of the environment. We distinguish space-oriented overall planning, such as urban land-use planning and sectoral planning, such as the clean air plan.

Environmental Liabilities

In the framework of environmental liabilities regulated by the Environmental Liability Act the operators of a facility are obliged to replace the damage caused by an environmental damage generated by this facility. It is based on the polluter-pays and expands absolute liability on the environmental media soil, water and air. According to the causality prove the accused companies have to prove doubtlessly that the facility was used conventionally (assumption of cause/cause guess). In this way, companies are motivated to avoid risk but also to monitor and document the production process. Within the scope of the contraction of a casualty assurance the insurer will check whether the company has taken accurate precaution measurements in order to create a bonus gradation as an incentive for the insurer as well as for the insured. In Germany environmental liability is regulated in the Environmental Liability Act enacted in 1990. The Environmental Damages Act (USchadG) contains further regulations. The USchadG implements the EU-guideline 2004/35/EG from 2004 about the environmental liabilities for avoidance and rehabilitation measures of environmental damages and adds both to the already existing regulations of the environmental liabilities Act and to other special laws i.e. the Soil Protection Laws.

Pursuant to this law, those who damage the environment (water, soil, species, natural habitats) in the context of their profession have to compensate for the caused damage. To wit, whenever a natural resource (species and natural habitats, waters and soil) are directly or indirectly alternated and whenever there is a direct causal relationship between the damage and the action of the responsible can be ascertained the originator has to restrain the damage and initiate the necessary rehabilitation measures (USchadG). Therefore, this law from 2007 realizes the aims of the polluter-pays principle. The law additionally claims a duty to inform, defend dangers and rehabilitate.

User assets

If users of environmentally friendly products or procedures have advantages these are called user assets. The business objects can independently decide, if they want to make use of the advantages provided by these products and procedures.

The advantages can have material, idealistic and other consumer benefit inclining/cumulative (idealistic and enhancing consumer use) character. User assets in particular grant the users of environmentally friendly processes and products the advantage of using more intensely or with less (convenience) disadvantages products or processes (i.e. use of low-noise construction equipment)

User assets in general grant advantages related to idealistic environmentally consciousness and advantages in the running costs or in buying products and processes by public purchasing bodies (i.e. ecolabel “Blue Angel” (“Blauer Engel”)).

Environmental reporting

Apart from laws that contain duties and incentives for companies to realize concrete environmental protection measurements, other laws demand/stipulate information about a companies’s environmental commitment: The Environmental Statistics Act introduced in 1974

obligates companies to provide, amongst others, information about waste disposal, water supply and sanitation, climate changing substances and spending on environmental protection, subdivided in the areas waste management, water protection, prohibition of noise pollution, air pollution control, climate protection, nature conservation and landscape protection and soil remediation.

The Environmental Information Act introduced in 2005 enforces the EU environmental information guideline from 2003 and aims at more profoundly informing the public. The public administration and private institutions, as long as they perform public tasks, are obligated to provide environmental information after having been asked for filing of application through giving issuing information or inspection of files. Environmental information comprises data about the constitution of environmental media, input and undesirable output (conducts), measurements, the implementation of environmental laws, cost-benefit-analysis, as well as human health. Moreover, voluntary instruments as the EU Eco-Management and Audit Scheme making companies draw up an environmental declaration and supranational organizations such as the GLOBAL REPORTING INITIATIVE call for an extended environmental reporting.

Cooperative solutions

Cooperative solutions realize eco-political goals with bilateral/mutual contracts and legally binding agreements as well as by founding ecology-oriented purpose associations. Sectoral agreement can be legally non-binding or binding. The latter can occur as self-commitment agreements (perform environmentally friendly activities) or self-binding agreements (refrain from environmentally damaging activities).

Federation solutions

Federation solutions are implemented in the form of cross-industry agreements and purpose associations Cooperative solutions are voluntary instruments and may be used whenever governmental measurements are anticipated. Companies can participate in the development and aim at more cost-efficient solutions but can also avoid declines in demand. Because of their voluntariness they can be applied in the short run. There is, however, a danger of anti-competitive agreements as well as delays of planned legislative projects in publicly announced but not held agreements.

Moral Suasion

As the weakest form of governmental intervention “Moral Suasion” can be used. It contains measurements of an according information policy as well as appeals to potential environmental polluters and shall stimulate companies to change their behaviour. Consumers and producers shall be convinced to change their behavior voluntarily making governmental intervention unnecessary. The information can display negative effects showing dangers for the society and individuals or can represent positive effects of environmentally conscious behaviour.

Aid on financing/Finanzierungshilfen

Financing aid creates financial incentives for the implementation of environmentally friendly products and production processes. They can be subdivided in grants, financial contributions as well as loans respectively subsidized loans used on various stages of value added. Apart from direct financing aids, eco-politically motivated tax reductions can come into effect. Financing aids do not account for the idea of the polluter-pays principle because the burden of acting environmentally friendly is carried by the state and therefore by the public. As utilization is costless even lorry effects may be supposedly being subsidized if measurements would have been taken anyway.

R&D Support/Promotion

On the one hand, the support of research projects aims at an acceleration in environmental progress. On the other hand, it tries to realize the polluter-pays principle through avoidance of burdens already on the first stage of the value adding process. It comprises support measures for companies in the sector of applied research and universities and non-university research facilities in the sector of basic research. In regards to sustainability the initiative of research for sustainability (FONA) of the Ministry of Education and Research can be mentioned.

Public procurement policy

The governmental procurement policy aims at promoting ecology orientation of companies by employ purposeful the governmental demand potential for products, processes and services.

The volume/extent of public procurement in Germany is indicated with at least 150 Billon € annually and 6-7 % of the gross domestic product (Statistisches Bundesamt, 2006; calculations by Statistisches Bundesamt, 2007a). This results in a market power of public demand, which can act as a driver of innovation for eco-conscious decisions in the procurement of products and services by public entities. The state as a purchaser therefore has a decisive role in the development of a market for greener products, in the attractiveness of environmental management systems and in the ecology-oriented process design. In addition, the state can represent a role model. It will foster environmentally sound public procurement by EU policies, but also activities of the federal government (e.g. www.beschaffung-info.de) and the countries.

Institutional environmental protection: Through financing institutional environmental protection activities of the presented stakeholders of environmental policy (ADVISORY COUNCIL OF THE ENVIRONMENT, FEDERAL MINISTRY FOR THE ENVIRONMENT, GERMAN FEDERAL FOUNDATION OF THE ENVIRONMENT etc.) are initiated and promoted. These stakeholders indirectly work on all principles of environmental policy.

Governmental spending from fee income: Dues as a special form of fees are prices for direct quid pro quo in the public sector. This means that services are provided by the state (governmental spending) and they are financed by fees. This shall enable a fair distribution of the emerging costs. The height (calculation) is essentially determined by the constitution (Art. 109) and Local tax laws (i.g. SächsKAG), but also by further directions such as the Recycling/ Waste Management Act. To calculate the fees, the following principles are in force:

The cost recovery principle demands, on the one hand, that the total fee revenue shall cover the total cost (financial precautions for public enterprises) and on the other hand that fees may at most be as high so that the total cost of their establishment are covered. Both aspects aim at preventing arbitrariness in fixing the fees.

The principle of equivalence demands an adequate proportion between fee and performance ("Exchange Justice"). This means that fees should be measured in regard to the extent of usage (performance) or to the average cost caused by the usage.

The principle of special remuneration explains, why fees in this textbook form part of governmental spending: Fees may only be charged for a "special", individually accountable performance of public facilities.

The equality set/sentence says that costs are to be distributed among the ones chargeable in accordance with the use of services.

The Steering principle eventually means that a pre-trial signal shall influence the behaviour according to governmental ideas in this case pushing a more environmentally friendly behaviour. As a measurement for fees both the realistic scale (depending on the actual measured size as

provision, weight or volume, e.g. water meter for drinking water) or the probability scale (depending on probable variables, i.e. number of persons in the household as a measure of waste generation if a measurement is not possible or expenses are too high) may apply. In fixing a basic fee the WKMS is recommended, in fees depending on performance the WKMS should be preferred.

Governmental spending from fee revenue

In contrast to fees, contributions are charged in order to fully or partly cover the expenses for the provision of a service regardless of their actual use for the provision of a service. The contribution amount results from the granted advantage and the amount of contributions must not exceed the finance expense analogous to the assessment of fees.

Property owners, for example, have to provide an infrastructure contribution for the establishment of a connection to the supply and disposal networks of the community, e.g. for the disposal of sewage. It is usually measured as the standard of probability according to the property size. Table 16 represents the difference between fees and contributions. For a comprehensive understanding special levies and taxes are also included in the comparison. Taxes are not helpful for environmental policy due to the Non-Affection Principle, to wit the lack of the lack of earmarking for certain state functions.

Table 16: Different fees and contributions

Measurement / Features	Fee	Contribution	Special Fee	Tax
Service in return character	+	+	-	-
Special compensation	+	+	+	-
Claim of the merit/of the performance	+	-	-	-
Sovereign monetary requirement	+	+	+	+

Environmental fees

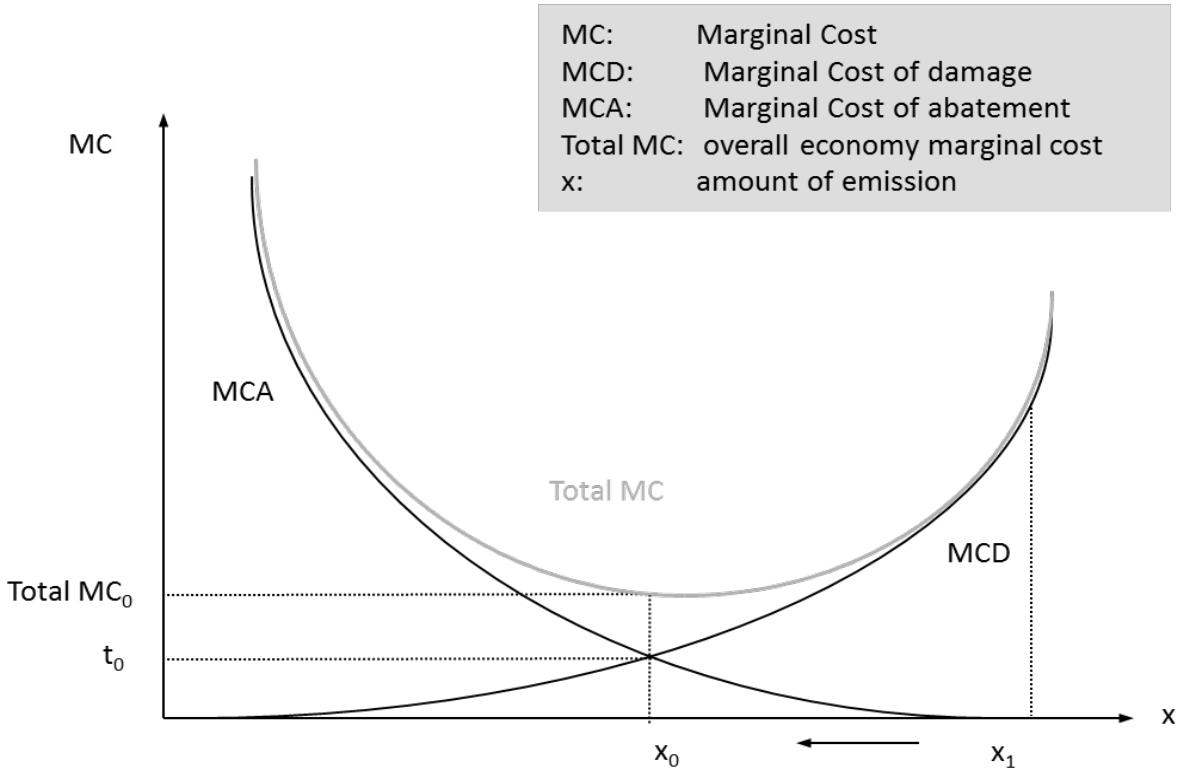
Next to fees and contributions, special fees represent a third group of governmental financial allowances, although they have no service in return character and do not implement the principle of special compensation. That is why environmental fees form a sub-category of governmental revenues. By charging environmental fees incentives and possibilities for financing and realizing eco-political goals shall be created or enhanced. They regulate the behaviour of companies indirectly; to wit the polluters can decide about their avoidance strategy. The charged fee is measured according to the scope of damage and therefore accounts for the polluter-pays principle. Ideally fees fulfil guidance and financing functions with the guidance function consisting in tree sub-functions:

Optimizing function: By fixing a pareto-optimal amount of fee the overall economy optimum is achieved for which holds:

Overall economy marginal abatement costs = Overall economy marginal damage cost

This function, though, can only be understood theoretically because the course of the overall economy curves is not known (Figure 9).

Figure 23: Macroeconomic cost progressions



Incentive and Cost minimizing function: The avoidance should be induced where it is cheapest. The overall economy costs of perusing eco-political goals can be minimized and the Pareto-Optimum can be achieved.

Subsidy function: By strengthening the incentive created by the fee for polluters in especially polluted areas or for pollution with especially strong possible environmental impact, the incentive function is fatherly inclined.

Environmental fees in particular can be subdivided in emission fees, combined fee and regulation systems and product fees. Through emission fees the internalization of social additional cost shall be accomplished, an example being the eco-tax. One example for combined fee and regulation systems are regulations for water protection. These add limited pretended to the waste water levies since the extent of the fee does not achieve the eco-political goal. Through product fees the usage of resources and products is charged (i.e. usage of economic fertilizer through a nitrogen discharge/tax).

Comparison of Fees and Regulations

In the discussion about environmental instruments fees and constraints are often compare. The following Figure 10 and Figure 11 show two different display formats of how fees and regulations work.

Both figures show that fees, depending on the marginal costs, can lead to different environmental performances of two companies whereas regulations result in the same environmental performance but different charging of costs.

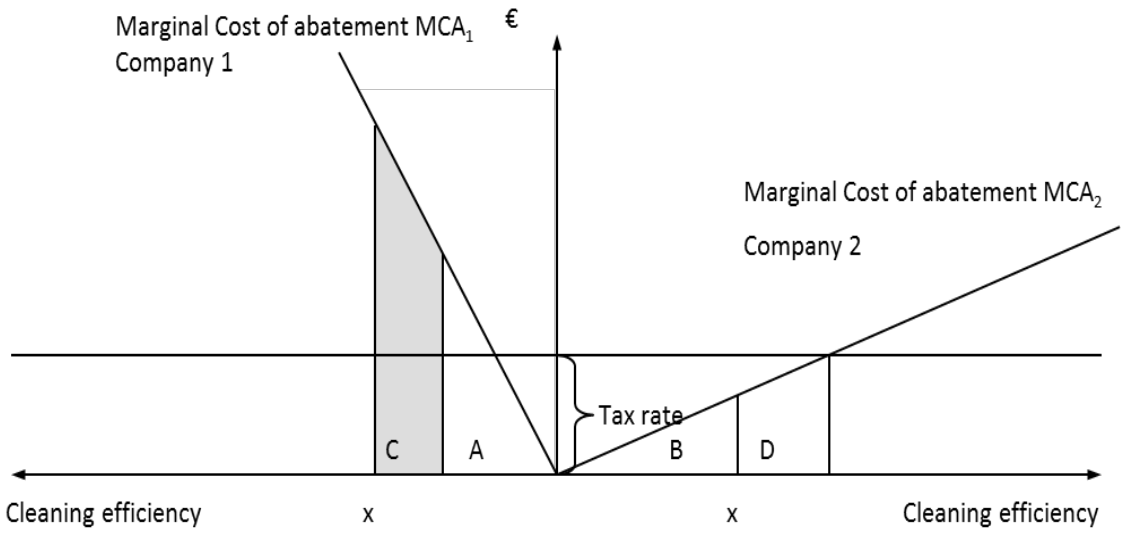
The advantage of the fees in comparison with regulations for two equally big enterprises can be determined as follows (cf. Figure 10).

Costs of the regulation in order to achieve a certain degree of purification: C+A for company 1 and B for company 2;

Costs of the fee: A for company 1 and B+D for company 2.

Therefore, the economic benefit can be deducted as (C+A+B) – (A+B+D) = C-D.

Figure 24: Comparison fees and regulations alternative I



Source: Based on Bartmann, 1996; Bea, 1973

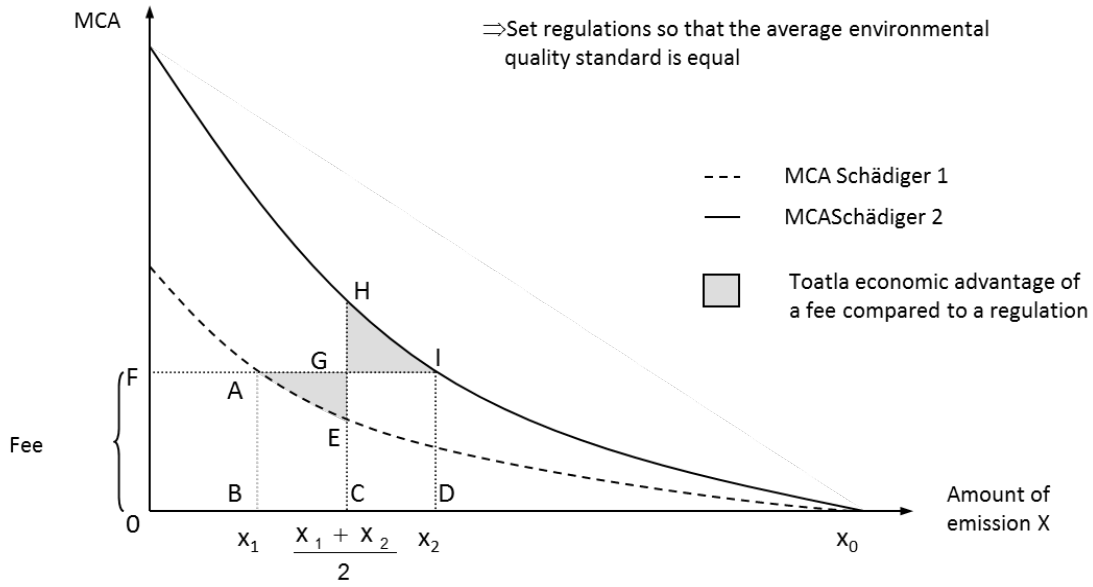
Alternatively, the relationship may be depicted differently (Figure 11):

Regulation: Cost for the <u>over-fulfilment</u> regulations by the injuring party 1: BCEA, costs for the fulfilment of regulations by the injuring party 2: CDIH

Fee: for injuring party 1: 0BAF, for injured party 2: 0DIF

Therefore, the economic benefit can be deducted as: AEG+GIH

Figure 25: Comparison fees and regulations alternative II

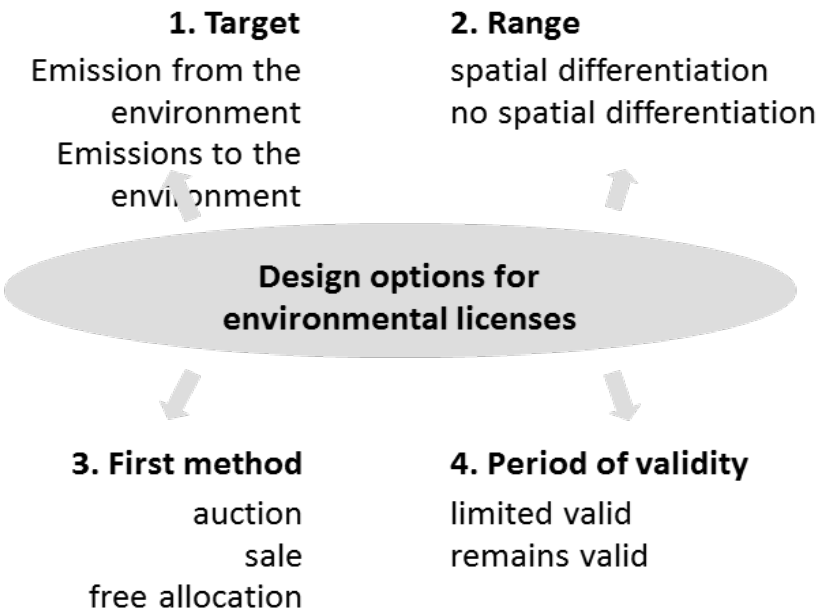


Environmental licenses

By dispensing pollution permits through the state a determined environmental standard shall be achieved at minimum cost. The idea consists in fixing the maximum emission amount and therefore the maximum quantity of licenses that are distributed among the affected emitters. In the consequence they are only allowed to emit damaging substances to the extent of the acquired amount. On a second stage these licenses can be traded. In the initial allocation four design sizes (cf. Figure 12).

Regarding the command variable of the licenses *Emissions standards* are supposed to be the first-best-solution. In this case they are not practicable, though, because the effect of emissions on emissions is only insufficiently known. That is why *Emission standards* are chosen as the second-best solution. In order to determine them governmentally fixed environmental standards are transformed into an according total emission amount by scientists; but there is still high regional pollution (so called "hot spots"). One solution im Sinne von BAUMOL/OATES (Price-standard approach) (cf. Baumol & Oates, 1971) is based on an emission goal which is achieved through a price determined by iterative adjustments. But since there is a difference between the emission of a company and the measured emission, diffusion coefficient is to be determined and additional conditions are to be introduced. One particular goal can be achieved at minimum cost. The government aims at the investigation of the pareto-efficient amount of emission based on inquired marginal benefit and marginal cost curves. Eventually, each polluter shall be assigned the amount of emissions that match this optimum. If these values are higher than the limit, this causes payments to the state, values below the limit lead to payments from the state.

Figure 26: Design options for environmental licenses



Regarding the range/scope of licenses a *spatial differentiation* has to be made. In order to prevent "hot spots "environmental licenses are differentiated so market zones with their own load limit are created. If there is no spatial differentiation a multitude of markets for licenses can be avoided, even though "hot spots" arise.

The Initial allocation procedure for environmental licenses can either be an auction, a disposal or a costless allocation.

Auction of environmental licenses: The state auctions pollution permits to the highest bidder. In this case, however, the operators of facilities who do already dispose of allowances for certain damaging substances have to acquire pollution permits. This therefore equals an abolishment of all approvals of operations yet granted and annuls the conservation of the status quo of old plants. Furthermore, a company is unsure how many licenses it will get.

Disposal of environmental licenses: The state sells licenses at a governmentally fixed price. It adds to the objections applicable in an auction, that the market clearing price of scarcity has to be determined for selling. Marginal abatement costs of the emitters would have to be known.

Costless allocation of environmental licenses: In this case, each emitter is granted certificates for the amount of de-facto emission caused (respectively the emissions approved by the stipulation system) and is allowed to trade them. This benefits, however, those emitters who have already intensely polluted the environment, or respectively have not invested in environmentally friendly technologies (so called grandfathering which allocates permits on basis of historical figures/values of a base period), new emitters are quasi discriminated because they are not assigned costless licenses.

Regarding the validity period of licenses limited and unlimited certificates can be distinguished. If there is a temporary *limitation* each possessor of licenses is given the right to emit the according amount of damaging substances for the duration of a fixed period. After the expiration of this period certificates lose their validity and the environmental agency has to distribute new (again limited) licenses. *Temporarily unlimited certificates* create sufficient planning criteria for companies but it remains to be settled how an enhancement in environmental quality can be achieved, i. e. by devaluation or governmental buyout.

License trading: After the initial allocation trading with pollution permits is possible in which those companies offer permits whose marginal cost for environmental protection measurements are smaller than buying the rights. If buying pollution permits represents the cheapest variant economic entities typically appear as consumers. Because the participating parties strive for an individual minimization of costs overall economic costs are also minimized. Moreover, both the state and private economic entities can raise environmental quality standards through devaluation or purchase of rights. On the other hand, buying and hoarding of licenses constructs market entry barriers and competitors are displaced.

Advantages and disadvantages: Summing up the advantages and disadvantages of all presented eco-political instruments are contrasted in the following (cf. Table 17).

Table 17: Eco-political Instruments

	Instrument	Advantages	Disadvantages
Non-fiscal	Regulations	Quickness of outcome Security of effects (practicable and directly controllable) Understanding of effects (easy to understand, known to engineers and jurists) High acceptancy within the society and political enforceability (immediately comprehensible effectiveness) High ecological efficiency More precise prognosis about behaviour of economic stakeholders Clearly defined facts of the case Few possibilities of evasion Regulations on compensations possible in order to rise the economic efficiency	Depends on facility Long duration until approval (time lag from regulatory deficit until adaptation) Establishment of an extensive bureaucracy Cost/effort for monitoring Vollzugsdefizit bei mangelnder personeller Ausstattung der Kontrollbehörden Lack of reversibility and flexibility Low market conformity (low allocation efficiency caused by rigid regulation) Lack of economic efficiency (cost minimization) Relatively little incentive for innovations exceeding the postulated goal (“Ratchet effect” in particular for old plants) Possible distortion of competition (i.e. regulation is limited to industrial economy) High need for information of planner (state of the technology and abatement costs) Endogeneity of the state of the technology Lack of control of possible substitutes

	Instrument	Advantages	Disadvantages
Non-fiscal (continued)			Declining acceptance in case of more profound regulation Unclear conceptual understanding of economic justification
	Instruments for environmental planning	Prognosis of consequences Preventive effect System character Sustainable, because long during Predominantly environmental media-specific "complex areas" = Integrated planning Flexible implementation through combination with regulations or other eco-political instruments Examination of the environmental impact quantifies and achieves high acceptance In principle: consensual goal setting	Lack of competence Lobbyism Errors are hardly reversible Very bureaucratic Long during process Difficult to handle the high complexity No immediate participation of the public Lack of transparency Compromises on the least common denominator (especially international harmonization)
	Environmental liabilities and environmental liability insurance	Security of effect is relatively high Rigid implementation of the polluter-pays principle Shift the burden of proof in favour of the injured Incentive for risk-free development of new products	Extensive amendments necessary Economic unacceptability and inappropriateness Difficult determination of the state of the technology Gaps in legislation de-facto obligatory insurance Need for gapless documentation of control

	Instrument	Advantages	Disadvantages
Non-fiscal		Use of the environment is assigned a price	Weakening of “normal operation” by proof Difficult price setting for the good “environment” Calculus is not welfare optimizing but tangentially protecting the environment
	Customer assets	Compliant with the market incentive effect / pull of demand for the use of environment-friendly products and procedures sensitization of manufacturers / users remains (personal interest for the reduction of environmental burdens) little side effects possibility of non-material benefits (Blue Angel (Blauer Engel)) partially simultaneous reduction of other risks e.g. for health small legal frame	On voluntary basis No behavioural determination/no determination in behaviour Little accuracy/exactness in goals
	Environmental reporting Environmental reporting (continued)	Incentive / demand pull to use environmentally friendly products and processes sensitization of producers / users remains (self-interest for pollution reduction) Only minor side effects Possibility of an ideal benefit generation (Blue Angel) possibly simultaneous reduction of other risks i.e. health risks Low depth of regulation Directly effective in the sense of environmental	High resistance Slow and gradual implementation Expenses on monitoring, information and administration in order to assess quality of data Discrepancy between report and actual behaviour Problems in privacy protection

	Instrument	Advantages	Disadvantages
Non-fiscal		information (depending on type of publicity obligation) Allows participation of citizens Basic prerequisite for environmental protection agreements Increases economic efficiency of environmental protection measures Higher transparency Triggers objective consternation Allows precise measurements Often connected parallel with the introduction of environmental indicators (environmental controlling) Environmental awareness, esp. perception of environmental factors Generates positive public pressure to change behaviour Companies with positive environmental balance sheet are favoured	
	Cooperative solutions	Economically efficient for participants (lowest cost) Market economy compliant instruments (including EC-compliant) Very quick to use High flexibility and broad applicability Role model function	Low ecological efficiency and, where appropriate, target inaccuracy Dilution of the originally planned environmental objective, especially in non-binding agreements Danger of competition distortion, distortion respectively debilitating agreements (in the sense of antitrust law) Risk of compromise at the expense of the general public

	Instrument	Advantages	Disadvantages
Non-fiscal (continued)		Implementation of the cooperation principle self-control mechanisms remain or are promoted (disposition freedom high) Use of the expertise of environmental organizations Can replace regulatory measures courteously (the latter lengthy, with acceptance problems, etc.) + Specifically tailored to problem solving + Short-term, political success for environmental authorities	Risk of environmental puntionalism (in concrete individual case solutions) Strategy for the prevention or delay of regulatory requirements Low sanction mechanisms (carry-held solution) Free rider Behaviour NIMBY-effect ("Not In My Back Yard") lobbyism's Conflict with already existing legal requirements
	Moralsuation	Internalization of environmental awareness Better information/knowledge Puts pressure on politics and administration to implement specific environmental policy measures Increase the chances of environmental mitigation measures through potential tortfeasor	No compulsion manipulability Difficult to quantify Low ecological efficiency Acts only in the long term

	Instrument	Advantages	Disadvantages
	Inducing of environment improving measures, i.e. aid on financing	+ Signal effect / trigger effect (ecological effectiveness) + Easier to enforce than regulations / taxes in accordance the polluter-pays principle + Simple political feasibility	- Selection often incomprehensible - Indefinite legal concept: "state of the technology" - Decommissioning of possibly ecologically and economically sound facilities - Problems of the common burden principle: among other things, at public expense; not-cause, polluting products are reduced - Uncertain environmental effectiveness -. Incorrect steering signals through depreciation allowances, especially larger companies with high profits benefit - lorry effects
Fiscal with public expenditures	R&D – Sponsorship	+ Role model + Targeted research support + Long-term orientation + Acceleration of existing research efforts + Positive side effects on innovation and competition	- Indirect support - Complexity of support programs - Volume of sponsorships - no broad impact, particularly big companies benefit - lorry effects - Uncertainty about the quality of the results - No warranty for the use of research results

	Instrument	Advantages	Disadvantages
Fiscal with public expenditures (continued)	Public procurement policy	+ Role model function of the state + Initiation of environmentally conscious private economic demand behaviour + Strengthening of the competitiveness of environmentally friendly products and processes + Support of the development of environmentally friendly processes and partly support of the reduction of operational production costs + Consideration as award criterion creates larger market for environmentally friendly products and services	Lack of self-motivation Positive environmental effect not guaranteed Dependence of the volume of demand of the public sector Low motivation effect for the testing of newer (and therefore more environmentally friendly) technologies Possibly costly Tender costs partly very high
	Financing of institutional environmental protection	+ Promotion of know-how + Use of the existing environmental knowledge + Strengthening the position of "environmental policy" at the political level + Early recognition of the needs of households and businesses in eco-political terms possible + Improved enforcement and assistance with environmental requirements for companies and households + Stimulus for politics and administration	Only indirect support No rapid effect Construction of bureaucracy

	Instrument	Advantages	Disadvantages
fiskalisch mit öffentlichen Ausgaben (fortgesetzt)	Fees	+ Control over outlays (standard) + in good accordance with polluter-pays principle (it is possible to set avoidance and recycling incentives) + Equivalence principle (performance and reward in close relationship) +,where appropriate, cost-effective management of municipal activities in the supply / disposal sector	- Justice of fees (disadvantages of the common burden principle) - Less incentive to reduce environmental aspects - Consumption behaviour with fixed rates is possibly independent - Less incentive to use environmentally friendly technologies - Transference of all costs to the customers - Fees do not fully cover social costs - Fees not in accordance with the polluter-pays principle do normally bring benefits only for businesses - Low consideration of the full cost of capital - "Freshwater standard" differentiates only insufficiently between damage and consumption sources
	Dues	+ See Fees	Not legally guaranteed utilization of the service See fees
Fiscal with public revenues	Fees	+ Compliant with the market + Cost minimization function + High incentive function (= dynamic economic efficiency) to internalize the costs for each generated environmental quality decline + induction of new production technologies for delivery + High effectiveness concerning individual pollution +Maximum cost ceiling (esp. important for small companies with high abatement costs)	Rare revision of the tax rate (possibly too low.) Inflation diminishes incentives Uniform fee rate unfair Continuous measurement of damaging substances necessary Used parameters controversial? Complex tax and fee system in Germany (detection problems, resistance of the levy payer) Marginal abatement cost has to be known broader introduction is not possible because of problems of group definition: Donations are of benefit to the group (the paying party must benefit), efficient only for relatively homogeneous groups, specific relationship between taxpayer and purposes of levying of taxes
Fiscal with public revenues (continued)	Fees (continued)		

	Instrument	Advantages	Disadvantages
	Licenses	+ compliant with the market + Ensuring optimal environmental impact in determining the amount of certificates + Minimization of individual economic switching costs + Market-oriented instrument with high scientific and economic acceptance + Ecological and economic (static) efficiency of Licenses + Normally transparent pricing + High latitude + High flexibility (application on Possible substitutes) + Regional burdens can be Explicitly Modelled + State may increase environmental standards by buying up + Administratively, Relatively easy to manage (establishment of administration for clearing of Licenses, control of data)	Disadvantage in competition: Mobilitätshemmung = Errichtung von Markteintrittsbarrieren durch etablierte Unternehmen Difficulties in differentiating regionally in case of particular environmental problems (i.e. in the air sector) in the sense of an exclusion principle Problem of an appropriate denomination Problems in establishing and maintaining an environmental stock market High costs of monitoring Verstoß gegen Verteilungsgerechtigkeit bei kostenloser Erstausgabe (grandfathering) im Luftreinhaltesektor können nur wenige Schadstoffe lizenziert werden More difficult market entry for new companies

Source: based on Bartmann, 1996; Günther, 1994; Jänicke et al., 2003; Rogall, 2000; source: Wicke, 1993

5 Indirect / objectified vs. direct / subjective concern

Relevance of the macro environment

For each company ecological, economic, technological, societal and political respectively legal framework conditions in different forms and intensity but can be described generally. In contrast the task environment presented in the following varies individually depending on the company.

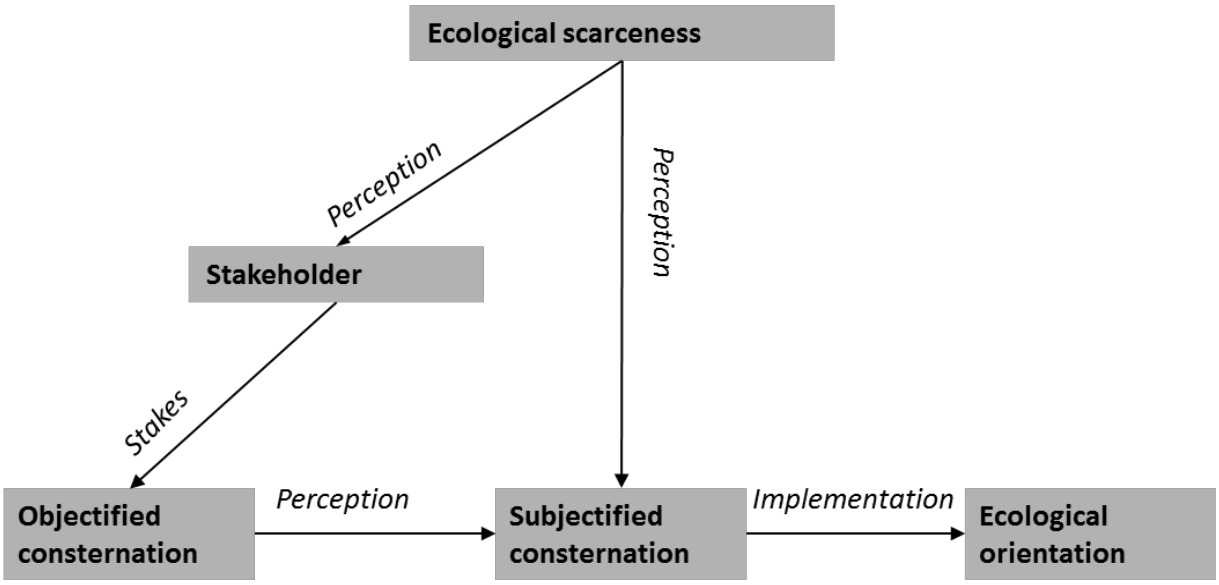
Indirect/objectified vs. direct/subjective consternation

Extent of ecology-oriented demands/ claims

All of the presented target groups destine the extent of ecology-oriented claims and therefore the anticipated incentives or sanctioning potential. The company with its management is not only bound to its owners but as a homo reciprocal also has to meet the demands of other groups

with which the company collaborates for fulfilling its tasks. These stakeholders therefore also determine insofar the company includes ecological aspects in their management.

Figure 27: From scarceness over Consternation to ecologic orientation Ecology orientation



Source: based on Günther, 1994

Indirect/objectified consternation

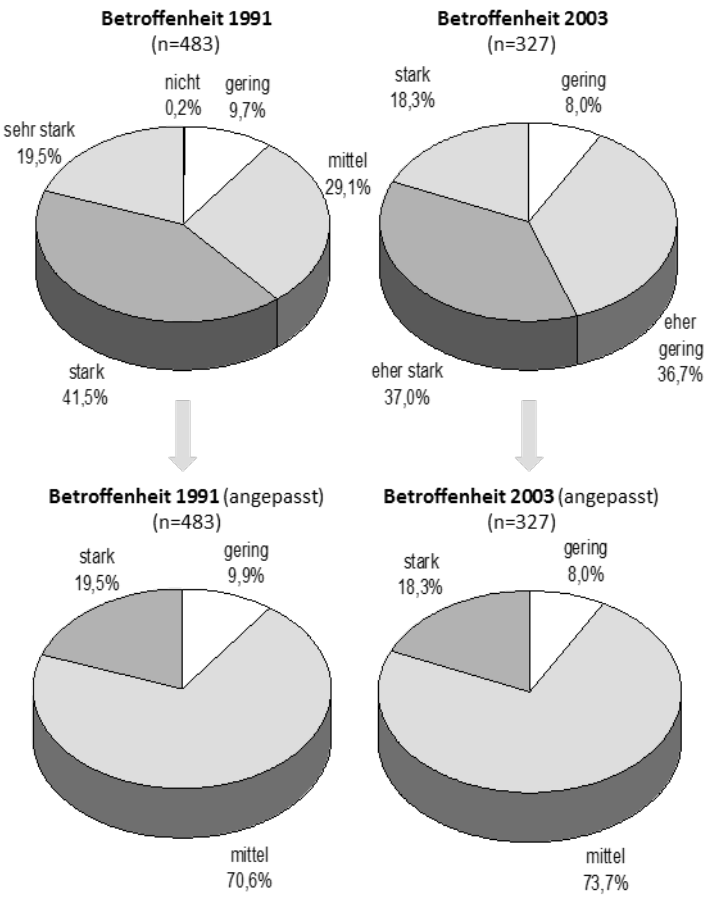
The objectified consternation is indirectly measured through the impact of influences caused by various stakeholders in the task environment, to wit customers, suppliers, shareholders, credit grantor, employees, legislator and public. That is why it is also called indirect consternation. The components of the macro environment, i.e. the economic or technologic framework conditions have no direct impact on the consternation of the companies but influence indirectly through the stakeholders. Exemplary, the economic framework conditions influence the buying power of customers. The structure of the macro environment influences, however, how companies convert consternation to ecology-oriented behaviour (cf. Meffert & Kirchgeorg, 1998).

Direct/subjective consternation

As can be deducted, there is subjective consternation, which is perceived by the management and which expresses the perception of objectified consternation or in the ideal case the direct perception of ecology-depending consternation. This kind of consternation is called direct consternation. There is a general rise in consternation among all companies, to wit they have to justify the consequences of their economic actions accounting for an increasingly severe danger for the environment and a sharper perception of environmental risks. More than that, company-demographic features such as company size and industry membership affect the extent of consternation. For the empirical examination of ecology-related consternation companies have been survey in 1991 and 2003 about how much their decisions are influenced by groups involved in the ecological transformation process (politics, market, public) (cf. Figure 14). Because both studies use different scaling, their categories have been summarized in order to enable a comparison. As can be seen, ecological consternation has not been changing. Between both studies new regulations of environmental protections have been implemented. However, the environmental consciousness of the public sank. Because the measurement does not

differentiate between laws, markets and public, the effect of both developments can be discovered. Future consternation of the companies, on the other hand, will rise (cf. Baum, Albrecht, & Raffler, 2007).

Figure 28: Empirical findings for ecology related consternation



Source: Baum et al., 2007

Thinking in messages - determine key performance indicators and create environmental reports

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After the presentation of monetary and non-monetary information and decision tools in the last chapter should answer the question how these instruments can be used for internal management using indicators and to external reporting**.**

Environmental reporting aims to measure, disclose and to be accountable to internal and external stakeholders about to what extent the company uses the functions of the environment and takes action to improve environmental performance. Thus, the communication of a company has two objectives: for internal stakeholders' environmental performance is measured in order to prepare decisions of corporate management, for external stakeholders the reporting on the environmental management system, the environmental performance, the ecology orientation of the value-added steps, the dealing with stakeholders and process and product innovations as well as environmental objectives are in the foreground. Finally, it should be noted that environmental reporting is increasingly part of sustainability reporting.

1 Environmental key performance indicators for internal management control

Basic idea of environmental key performance indicators is to represent ecologically relevant issues and developments to the management as report user, existing information is prepared as environmental key performance indicators. These can both provide a holistic overview of the company's operations as well as detailed information. Absolute key performance indicators or cardinal numbers can be quantified as sums, differences or averages in monetary or non-monetary form, i.e. as numbers, for example, greenhouse gas emissions in tonnes of CO_2 equivalent. If the target is an ecology-oriented penetration of the company, the linking of different information in the form of relative indicators or ratios is of major importance. These can be considered in relation as proportion (e.g. share of hazardous waste in the total waste volume), relational (e.g. energy consumption per employee) or indices (e.g. reduction of the water consumption based on the year 2008). If indicators are highly concentrated measurements, which select economically relevant and quantitatively detectable values as absolute or relative numbers, specifically delimit, logically summarize and prepare in concentrated form, environmental indicators meet this task for ecologically relevant situations and contexts.

Key performance indicator systems for representing contexts

The presentation of situations in a single indicator meets the requirement of targeted, but rarely balanced information. Since relations cannot be detected directly, also the possibilities of influence cannot be derived directly. The requirement for balanced information requires both the representation of an individual situation as well as its embedding in the comprehensive context. An indicator system, which considers interdependencies between the individual indicators and illustrates complex situations, meets these demands. A key performance

indicator system is generally a set of quantitative variables, whereas the individual indicators are in objectively logical connection to each other, complement or explain each other and are generally positioned on a common overarching goal. Key performance indicator systems need to be a reflection of the target system of the company and of its conception a concentrated representation of the current business situation.

Computing systems or classification systems

Computational key performance indicator systems represent objectively logical and calculable situations. Thus, single indicators are derived as a computational result of upstream or downstream as a computational factor of downstream indicators. The top key performance indicator of a computing system should embody the most important business goal and is broken down by the allocation, substitution and expansion in sub-indicators. In this way, a hierarchical and pyramidal structure occurs, which can be analysed bottom-up (synthetic procedure: How will my decision affect the overall indicator?) or top-down (analytical procedure: Why the top key performance indicator has changed?). As an example, the represented figure of the EVA™ can be mentioned. Thus, the monetary consequences of ecology orientation with regard to their effect on the EVA ™ can be examined:

MOBILITY UNLIMITED has several options to increase the EVA. The calculation rule mentioned above shows, that the EVA consists of three components. By several measures these three components can be selectively influenced. This is exemplified in the following.

<u>1. Net operating profit after tax NOPAT</u>

$$\boxed{\text{NOPAT} = \text{sales} - \text{cash costs}}$$

An increase of NOPAT is possible by increasing the sales and/or the reduction of cash costs. The quantity of 1,000 sold vehicles in one division in 2006 was achieved in 2007, too.

a) Sales

The installation of a biodiesel engine leads to the achievement of a price premium. A market survey indicates that the customer would pay for a vehicle with biodiesel engine € 17,800 (compared to 17,000 € for a model with a petrol engine).

b) Cash costs

In 2006, € 1.5 million cash costs were incurred. In 2007, these were reduced by 50,000 € by energy savings and waste.

$$\text{NOPAT}_{2006} = 17{,}000 \frac{€}{\text{vehicle}} \times 1{,}000 \text{ vehicles} - 1{,}500{,}000 \text{ €} = \underline{\underline{15{,}550{,}000 \text{ €}}}$$

$$\text{NOPAT}_{2007} = 17{,}800 \frac{€}{\text{vehicle}} \times 1{,}000 \text{ vehicles} - 1{,}450{,}000 \text{ €} = \underline{\underline{16{,}350{,}000 \text{ €}}}$$

<u>2. Weighted average cost of capital (WACC)</u>

$$\boxed{\text{WACC} = \frac{(\text{costs of equity} \times \text{equity}) + (\text{costs of bowrrowed capital} \times \text{borrowed capital})}{\text{equity} + \text{borrowed capital}}}$$

a) Costs of equity

The introduction of active risk management and the use of the new drive concept lead to a reduction in the cost of equity from 12% to 10%. The equity of MOBILITY UNLIMITED amounts € 70 million in 2006 and 2007.

b) Costs of borrowed capital

Reducing the cost of borrowed capital from 6% to 5% is realized by a positive external rating, which results from the active risk management and reduced costs. The borrowed capital remains unchanged at € 20 million, too.

$$\text{WACC}_{2006} = \frac{0.12 \times 70{,}000{,}000\ € + 0.06 \times 20{,}000{,}000\ €}{70{,}000{,}000\ € + 20{,}000{,}000\ €} = 10.6667\ \%$$

$$\text{WACC}_{2007} = \frac{0.10 \times 70{,}000{,}000\ € + 0.05 \times 20{,}000{,}000\ €}{70{,}000{,}000\ € + 20{,}000{,}000\ €} = 8.8889\ \%$$

3. Net Operating Assets

$$\boxed{\text{NOA} = \text{fixed assets} + \text{current assets} - \text{interest - free, short - term borrowed capital}}$$

a) Fixed assets

The increase in fixed assets is realized through the use of integrated technologies as part of risk management. In particular, the use of a new paint with an environmentally friendly painting contributes to this. The acquisition costs of the investment is € 1 million. The previous fixed assets amount € 7 million.

b) Current assets

The former current assets amount € 4 million. There will be no measures to change the current assets. MOBILITY UNLIMITED currently does not have short-term borrowed capital.

$$\text{NOA}_{2006} = \text{fixed assets}_{2006} + \text{current assets}_{2006} = 7{,}000{,}000\ € + 4{,}000{,}000\ € = \underline{\underline{11{,}000{,}000\ €}}$$

$$\text{NOA}_{2007} = \text{fixed assets}_{2007} + \text{current assets}_{2007} = 8{,}000{,}000\ € + 4{,}000{,}000\ € = \underline{\underline{12{,}000{,}000\ €}}$$

4. Calculation of EVA

$$\text{EVA}_{2006} = \text{NOPAT}_{2006} - \text{WACC}_{2006} \times \text{NOA}_{2006} = 15{,}550{,}000\ € + 10.6667\ \% \times 11{,}000{,}000\ € = \underline{\underline{14{,}326{,}666.67\ €}}$$

$$\text{EVA}_{2007} = \text{NOPAT}_{2007} - \text{WACC}_{2007} \times \text{NOA}_{2007} = 16{,}350{,}000\ € + 8.8889\ \% \times 12{,}000{,}000\ € = \underline{\underline{15{,}283{,}333.33\ €}}$$

MOBILITY UNLIMITED thus achieves an increase of corporate value of € 956,667.66 through the implementation of various ecology-oriented strategies compared to the previous year.

Legend:

EVA = Economic Value Added

NOA = Net Operating Assets

NOPAT = Net Operating Profit After Taxes

WACC = Weighted Average Cost of Capital

With help of computing systems, networked cause-effect relationships cannot be represented, because only vertical, in no case horizontal dependencies are representable. For a classification system, the computational link between the system elements is missing; but they are in a logically structured relation. Because of their not strictly necessary link various aspects may be included in such a key performance indicator system. The selection of individual indicators is subjective, as they cannot be derived from unique calculation rules. Thus, networked relations of reality can be represented. In the selection and creation of indicators for calculating and classification systems the following aspects are to be considered: quality and currency of the underlying information system and the acquired and processed data as well as correct cause-effect relations (which is a challenge in environmental cross-media aspects).

Areas of environmental key performance indicator systems

Environmental key performance indicator systems are in general built as classification systems due to the variety of aspects. But within there may be partially computational links. As environmental key performance indicator systems are designed to represent the environmental performance of the company or its divisions in an overview, it can be used for tasks of planning, control and monitoring: key performance indicator systems support planning tasks by providing the problem situation in an overall context. This allows to detect existing possibilities for action more easily (e.g. by the knowledge of cause-effect relationships) and to analyse the effects of action alternatives. Planning as mental anticipation of future action is therefore possible. For example, MOBILITY UNLIMITED can use the indicator system based on the EVA ™, to predict the effect of strategic decisions. To achieve defined corporate goals, these are to be dissolved in the fields of activity and levels of hierarchy by suitable control instruments to provide a tailored control instrument for the respective area. Indicators are particularly suited for control tasks because they can be determined individually for differences between the areas or trans-sectoral for commonalities. In addition, with the help of key performance indicator systems, variables are controlled, which are non-monetary and therefore do not necessarily have to be taken from the accounting. In a procurement guideline MOBILITY UNLIMITED can put specifications for an ecology-oriented procurement with help of indicators in concrete terms (e.g. energy consumption of office communication equipment). The management can also specify target values for its subordinated bodies, which again can derive possibilities from the key performance indicator systems to achieve these targets. A continuous review of the realized values (control task) is a necessary condition for the achievement of defined objectives. The evaluation of the obtained data requires benchmarks. These can be obtained from data from previous periods, from other companies or from standards. Accordingly, one can distinguish between the time comparison, the intercompany comparison and the target-performance comparison. The time comparison shows the evolution of a company or a location over several periods (e.g. energy consumption per ton of output). The intercompany comparison compares companies of the same branch of business with each other making sure that absolute values are comparable only in case of same size of the companies or locations. Therefore, usually ratios must be applied (e.g. space requirements of the production in square meter). A target-performance comparison as an instrument of corporate control is of particular importance because the actual performance of legally prescribed or internally defined critical values can be compared (e.g. emission limit). If the indicators are structured by functional areas, action and decision-oriented information can be provided for all departments with the help of the ecology-oriented key performance indicator system. Thus, vulnerabilities are identifiable in the respective functional areas and potentials can be exposed.

Principles for an environmental key performance indicator system

In order to use an environmental indicator system equally for purposes of planning, control and monitoring of ecologically relevant facts, the following principles are to be taken into account in the construction of the system.

<u>Image of the target system:</u>

The environmental key performance indicator system must be constructed so that the business objectives are reflected. In the case of ecology orientation of a company, this means that both the profit and the ecology orientation should be integrated into the key performance indicator system. Monetary data can be divided into cost and revenue variables, non-monetary data into input-and output-oriented information.

Completeness:

The environmental key performance indicator system must meet the criterion of completeness, i.e. all degrees of target achievement intended by the company need to be mapped and monitored by the values included in the key performance indicator system. This requires an in-depth consideration which is to be performed by the analysis of individual value-added steps with the help of subsystems.

Concentration of reality:

To serve as a starting point for measures of planning, controlling and monitoring and to be rapidly and comprehensively configurable by the operational decision-makers, environmental key performance indicator system must represent a concentration of reality. This ensures a realistic decision basis and encourages efficiency of decision support by the concentration of the data base.

Quantifiability:

Environmental indicators can only be formed from quantitatively detectable information. The basic values must therefore be formulated as a monetary amount or in dimensions of measurable quantities. In addition, the elements have to be consistently referred, assessed and defined over time. Facts which do not meet this condition, i.e. which are only qualitatively representable, cannot be considered in an environmental key performance indicator system.

Documentation of absolute values:

Relative environmental indicators, such as the energy consumption of coal equivalent per ton of output, allow an assessment of the environmental situation of a company, especially in comparison with other companies. The basic problem of this approach, however, is that it makes no statement about the absolute burdens or discharges of the ecological environment by the company. In order to document the actual impairment of the ecological environment by a company the absolute environmental indicators of the company must be detected (i.e. in the example, the energy consumption in coal equivalents per se).

Materiality:

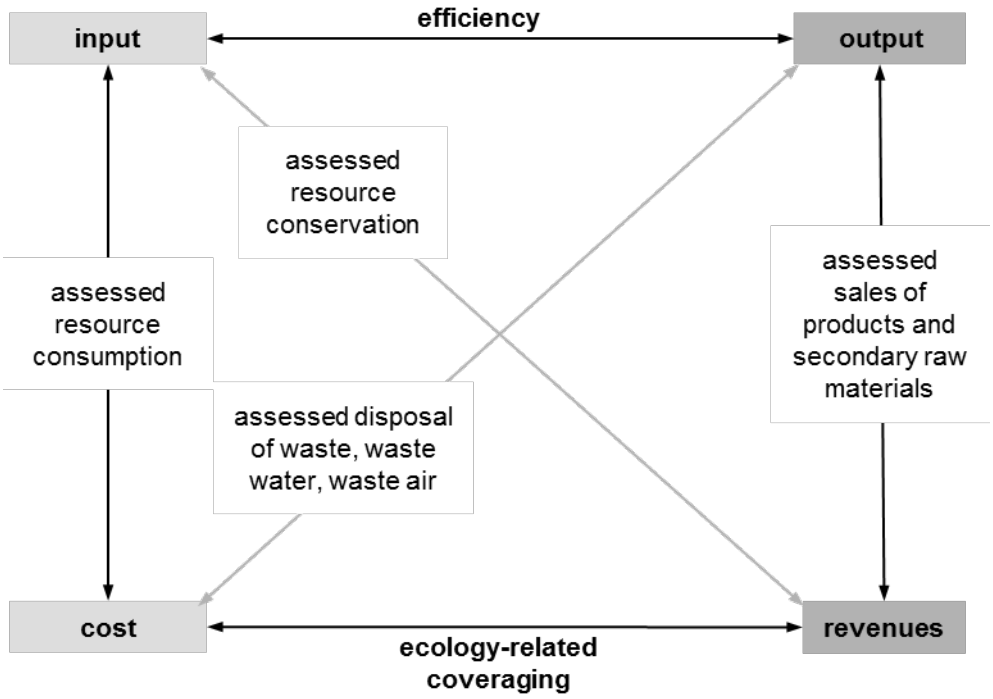
An environmental key performance indicator system must be manageable in scope. This idea also accommodates the economic principle meaning that there has to be an appropriate relationship between the effort of creating a key performance indicator system and the benefits of mediated information. The principles of materiality and efficiency are to be observed.

Monetary or non-monetary key performance indicators

Ideally environmental key performance indicator systems represent both profit and environmental objectives that are in competition particular according to the maturity: Companies make more economically short-term decisions, whereas environmental objectives have a long-term focus. Exceptions are industries such as forestry, where long-term decisions are natural due to the rotation periods. Also the urban water management and the energy industry are more familiar with long-term formative decisions than other industries due to capital commitment.

Regardless of which rank the objectives take, both profit and environmental goals are to subordinate to the goal of long-term livelihood security of the company. Since the priorities of companies are to be determined individually an environmental key performance indicator system should integrate both monetary values (costs and revenues) and non-monetary values (input and output) (Figure 1).

Figure 29: Relationship between monetary and non-monetary indicators



Source: GÜNTHER 1994, p. 295

Monetary environmental key performance indicators

For the monetary analysis, costs and revenues are studied. In case of costs functional areas are to be considered first, e.g. the environmental costs of research and development, to reveal the meaning of each value-added step for the entire company. From this cost block the ecology costs are to be split and analysed. In case of revenues on the one hand savings and on the other hand additional revenues caused by ecology-oriented measures are considered. Finally, the ecology costs occurred in one value-added step are compared with the ecology revenues or savings of the ecology orientation. This ratio indicates the extent to which the costs of ecology orientation are covered by the revenues (ecology-related covering). Thus it becomes clear how high are the additional cost burdens on this value-added step in balance and whether these are covered by higher prices. Under certain circumstances, the savings and additional revenues already exceeds the ecology costs. Thus there is ceteris paribus increased profitability for the company.

Non-monetary environmental key performance indicators

In the field of non-monetary environmental key performance indicators input and output-related circumstances or transactions are compared with each other. The input-oriented environmental indicators reflect the extent to which natural resources are used. Output-based environmental indicators are related to the exposure of the object function of the ecological environment. Based on the determined input and output values the efficiency factor can be determined. It expresses the ratio of an input value to an output value (efficiency).

Below an excerpt of the environmental key performance indicator system of MOBILITY UNLIMITED for logistics and procurement is represented (Table 18).

Table 18: Environmental key performance indicators of MOBILITY UNLIMITED

Indicator	Unit/Calculation	2006	2007
Steel consumption	t	340,325	389,512
Aluminium consumption	t	12,027	11,375
Share of renewable ressources	Amount of renewable resources in t / Total material consumption in t	2.9 %	2.9 %
Varnishs and fillers	t	7,915	7,326
Oils	t	645	589
Binders	t	4,586	4,098
Total amount of packaging	t	80,236	79,294
Share of reusable packaging	Amount of reusable packaging in t / Amount of packaging in t	56 %	56 %
Total amount of waste	t	65,985	66,210
Waste for recycling	t	41,256	43,021
Waste for disposal	t	24,729	23,189
Metallic waste (scrap)	t	215,036	236,985
Total hazardous waste	t	2,705	2,648
Share hazardous waste	Amount of hazardous waste in t / Total amount of waste in t	4.1 %	4.0 %
Share of suplliers with environmental management system (EMS)	Number of suppliers with EMS / Total number of suppliers	64 %	66 %
Share of purchasing volume of suppliers with EMS	Purchasing volume of suppliers with EMS / Total purchasing volume	88 %	89 %

Proposal for environmental key performance indicators in the standardization

As already introduced, control of environmental performance within the company must go ahead the environmental reporting to the public. The DIN EN ISO 14031 is an international standard devoting to the question of how such an environmental performance assessment can be made within an organization and can be created with indicators. The standard defines the environmental performance assessment as "the process to support management decisions for the environmental performance of an organization by selection of indicators, data collection and analysis, assessment of information according to environmental performance criteria, reporting and communication as well as periodical review and improvement of this process" (DIN EN ISO 14031:1999, p. 5). As environmental performance, the actual results of an environmental management system are classified. At the strategic level, the performance of an installed environmental management system in relation to the formulation of ecology-oriented objectives and the creation of appropriate conditions (measures, structures and processes) for planning, controlling and monitoring of the implementation of these objectives is considered (e.g. number of achieved objectives and targets or profitability of projects for environmental improvement). At the operational level, the environmental performance refers to the results of the installed environmental management system. The operational level aims at the determination of the results and thus of the ecological efficiency, i.e. the input/output ratio for the environmental goal achievement, while at the strategic level decisions about questions of ecological efficiency are made by assessing the degree of target achievement and the assessment of the environmental objectives.

Environmental performance assessment according to DIN EN ISO 14031

The individual steps of environmental performance assessment are assign to the four basic stages of the process "Planning - Implementation - Verifying - Acting" of the Deming circle (DIN EN ISO 14031:1999, p. 6). Most important within these four steps, is the selection of indicators for the environmental performance assessment. Two categories of indicators are distinguished: The Environmental Condition Indicators (environmental status indicators) and the Environmental Performance Indicators: While the environmental status indicators provide information about the local, national and global environmental situation, the environmental performance indicators aim directly at the individual organization and the mapping their environmental management conditions (e.g. number of environmental objectives, employees in the environmental management sector) and their environmental aspects (e.g. information about emissions into air, water, soil). The assessment of environmental performance takes place by a target-performance comparison, i.e. by the comparison of indicators with the objectives of the organization. The represented and assessed environmental performance can then be subject of the reporting and communication of the organization to external recipients and basis for possible improvements in the determination of environmental performance.

Environmental management information systems (EMIS)

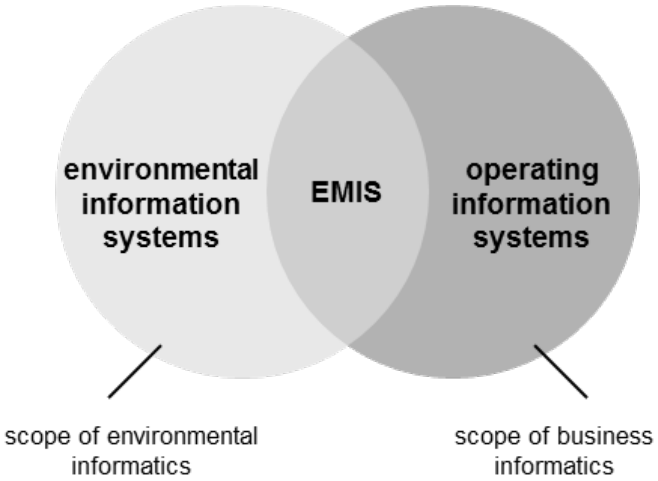
If IT systems, i.e. corporate environmental information systems are used to gather prepare and analyse the information, costs and benefits of performance measurement systems can enter into a meaningful relationship. An environmental management information system (EMIS) is an organizational-technical system for the systematic collection, processing and provision of environmentally relevant information in an organization. Its primary purpose is the collection of operational pollution and the support of environmental protection measures (HAASIS 1995 p. 7). Thus EMIS serve on the one hand the internal decision support and on the other hand lay the basis for reporting for information supply of external actors.

Tasks of EMIS

Such environmental information systems typically result from the expansion of existing information systems to environmental aspects. In addition, they can include organizational and process data besides quantity and quality indicators of inputs and outputs. Although computing systems that can convert individual indicators into each other, are difficult to apply in the ecology-related field due to the multi-causality, at least classification systems in terms of benchmarking can be built. In the context of the EMIS concepts discussed by HILTY (HILTY 2006, p. 92), such a key performance indicator system can be used to support the controlling. The information obtained can be used both for internal controlling and for the communication of corporate environmental performance to the public (environmental reporting). Besides these controlling oriented EMIS the task oriented EMIS are another category, which are used for special operational tasks such as the waste or hazardous substance management and which are used to the greatest possible extent as stand-alone systems, i.e. isolated from other business information systems.

The third group includes the production-related EMIS. The inclusion of the thoughts of the emission and waste reduction in production planning and control as well as the corresponding information systems are characteristics of this category. Even in the design (Computer-Aided Design, CAD) a product design tailored to subsequent recycling processes (e.g. disassembling, reprocessing and reinstallation of components) can be in the focus of an EMIS.

Figure 30: Environmental management information systems



Source: HILTY 2006, p. 54

2 Voluntary external environmental reporting as part of sustainability reporting

Subject of report in the narrow sense

If the focus is on the environmental functions supply, admission and regulation, the report object in the narrow sense should be the use of these functions, which is represented with the help of environmental indicators. Therefore, the environmental part of sustainability reporting, the environmental reporting, can be organized as follows: Inputs into the company (energy, water and material) use the supply function, outputs from the company (emissions, waste water and waste) use the object function. As an indicator for the control function for example the impacts on biodiversity can be represented. Aspects outside the corporate boundary are the environmental aspects of transportation and products and services of the company.

Subject of report in the broader sense

Since the provision of corporate environmental performance is integrated in the business control process, the environmental reporting usually includes, beyond the environmental performance, the presentation of the environmental management system, the ecological relevance and measures of individual functional areas, ecological relevant innovation and the management of the stakeholders (see for further readings for the development in the field of sustainability reporting LANGE/PIANOWSKI 2008; ISENMANN/GÓMEZ 2008). The table below provides an overview of the components of a report in a broader sense (Table 2).

Table 19: Subject of report in the broader sense

ecology orientation
corporate guidelines
environmental guidelines
responsibilities and deadlines
type of environmental management system and included locations
external assessments

environmental performance LCI of direct environmental aspects ecology-oriented assessment of direct environmental aspects economic assessment of direct environmental aspects measures to control the environmental performance target achievement
value-added steps procurement (suppliers) utilization (customers) facility management disposal logistics employees
innovations research and development operating performance institutional innovations environmental investments
stakeholder competitors politics society education and research ecological framework conditions (nature and climate protection)

Source: GÜNTHER/KAULICH 2007, p. 36 ff.

Guideline for the GLOBAL REPORTING INITIATIVE (GRI)

But in what form this contents should be represented by the company? For this the guideline of the GRI provides a comprehensive support for companies. The organization already introduced to the actors of environmental policy was founded in 1997 as a joint initiative of the U.S. NGO „COALITION FOR ENVIRONMENTALLY RESPONSIBLE ECONOMICS“ (CERES) and the „UNITED NATIONS ENVIRONMENT PROGRAMME“ (UNEP). Since then the GRI has been worked to settle a globally applicable, mandatory guideline for sustainable reporting and to promote its global acceptance. Because until 2015, more than 60,000 reports were published according to these guidelines and are publicly available on www.corporateregister.com, environmental reporting based on the guideline for sustainability reporting of the GRI should be presented in this book. This guideline (in the English version: Sustainability Reporting Guidelines) shall serve as a checklist for organizations when reporting. The objective is to represent both the economic and environmental as well as the social dimension of their business activities. After the first version in 2000, the second version in 2002 and the third version in 2006, 2013, the fourth version of the guideline was passed. Superior objective is to support the reporting organizations and their stakeholders on the way to a more sustainable development. The three components of a sustainability report required for this are the presentation of strategy and profile of the

company, the description of management's approach and performance indicators. Hereinafter, all three main focuses are discussed separately, whereas the economic and social performance indicators are presented only in an overview, on the contrary the ecological ones more detailed. The GRI helps companies with two questions of reporting: For the HOW of reporting principles for the content and its quality and for the choice of system boundary were developed and protocols were created or existing ones were chosen as reference. For the WHAT of reporting general disclosure areas were proposed and supplemented by sector specific conditions, so-called sector supplements. This was further extended by national particularities.

Reporting principles

The GRI has formulated four principles for the demarcation of the contents and six for the quality of its presentation, which have their roots in the requirements of reporting of financial data (financial statements etc.). But there were also examples for the environmental sector, e.g. the principles already passed in 1997 by the DEUTSCHES INSTITUT FÜR STANDARDISIERUNG (DIN) e.V. for the preparation of an environmental report (DIN 33922). Each criterion is first defined and then explained. So-called check statements should help the company to verify compliance. Hereinafter, the definitions of the GRI guidelines are presented (Global Reporting Initiative (GRI) 2013 p. 16 ff.):

Principles for defining **report content**:

Stakeholder Inclusiveness: „The organization should identify its stakeholders, and explain how it has responded to their reasonable expectations and interests. "

Sustainability Context: „The report should present the organization's performance in the wider context of sustainability. "

Materiality: „The report should cover Aspects that: Reflect the organization's significant economic, environmental and social impacts; or substantively influence the assessments and decisions of stakeholders "

Completeness: „The report should include coverage of material Aspects and their Boundaries, sufficient to reflect significant economic, environmental and social impacts, and to enable stakeholders to assess the organization's performance in the reporting period. "

Principles for defining report quality:

Balance: „The report should reflect positive and negative aspects of the organization's performance to enable a reasoned assessment of overall performance. "

Comparability: „The organization should select, compile and report information consistently. The reported information should be presented in a manner that enables stakeholders to analyse changes in the organization's performance over time, and that could support analysis relative to other organizations. "

Accuracy: „The reported information should be sufficiently accurate and detailed for stakeholders to assess the organization's performance. "

Timeliness: „The organization should report on a regular schedule so that information is available in time for stakeholders to make informed decisions "

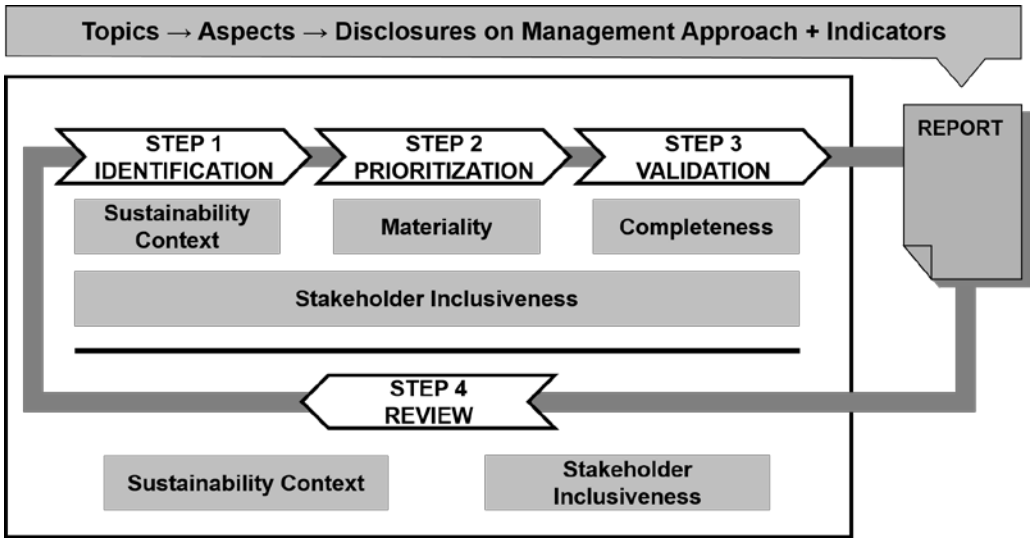
Clarity: „The organization should make information available in a manner that is understandable and accessible to stakeholders using the report. "

Reliability: „The organization should gather, record, compile, analyse and disclose information and processes used in the preparation of a report in a way that they can be subject to examination and that establishes the quality and materiality of the information. "

Defining material aspects and boundaries

The boundaries are redefined for each essential aspect according to the impact of business activities along the value chain. Therefore, the boundaries may vary for each aspect and may include different business segments or parts of the value chain. For the decision to determine the material aspects and boundaries, the following sequence can be used (Fig. 3).

Figure 31: Defining material Aspects and Boundaries - process overview



Source: GLOBAL REPORTING INITIATIVE (GRI), 2013, p. 90.

Protocols

The protocols of the GLOBAL REPORTING INITIATIVE (GRI) ensure the consistent representation of the report contents. The GRI guideline distinguishes between indicator protocols and technical protocols. Indicator protocols exist for each economic, environmental and social performance indicator on the GRI guideline. They contain definitions, notes for the preparation of the report and further information, which ensure that performance indicators are interpreted uniformly. For example, the instruction for the indicator EN16 is: "Report the greenhouse gas emissions as the sum of direct and indirect emissions in tonnes of CO_2 equivalent." For determining the company receives one and a half-page explanation. Technical protocols contain statements on issues in reporting, such as determination of boundaries of the report. They should be used in conjunction with the GRI guideline and the sectoral supplements.

Content of the report - Standard Disclosures

There are two different types of Standard Disclosures: General Standard Disclosures and Specific Standard Disclosures.

The General Standard Disclosures are applicable to all organizations preparing sustainability reports. The General Standard Disclosures are divided into seven parts: Strategy and Analysis, Organizational Profile, Identified Material Aspects and Boundaries, Stakeholder Engagement, Report Profile, Governance, and Ethics and Integrity.

The Guidelines organize Specific Standard Disclosures into three Categories - Economic, Environmental and Social. The Social Category is further divided into four sub-Categories, which are Labour Practices and Decent Work, Human Rights, Society and Product Responsibility. Additionally, Disclosures on Management Approach (DMA) are intended to give the organization an opportunity to explain how the economic, environmental and social impacts related to material Aspects are managed.

Table 20: Report contents Global Reporting Initiative

Strategy and analysis	Statement from the most senior decision-maker of the organization (such as CEO, chair, or equivalent senior position) about the relevance of sustainability to the organization and the organization's strategy for addressing sustainability
	Description of key impacts, risks, and opportunities
Organizational profile	Name of the organization
	Primary brands, products, and services
	Location of the organization's headquarters
	Number of countries where the organization operates, and names of countries where either the organization has significant operations or that are specifically relevant to the sustainability topics covered in the report
	Nature of ownership and legal form
	Markets served (including geographic breakdown, sectors served, and types of customers and beneficiaries)
	Scale of the organization
	0 Total number of employees by employment contract and gender, total number of permanent employees by employment type and gender, total workforce by employees and supervised workers and by gender, total workforce by region and gender, significant variations in employment numbers
	1 Percentage of total employees covered by collective bargaining agreements
	2 Organization's supply chain
	3 Significant changes during the reporting period regarding the organization's size, structure, ownership, or its supply chain
	4 Precautionary approach or principle addressed by the organization
	5 Externally developed economic, environmental and social charters, principles, or other initiatives to which the organization subscribes or which it endorses
	6 Memberships of associations (such as industry associations) and national or international advocacy organizations
	7 All entities included in the organization's consolidated financial statements or equivalent documents

Identified Material Aspects and Boundaries	8	Process for defining the report content and the Aspect Boundaries and how the organization has implemented the Reporting Principles for Defining Report Content
	9	Material Aspects identified in the process for defining report content
	0	Aspect Boundary within the organization for each material Aspect
	1	Aspect Boundary outside the organization for each material Aspect
	2	Effect of any restatements of information provided in previous reports, and the reasons for such restatements
	3	Significant changes from previous reporting periods in the Scope and Aspect Boundaries
Stakeholder Engagement	4	Stakeholder groups engaged by the organization
	5	Basis for identification and selection of stakeholders with whom to engage
	6	Organization's approach to stakeholder engagement, including frequency of engagement by type and by stakeholder group, and an indication of whether any of the engagement was undertaken specifically as part of the report preparation process
	7	Key topics and concerns that have been raised through stakeholder engagement, and how the organization has responded to those key topics and concerns, including through its reporting. Report the stakeholder groups that raised each of the key topics and concerns
Report Profile	8	Reporting period (such as fiscal or calendar year) for information provided
	9	Date of most recent previous report (if any)
	0	Reporting cycle (such as annual, biennial)
	1	Contact point for questions regarding the report or its contents
	2	'In accordance' option (Core or Comprehensive) the organization has chosen
	3	organization's policy and current practice with regard to seeking external assurance for the report and relationship between the organization and the assurance providers
Governance	4	Governance structure of the organization, including committees of the highest governance body
	5	Process for delegating authority for economic, environmental and social topics from the highest governance body to senior executives and other employees
	6	Statement whether the organization has appointed an executive-level position or positions with responsibility for economic, environmental and social topics, and whether post holders report directly to the highest governance body

	7	Processes for consultation between stakeholders and the highest governance body on economic, environmental and social topics
	8	Composition of the highest governance body and its committees
	9	Statement whether the Chair of the highest governance body is also an executive officer
	0	Nomination and selection processes for the highest governance body and its committees, and the criteria used for nominating and selecting highest governance body members
	1	Processes for the highest governance body to ensure conflicts of interest are avoided and managed. Report whether conflicts of interest are disclosed to stakeholders
	2	Highest governance body's and senior executives' roles in the development, approval, and updating of the organization's purpose, value or mission statements, strategies, policies, and goals related to economic, environmental and social impacts
	3	Measures taken to develop and enhance the highest governance body's collective knowledge of economic, environmental and social topics
	4	Processes for evaluation of the highest governance body's performance with respect to governance of economic, environmental and social topics
	5	Highest governance body's role in the identification and management of economic, environmental and social impacts, risks, and opportunities
	6	Highest governance body's role in reviewing the effectiveness of the organization's risk management processes for economic, environmental and social topics
	7	Frequency of the highest governance body's review of economic, environmental and social impacts, risks, and opportunities
	8	Highest committee or position that formally reviews and approves the organization's sustainability report and ensures that all material Aspects are covered
	9	Process for communicating critical concerns to the highest governance body
	0	Nature and total number of critical concerns that were communicated to the highest governance body and the mechanism(s) used to address and resolve them
	1	Remuneration policies for the highest governance body and senior executives
	2	Process for determining remuneration
	3	Stakeholders' views sought and taken into account regarding remuneration, including the results of votes on remuneration policies and proposals, if applicable

	4	Ratio of the annual total compensation for the organization's highest-paid individual in each country of significant operations to the median annual total compensation for all employees (excluding the highest-paid individual) in the same country
	5	Ratio of percentage increase in annual total compensation for the organization's highest-paid individual in each country of significant operations to the median percentage increase in annual total compensation for all employees (excluding the highest-paid individual) in the same country
Ethics and Integrity	6	Organization's values, principles, standards and norms of behaviour such as codes of conduct and codes of ethics
	7	Internal and external mechanisms for seeking advice on ethical and lawful behaviour, and matters related to organizational integrity, such as helplines or advice lines
	8	Internal and external mechanisms for reporting concerns about unethical or unlawful behaviour, and matters related to organizational integrity, such as escalation through line management, whistleblowing mechanisms or hotlines
Indicators		**Economic:** Economic performance Market presence Indirect economic impacts Procurement practices
		Environmental: Materials Energy Water Biodiversity Emissions Effluents and waste Products and services Compliance Transport Overall Supplier environmental assessment Environmental grievance mechanisms

5. Management approach and performance indicators (ongoing)	**Social performance indicators:** Labour practices and decent work: Employment Labour/management relations Occupational health and safety Training and education Diversity and equal opportunity Equal remuneration for women and men Supplier assessment for labour practices Labour practices grievance mechanisms uman rights: Investment Non-discrimination Freedom of association and collective bargaining Child labour Forced and compulsory labour Security practices Indigenous rights Assessment Supplier human rights assessment Human rights grievance mechanisms ociety: Local communities Anti-corruption Public policy Anti-competitive behaviour Compliance Supplier assessment for impacts on society Grievance mechanisms for impacts on society Product responsibility: Customer health and safety Product and service labelling Marketing communications Customer privacy Compliance

Source: GLOBAL REPORTING INITIATIVE (GRI) 2013 p. 20 ff.

Content of the report - sector disclosures

Sector disclosures complement the GRI guideline by industry recommendations for the application of the guideline in specific industries. Moreover, they contain industry-specific performance indicators, which are relevant for each sector, but not for other sectors. GRI has made sector disclosures for the following sectors available: Airport operators, Construction and

real estate, electric utilities, event organizers, financial services, food processing, media, mining and metals, NGOs, and oil and gas. The sector disclosures are available in addition to the GRI guideline and includes notes and comments on the existing indicators for companies in specific sectors in order to adapt the content better to the environmental aspects and specific requirements of each sector. These relate to the aspects materials, energy, water, biodiversity, emissions and contain mainly information about units, definitions and calculation methods. For example, in EN8 not only the water withdrawal according to various sources is reported, also a breakdown according to the use (process and cooling water) is done. It is further recommended that emissions in relation to the generated power are to be indicated (in MWh).

Indicators

Core of the reporting according to GRI are the economic, environmental and social performance indicators.

Objectives of the GRI reporting are:

a) Reporting on trends: Information should be presented for the current reporting period (e.g., one year) and at least two previous periods, as well as future targets, where they have been established, for the short- and medium-term.

b) Use of protocols*:* Organizations should use the protocols that accompany the indicators when reporting on the indicators. These give basic guidance on interpreting and compiling information.

c) Presentation of data: In some cases, ratios or normalized data are useful and appropriate formats for data presentation. If ratios or normalized data are used, absolute data should also be provided.

d) Data aggregation: Reporting organizations should determine the appropriate level of aggregation of information. See additional guidance in the general reporting notes section of the guidelines.

e) Metrics: Reported data should be presented using generally accepted international metrics (e.g., kilograms, tonnes, litres) and calculated using standard conversion factors. Where specific international conventions exist (e.g., GHG equivalents), these are typically specified in the indicator protocols.

Classification proposal for environmental indicators

The environmental dimension of sustainability concerns the organization's impact on living and non-living natural systems, including land, air, water and ecosystems. The environmental category covers impacts related to inputs (such as energy and water) and outputs (such as emissions, effluents and waste). In addition, it covers biodiversity, transport, and product and service-related impacts, as well as environmental compliance and expenditures. GRI designed a classification proposal for the environmental indicators. (Table 21).

Table 21: Overview of the G4 environmental indicators

Materials
EN1. Materials used by weight or volume EN2. Percentage of materials used that are recycled input materials
Energy
EN3. Energy consumption within the organization EN4. Energy consumption outside of the organization EN5. Energy intensity EN6. Reduction of energy consumption EN7. Reductions in energy requirements of products and services
Water
EN8. Total water withdrawal by source EN9. Water sources significantly affected by withdrawal of water EN10. Percentage and total volume of water recycled and refused
Biodiversity
EN11. Operational sites owned, leased, managed in, or adjacent to, protected areas and areas of high biodiversity value outside protected areas EN 12. Description of significant impacts of activities, products, and services on biodiversity in protected areas and areas of high biodiversity value outside protected areas EN13. Habitats protected or restored EN14. Total number of IUCN red list species and national conservation list species with habitats in areas affected by operations, by level of extinction risk
Emissions
EN15. Direct greenhouse gas (GHG) emissions (scope 1) EN16. Energy indirect greenhouse gas (GHG) emissions (scope 2) EN 17. Other indirect greenhouse gas (GHG) emissions (scope 3) EN 18. Greenhouse gas (GHG) emissions intensity EN29. Reduction of greenhouse gas (GHG) emissions EN20. Emissions of ozone-depleting substances (ODS) EN21. NO_X, SO_X, and other significant air emissions
Effluents and Waste
EN22. Total water discharge by quality and destination EN23. Total weight of waste by type and disposal method EN24. Total number and volume of significant spills EN25. Weight of transported, imported, exported, or treated waste deemed hazardous under the terms of the BASEL Convention Annex I, II, III and VIII, and percentage of transported waste shipped internationally EN26. Identity, size, protected status, and biodiversity value of water bodies and related habitats significantly affected by the organization's discharges of water and runoff
Products and Services
EN27. Extent of impact mitigation of environmental impacts of products and services

EN28. Percentage of products sold and their packing materials that are reclaimed by category
Compliance
EN29. Monetary value of significant fines and total number of non-monetary sanctions for non-compliance with environmental laws and regulations
Transport
EN30. Significant environmental impacts of transporting products and other goods and materials for the organization's operations, and transporting members of the workforce
Overall
EN 31. Total environmental protection expenditures and investments by type

Source: GLOBAL REPORTING INITIATIVE (GRI) 2013, p. 52 ff.

Content analysis for the evaluation of information

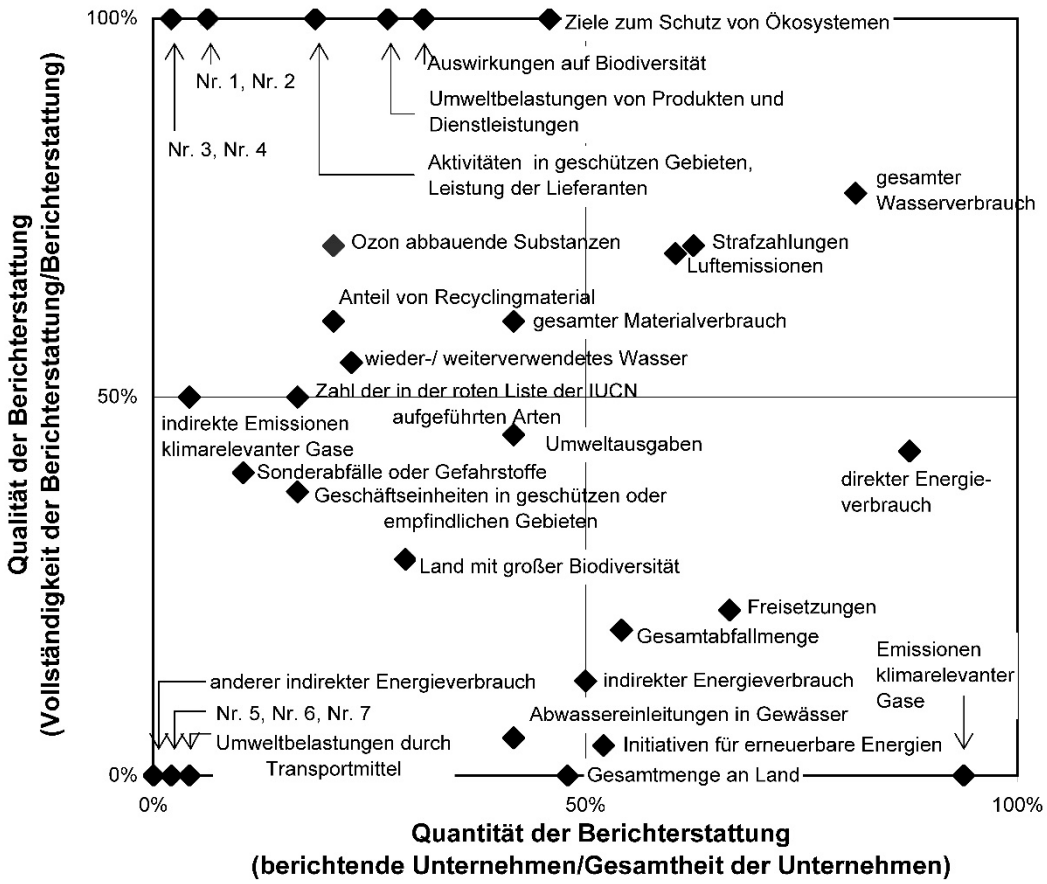
Since the reports do not follow a legally defined structure, they are constructed differently in spite of the guideline and the reader has to gather the information on his own. For this, one can use the tool of content analysis. The aim is generally to systematically and intersubjective verifiable describe characteristics in form and content of messages (FRÜH 2007, p. 25). For this purpose, eight steps are to be completed, for which the implementation of the environmental performance as a report subject in the narrower sense within the framework of the evaluation of the GRI reporting is presented in the following table (Table 22).

Table 22: Content analysis using the example of the Global Reporting Initiative

Formulation of the question	Which statement can be made about the environmental performance of the company/an industry?
Determination of the material sample	all business reports according to GRI in 2007 of an industry
Installing of the category system	all sections of the environmental performance according to GRI (materials, energy, water, biodiversity, emissions, effluents and waste, products and services, legal compliance, transport, total)
Definition of categories	according to the performance indicators protocols for all indicators of the above sections
Determination of the units of analysis	parts of the report devoted to environmental performance indicators in accordance with GRI indicator list
Coding according to the available decision rules for each indicator	2, if category is fulfilled 1, if category is partly fulfilled 0, if category is not fulfilled

Evaluation	quantity = number of reported indicators (not reported: group with all companies coded with 0; reported: group with all companies coded with 1 and 2) quality = degree of performance in case of reporting of the indicator (i.e. coding with 1 or 2): Does the reporting meet the GRI guideline, as they are specified in the indicator protocols? (low quality: group with all companies coded with 1; high quality: group with all companies coded with 2)
Presentation and interpretation of results	The evaluation results can be illustrated as shown in the following example.

Figure 32: Quantity/quality chart



Source: GÜNTHER/HOPPE/POSER 2007, p. 17

To show how the content analysis can look in its implementation, the procedure for the report subject is finally presented in the broader sense, as it has been implemented for the Good Company Ranking in 2006 in the field of environment (KRÖHER 2007 p. 76 ff.) (Table 23).

Table 23: Content analysis using the example of the Good Company Ranking

Formulation of the question	To which extent does the Company take charge of the environment?
Determination of the material sample	environmental report and environmental statement sustainability report or corporate responsibility report or CSR report business report code of conduct and corporate governance code or ethical code websites: sub items „environment“ or „CSR“ as well as „news“
Installing of the category system	five recognised concepts of operational environmental economics: environmental management system (environmental aspects of business processes), environmental performance measurement, added-value circle, innovation management and stakeholder approach
Definition of categories	e.g. the category of "environmental performance measurement", subcategory "economic evaluation": Are economic evaluations performed with regard to direct environmental aspects?
Determination of the units of analysis	phrases or statements that represent the proceeding of the company
Coding according to the available decision rules for each indicator	1, if category is fulfilled 0, if category is not fulfilled
Evaluation	determination of frequencies, intensities, or contingencies
Presentation and interpretation of results	in tabular form: five spreadsheets for each company

3 External reporting requirements

Finally, the question arises whether there are reporting requirements in addition to the voluntary reporting. For this purpose, the reporting requirements of the environmental statistics act, the pollutant release and transfer register (PRTR), the German emissions trading authority and the German accounting standard 15 are finally represented. The chapter is completed with the recommendation of the EU for integrating environmental aspects in the financial statements (Table 24).

	Umweltstatistik-gesetz (UStatG) (Environmental Statistics Act)	Gesetz zur Ausführung des Protokolls über Schadstoff-freisetzungs- und –ver-bringungsregister (SchadRegProtAG)	Treibhausgasemissionshandels-gesetz (TEHG) (Greenhouse Gas Emission Trading Law)	Deutsche Rechnungslegungs standards 5 und 15 (DRS 5 und 15) (German	Empfehlung zur Berücksichtigung von Umweltaspekten in Jahresabschluss und Lagebericht von	EMAS-Privilegierungs-VO (EMASPrivilegV) (EMAS Privilege Regulation)
Subject	public or private water supply and wastewater disposal climate-effecting and wastewater hazardous substances,	Releases to air, water and land of any pollutant when exceeding a threshold (Annex II E-PRTR-VO); transfer of hazardous and non-hazardous waste, (from certain minimum quantities)	report on the greenhouse gas emissions; CO2, CH4, N2O, HFCs, SF6 and perfluorocarbons	DRS5: operational risk: risks in operating systems or processes, in particular legal and operational risks DRS15: presentation of important legal	recognition, measurement and disclosure of environmental liabilities, expenses and risks and related assets recognition and measurement of environmental	copy of the reports referred to: § 12 Abs.6 for limiting emissions of highly liquid halogenated organic compounds; § 8 Abs. 5 Satz 3 of the regulation on the control of volatile organic compounds. § 6 Abs. 3 Satz 4 of the ordinance on the control of
Measuring method	not specified	Declaration, whether: measurement,	measurement or calculation	quantitative representation	not specified	not specified
Obligation to report	authorities and companies according to § 18 UStatG	companies which carry out the activities listed in Annex I E-PRTR-VO and exceed the capacity thresholds	companies in the energy conversion and forming, iron and steel production and processing, mineral	parent companies, which are obliged by § 315 HGB to prepare consolidated financial	companies covered by the provisions of 1999/60/EWG and 90/605/EWG	operators of EMAS-validated plants
Legal validity	2005	2006	2005	2005	2001	2002
Period	annual	annual	annual	annual	annual	annual
Access to data	GENESIS (https:// www-genesis.desta	electronic database (http://www.home.prtr.de/index.php)	CSR Reports, corporate environmental	group management report	financial statements and management report of the	-

	Bundesimmissionsschutz-gesetz	12. Verordnung zur Durchführung des Bundes-	Kreislaufwirtschafts- und Abfallgesetz (KrW-	Bio-Abfallanlagen-verordnung (30.
Subject	emission declaration (§ 27 BImschG): Air contaminants within a period (amount, spatial and temporal distribution)	safety report: concept to prevent accidents, safety management system; threats and countermeasures; report on the design, construction, operation and maintenance of hazardous operating areas; Internal emergency plans; information for	waste balance (§ 30 KrW- / AbfG) type, quantity and stay of hazardous waste (threshold: § 18) report on the measurement and monitoring measures prescribed in the ordinance; emission	measurement methods and equipment for continuous measurement of emissions: results of calibration and verification of functionality evaluation of the continuous
Measuring method	not specified	not specified	not specified	not specified
Obligation to report	operators of plants that cause serious environmental damage, or endanger the public by	plant operator for operating areas where dangerous substances exceed certain amounts (see Annex I, column 5, StörfallVO)	producers of hazardous waste (creation of the waste balance) dump operators (creation of emission	operator of the facility for the biological or biological-physical disposal of municipal waste
Legal	2002	2000	1994	2001
Period	annual	annual	annual	annual
Access to	-	-	-	-

4 Russian Additions tot he chapter

In the Russian Federation environmental reporting is legally binding and regulated by the orders of the Federal State Statistics Service. For example, the reports of the railways in the Russian Federation - JSC "Russian Railways" is formed in accordance with the following regulations:

1. Order of the Federal State Statistics Service dated October 19, 2009 № 230 "On approval of statistical tools for organizing federal statistical monitoring of the water use by the Federal Agency for Water Recourses" (http://base.consultant.ru/cons/cgi/online.cgi?req=doc;base=LAW;n=161673).

2. Order of the Federal State Statistics Service dated August 9, 2012 № 441 "On approval of statistical tools for the organization of federal statistical monitoring of agriculture and environment" (http://base.consultant.ru/cons/cgi/online. cgi? req = doc; base = LAW; n = 161,673).

3. Order of the Federal State Statistics Service dated January 28, 2011 № 17 "On approval of statistical tools for organizing federal statistical monitoring of production and consumption

wastes by the Federal agency of Supervision of Natural recourses (RosPrirodNadzor)" (http://www.garant.ru/products/ipo/prime/doc / 12082841 /).

4. Order of the Federal State Statistics Service dated August 6, 2013 № 309 "On approval of statistical tools for the organization of federal statistical monitoring of agriculture and environment» (http://www.consultant.ru/document/cons_doc_LAW_172154/).

5. Order of JSC "Russian Railways" dated November 12, 2004, № 3570r "On approval of the internal form of statistical reporting ZO-1" Report on the environmental performance of structural divisions of the branches of JSC "Russian Railways".

Rosstat (Federal State Statistics Service) reporting templates contain the following sections (See Figure 27 and Figure 28):

1. "Current costs for environmental protection" and kinds of environmental activities.
2. "The payment for a negative impact on the environment (environmental payments)"

Statistical reporting form ZO-1 "Report on the environmental performance of structural divisions of the branches of JSC" Russian Railways "is the internal corporate documents and filled only in the structural units of JSC" Russian Railways "(See Figure 29 and Figure 30). The data from this form are the basis for the environmental reporting in the whole country.

Figure 33: The performance indicators of Rosstat for "Current expenditure on environmental protection"

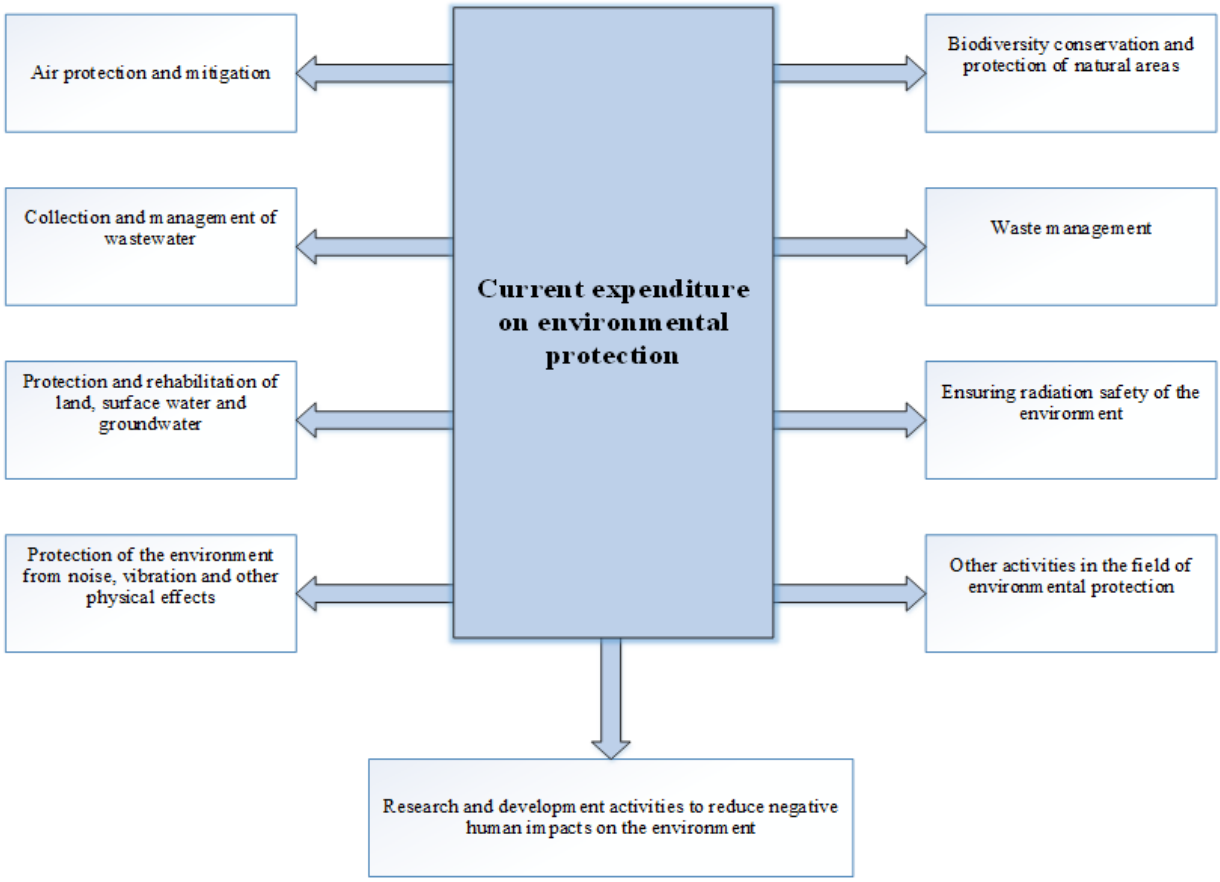


Figure 34: The performance indicators of Rosstat for: "Payment for the negative impact on the environment (environmental payments)"

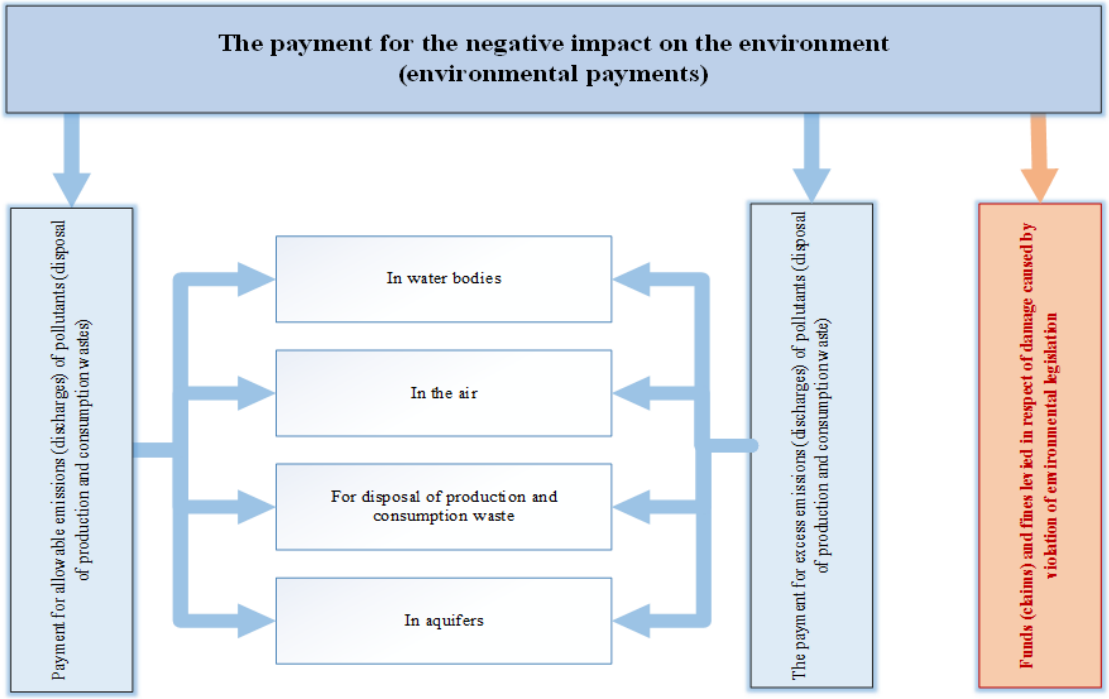


Figure 35: Indicators of statistical reporting of JSC "Russian Railways" (Beginning)

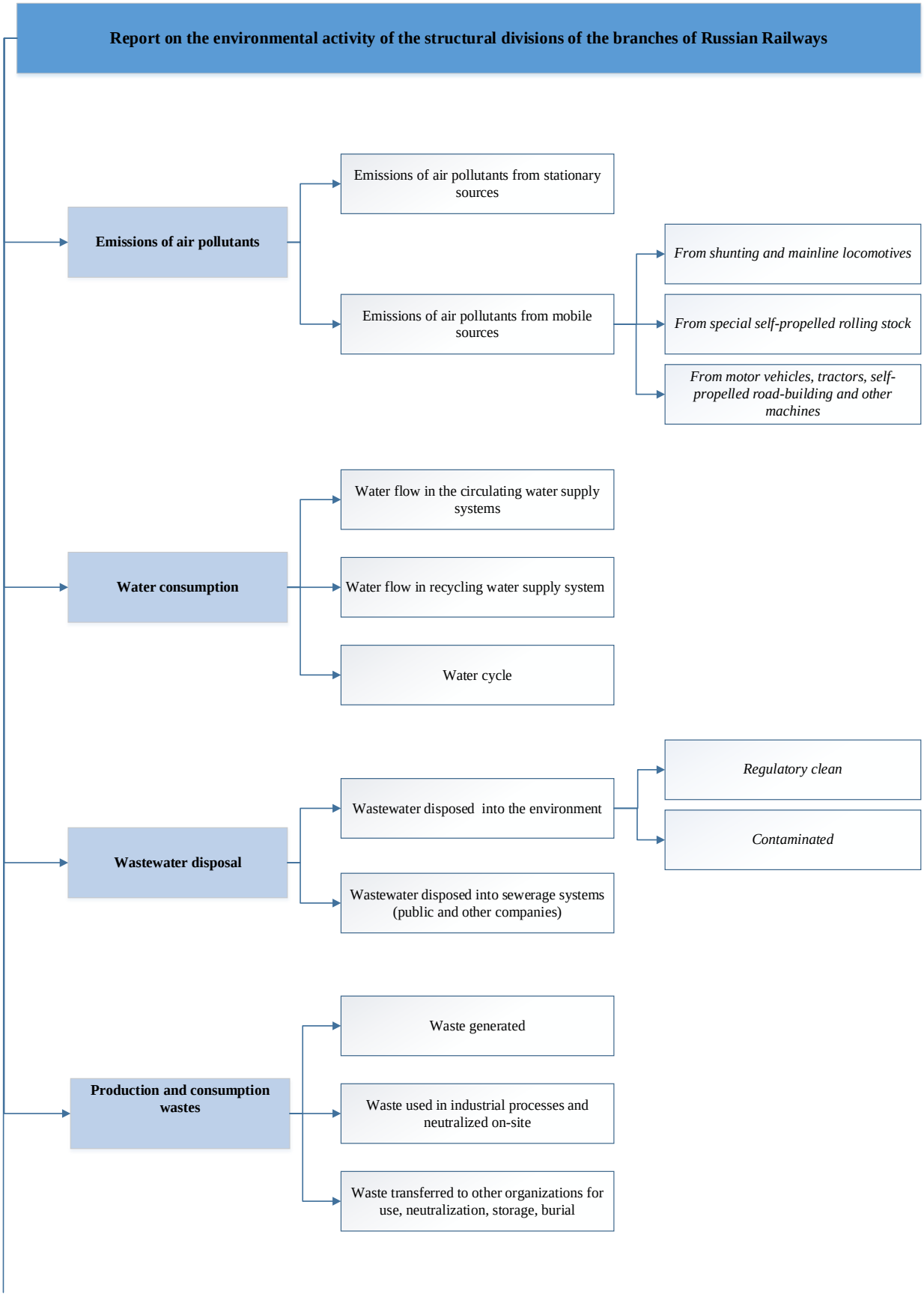
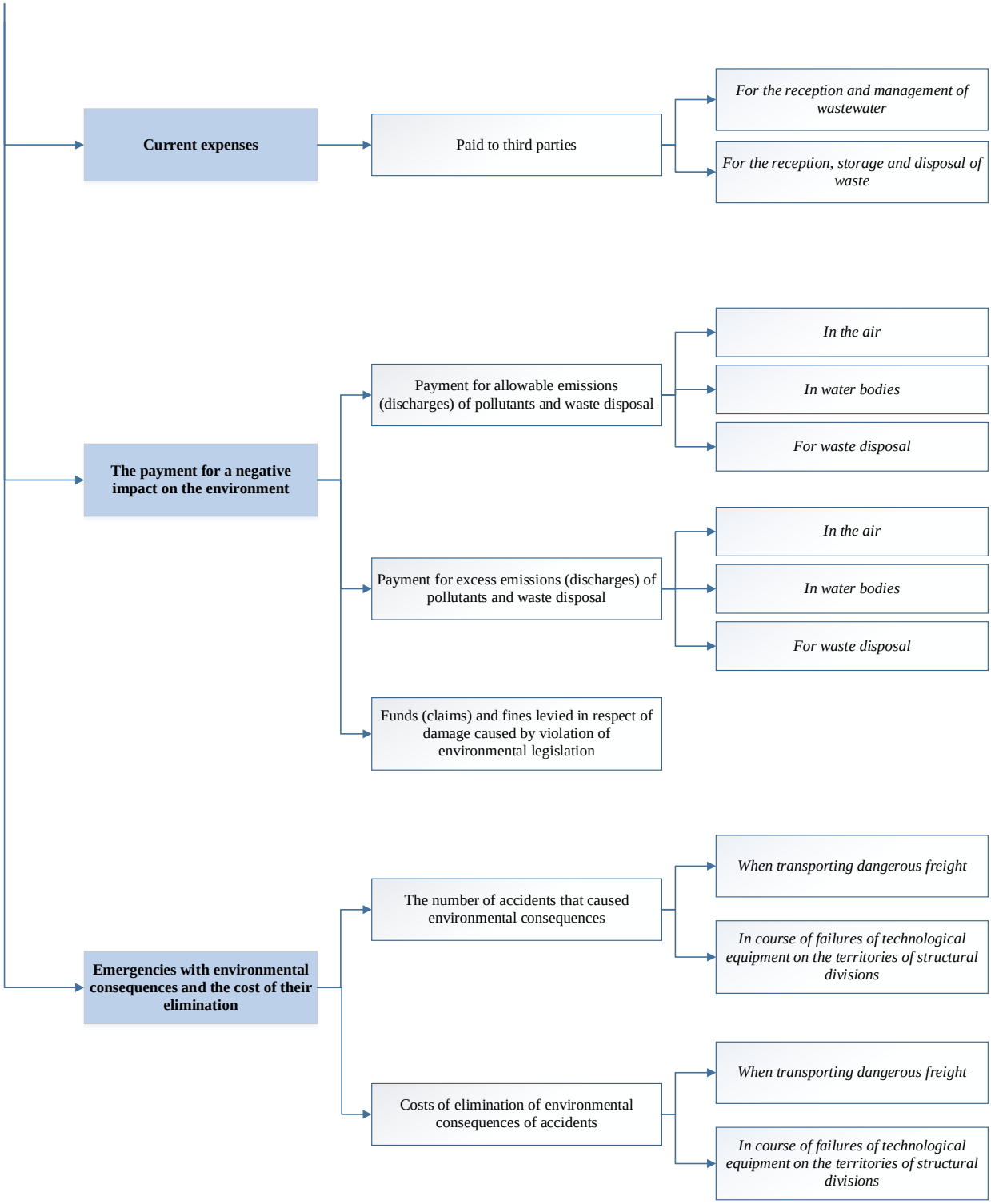


Figure 36: Indicators of statistical reporting of JSC "Russian Railways" (Ending)



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REVIEWS

Review

Scientific monograph entitled “Environmental management & audit“ is the result of Tempus Lifelong learning project RECOAUD. The monograph transparently represents some issues and challenges of environmental management, which tries to respond to climate change and ecological scarcity. The monograph unites contributions from European and Russian scientists from different scientific areas, thus it provides more holistic approach to the same thematic. The monograph should therefore reach especially wide target group of readers, as they can be recognized in students, experts from industry as well as in teachers.

The reader of the monograph gets a comprehensive overview and presentation of environmental management and audit at the theoretical level in the considered specific areas. In the monograph the results of research in the field of environmental management and audit, as well as trends and challenges in the development of this field are highlighted.

Monograph “Environmental management & audit“ consists of 4 books – Scarcity and Introduction of Environmental Management, Management Systems, Controlling and Stakeholders, and Environmental Assessment (Featured Articles). These topics represent the complexity, heterogeneity and multidisciplinary of the project Tempus RECOAUD.

In terms of the content, structure and the holistic approach from diverse international group of authors to this monograph, I conclude that the monograph completely fulfills the preconditions for a scientific monograph, thus it deserves to be published by the International publisher SPH.

Reviewer:
BAGRAT YERZNAKYAN
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Russian Academy of Sciences

Review

This scientific monograph “Environmental management & audit“ is the result of three-year work on an international project entitled "Environmental management in Russian companies – retraining courses for the sensibilization for and integration of Eco-Audit programs in corporate decision-making (RECOAUD)". It contains more than 600 pages of interesting text written by 31 authors from EU and Russian Federation, edited by dr. Borut Jereb, Darja Kukovič and dr. Daria Meyr.

The monograph is well structured and contains different forms of content – whether it is formed as chapters and subchapters or as articles, which has been written on a high level of methodological and research standards.

In the first part of the monograph, Scarcity, the Framework of Environmental management and Environment management systems are represented. Second part represents Supply chain and Value chain Management, Logistics and Transport with Case studies at the end. The third part talks about Controlling and Stakeholders. The last part contains featured articles on Environmental assessment issues.

The monograph is the result of successful scientific and inter-faculty cooperation. It is useful for those who engage in the field of environmental management and audit in science and practice, or it can be used for study purposes. Thus, the contents of monographs meets the conditions for a scientific monograph, therefore I recommend it to be published.

Reviewer:
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