








Öko-Institut e.V.
Institut für angewandte Ökologie
Institute for Applied Ecology

PROSA – Product Sustainability Assessment

Guideline

PRODUCT SUSTAINABILITY ASSESSMENT PROSA PRODUKT-NACHHALTIGKEITS-ANALYSE

Prosa – Product Sustainability Assessment
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PROSA in brief

New challenges

Strategic product portfolio planning, product development and product marketing have become more complicated. Global markets with diverse cultures and rapidly changing consumer attitudes present a need to deploy *integrated* prospective management methods. The growing influence of the social setting of industrial activity is a further reason for using such tools. This setting includes statutory requirements such as socio-economic benefit analysis under the European Union's chemicals law in the shape of REACH, the MEEuP integrated assessment method required by the EU Eco-Design Directive, market-driven elements such as financial rating, voluntary agreements such as corporate reporting, and also the sharp eye of NGOs and the media on the social acceptability of production processes in developing and newly industrializing countries.

Very few methods to tackle these new challenges have yet been developed which are clearly characterized and proven in practice. PROSA is one such method. PROSA gives particular attention to the analysis of social and economic aspects, and to the consideration of utility aspects and consumer research. In the process of developing the individual tools that make up the method, care was taken to engage in close international exchange and harmonization, for instance with SETAC on Life-Cycle Costing, with UNEP-SETAC on Social LCA and with major industrial companies on application in practice. The present manual presents the state of development of the PROSA method as of March 2007.

PROSA (Product Sustainability Assessment)

is a method for the strategic analysis and evaluation of product portfolios, products and services. The goal is to identify system innovations and options for action towards sustainable development. PROSA structures the decision-making processes that this requires, reducing complexity to key elements.
Important fields of application include

- strategic planning and product portfolio analysis in companies,
- product policy and dialogue processes,
- sustainable consumption and product evaluation
- as well as product development and marketing

Thanks to its open structure, PROSA can also be used to analyse sustainability at other levels, such as technologies, large infrastructural projects or geographical units.
PROSA spans complete product life cycles and value chains; it assesses and evaluates the environmental, economic and social opportunities and risks of future development trajectories. PROSA is a process-driven and iterative methodology which gives due regard to time and cost restrictions. **It calls as far as possible on existing, well-established individual tools (Megatrend Analysis, Life-Cycle Assessment, Life-Cycle Costing etc.).**

The following figure shows the basic structure of PROSA.

GEFÖRDERT VOM
Bundesministerium für Bildung und Forschung

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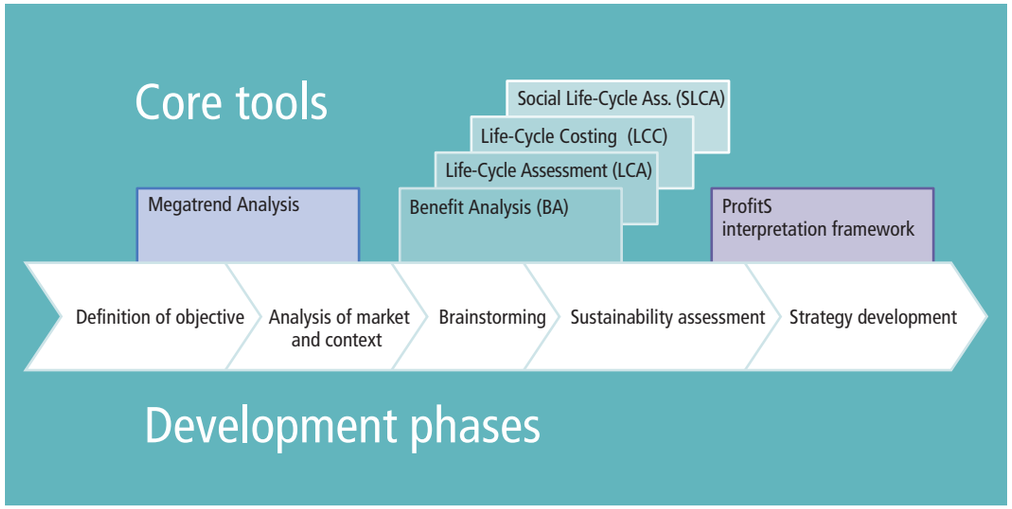
SÖF Sozial-ökologische Forschung

Figure 1 – Basic structure of PROSA



The sequence of work is guided by the typical phases of strategy formulation processes. The **Pathfinder** structures the process.

PROSA is an open-ended methodology that does not pre-define outcomes. It places a particular focus on the evaluation process and on interpretation frameworks. Prevailing normative disparities and conflicts among individual stakeholders, cultures and (world) regions as well as changing social values are identified clearly – as are potential approaches towards common innovation. PROSA moderates, in a targeted manner, opposing interests and decision-making situations that arise in corporate product development or in public product policy and dialogue processes.

The following elements are essential to PROSA:

- focus on system innovation,
- clear process management (Pathfinder),
- analysis of benefit and utility,
- inclusion of complete product life cycles and value chains,
- integrated analysis of the environmental, economic and social dimensions, giving equal standing to each dimension.

This manual explains how to use PROSA in the strategic planning of large companies, and illustrates the method with case studies. A simplified method suited for small and medium-sized enterprises (SMEs) is also available.

The advantages of using PROSA

The method

- provides a strategic radar for opportunities and risks
- identifies future markets and new consumer needs
- takes account of present and future societal settings
- helps to avoid misinvestment
- inspires by relaying the views and values of a broad range of actors, regions and cultures
- identifies complexity and reduces it to the key elements, and sets clear priorities.

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Website www.prosa.org

Pathfinder

Product sustainability assessments present major challenges. These challenges will be mastered successfully and efficiently if work procedures and decision-making processes have a clear and well-reasoned structure – which, in PROSA, is imposed by a special process tool called the Pathfinder. The Pathfinder specifies the way PROSA is carried out – the chronological sequence, the selection of (core) tools – and provides aids such as indicator lists, time and cost management structures, graphics routines and interpretation frameworks.

The Pathfinder sets out the prototypical performance of PROSA (cf. figure on the right). When used by companies, the company's own specific management tools, checklists or interpretation frameworks can be used readily. A strategy team should be formed within the company to carry out or support PROSA.

The sequence of the process is guided by the typical phases of strategy formulation processes: definition of objective, analysis of market and setting, brainstorming, evaluation and strategy formulation. The performance of PROSA is process-led and iterative – initial, orientative analyses are pursued in greater depth later on, new ideas or unexpected findings can change the course of the process or can cause previous phases to be reworked.

Core tools and new tools
A set of core tools is used to support work in the individual phases. Most of the tools are mature and in common use, and are already deployed in most large companies and in public product policy. These include megatrend analysis, consumer research and Life-Cycle Assessment (LCA). Three new core tools were specially developed for PROSA: Social LCA, Benefit Analysis (based on consumer research) and the ProfitS (Products Fit to Sustainability) evaluation framework.

Process-led and iterative

Depending upon context, certain tools can gain greater or lesser importance or can prove to lack relevance in the specific case. Conversely, other tools can be used without difficulty when they are required – a "joker" is placed to mark the position of such special tools in the process. Such tools may include safety analyses for facilities where major accidents are an issue, (eco)toxicological risk assessment, noise studies, pre-investment appraisals etc. PROSA is used to select and determine the depth of analysis of the different tools and indicators, and ensures integration of the various findings.

The assignment of individual steps and tools to specific phases is to be understood as a recommendation. Depending upon context, the steps are carried out in different depths. Core tools can also be applied in other or several phases of the PROSA process. For instance, evaluation takes place in the last phase, but important pre-evaluations already take place in the first phases – when determining the goal, identifying stakeholders, prioritizing ideas and selecting indicators. Departures from the recommended or planned sequence of work are possible without further ado – but they should be decided upon and reasoned clearly.

The next sections of this manual present in detail and explain with case studies the following tools:

- Product Portfolio Sustainability Analysis,
- Life-Cycle Costing,
- Eco-Efficiency Analysis,
- Social LCA and the assessment model SocioGrade,
- Benefit Analysis and the assessment model BeneGrade and
- the overall interpretation framework ProfitS.

The annex to this brochure contains several checklists and overviews designed to aid the performance of PROSA. These can readily be substituted by company-specific checklists where such exist.

- **Checklist for the selection of internal and external actors**
- **Checklist for the opportunities and risks arising from cooperating with actors**
- **Overview of aspects relating to the indirect or direct involvement of stakeholders**
- **Decision matrix for indicator selection, taking account of time requirements and data availability**
- **Integration checklist to test whether the findings of the individual tools match**

Figure 2 – Sequence of PROSA and tasks of the individual phases

Phase	Task and outcome of phase	Tools and aids
Definition of objective	Concretize the task and capacities (human and financial) and set schedule	
	Carry out internal and external actor analysis and clarify involvement of internal and external actors (companies, stakeholders)	Actor Analysis Stakeholder Involvement Checklist Actor Cooperation Checklist
	Select priority product fields	Product Portfolio Analysis
Analysis of market and context	Comprehensive characterization of the product and its setting (society, market, technology, country or region etc.), where appropriate synopsis of conceivable system developments in consistent scenarios	
Brainstorming	Collect visions, ideas, product or system alternatives. Prioritize these for the assessment phase	
	Select the sustainability references to be evaluated, and determine suitable key indicators, determine minimum sustainability criteria	Indicator List Decision Matrix
Sustainability assessment	In-depth sustainability assessment	Integration Checklist
	Analyse environmental aspects throughout the product life cycle	Life-Cycle Assessment (LCA)
	Analyse economic aspects throughout the product life cycle	Life-Cycle Costing (LCC)
	Analyse social/societal determinants throughout the product life cycle	Social LCA (SLCA)
	Identify consumer groups and their needs and utility demands	Consumer Research Benefit Analysis
	If required, assess further or other aspects using special tools such as safety analyses, toxicological analyses, noise studies etc. ("Joker" to mark the position of such tools in the process)	Joker
Strategy planning	Derive development paths and concrete strategic options for action and subsequently evaluate these. The evaluation includes a benefit-sustainability appraisal and an examination whether minimum sustainability criteria are complied with. Options for action can also relate to communication or re-organization (modification of strategy or of the organization, organizational learning etc.).	"ProfitS" (Products Fit to Sustainability) integrated interpretation framework and evaluation frameworks for individual dimensions: - EcoGrade - Eco-Efficiency - SocioGrade - BeneGrade

Product Portfolio Analysis

PROSA Product Portfolio Analysis is used to select the product areas, business units or key products to be analysed in greater depth. If work conducted previously has already led to this selection, product portfolio analysis can be dispensed with.

PROSA portfolio analysis involves both a classic, economically focussed portfolio analysis and a sustainability portfolio analysis. The PROSA Product Portfolio Analysis confronts the economically determined self-perception of a company with an external perception from the sustainability perspective and from a stakeholder perspective.

Classic product portfolio analysis

In a first step, a classic product portfolio analysis focussing on market and competition aspects is conducted, and aligned with the product portfolio matrix. Depending upon the company in question, different types of product portfolio analyses can be carried out. The two best known are:

- the *Boston Portfolio* (see Figure 3) developed by the Boston Consulting Group. Here Strategic Business Units (SBUs) of the company are analysed, and a matrix chart produced placing their relative market share in relation to their market growth rate. Depending upon the position in the chart, this leads to four types of SBU: cash cows, rising stars, poor dogs, question marks.

- the *competitive advantage / market attractiveness portfolio* developed by McKinsey. Here the relative competitive advantage and market attractiveness are characterized in more differentiated fashion using several indexes, and the nine types of SBU are more differentiated.

PROSA Product Portfolio Analysis

In a second step, the PROSA Product Portfolio Analysis is carried out, which supplements the economic aspects of the Strategic Business Units (SBUs) to capture social and environmental aspects:

- **Social and environmental risks in production, in business processes and in the market; captured as hotspots in the PROSA Product Portfolio – Sustainability Risks (cf. Figure 3 on the next page; presented without case study).**

- **Social and environmental opportunities arising from product innovations, improved market position and adherence to key objectives of society, captured as benefits and eco-potential in the PROSA Product Portfolio – Sustainability Opportunities (cf. Figure 5 on the next page; shown for the example of a prefabricated house manufacturer).**

Special attention is given to potential new products or services. Product-related sustainability innovations can hold out the following opportunities:

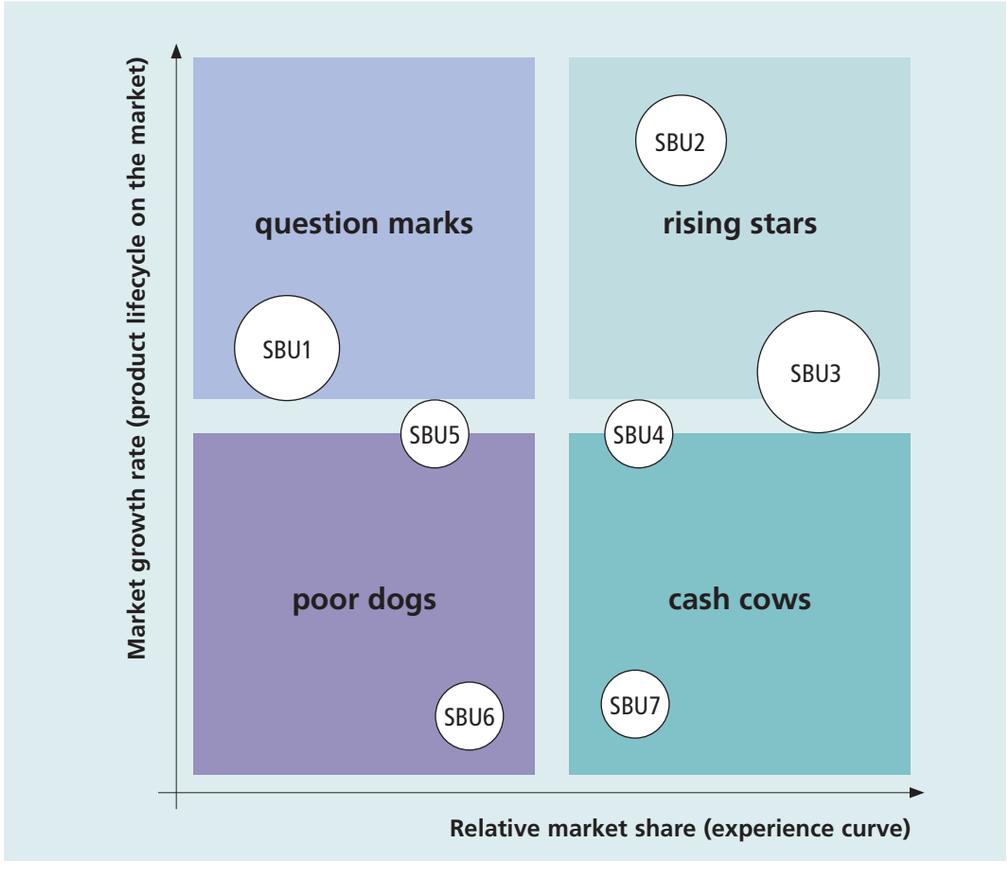
- Identification of new business opportunities (markets) that were not previously recognized
- Migration into business fields that will by their very nature provide long-term opportunities
- Greater orientation to growing long-term customer wishes
- Generation of win-win situations for the company and society, and thus improved reputation of the company

A final **SWOT analysis** provides an integrated perspective on the internally perceived (economic) strengths and weaknesses and the externally perceived (social and environmental) opportunities and risks.

Work best conducted by means of a multi-stakeholder workshop

The key environmental and social sustainability linkages are best identified and assessed within a multi-stakeholder workshop. This approach delivers direct and up-to-date information and accurate appraisals of future options and positions. It would also be conceivable to conduct a screening of product-specific sustainability linkages by means of an expert appraisal or through a strategy team within the company, but this would presuppose greater availability of orientative quantitative data in order to deliver a comparable stability of results. Involving stakeholders in the strategic phase naturally presents risks, such as confidentiality problems. Figure 25 in the annex shows three options by which to involve stakeholders, and the advantages and drawbacks of these options.

Figure 3 – Schematic of a Boston Portfolio with the Strategic Business Units (SBUs)



Case study:
Prefabricated house manufacturer

A major prefabricated house manufacturer aims to expand its business areas in Germany. Following exhaustive market surveys and consumer research, four possible new Strategic Business Units (SBUs) are identified and are discussed with stakeholders. The PROSA portfolio analysis of sustainability opportunities results in the following assessments (cf. also Figure 5).

Standardized thermal insulation of existing buildings (SBU1)

High eco-potential (very large stock of existing buildings, energy reduction potential is very high per building and overall; major contribution to climate change mitigation); the key social objective of "creating employment" is promoted (Benefit 1) because insulating existing buildings creates many jobs in crafts companies and the construction sector; the key social objective of "securing energy supply" (Benefit 2) is promoted because energy consumption is reduced significantly.

New construction of plus-energy houses (SBU2)

Eco-potential is given, but is smaller for the foreseeable future than in the case of the thermal insulation of existing buildings, because only a few hundred thousand houses are newly built per year. The key social objective "securing energy supply" (Benefit) is promoted nonetheless.

Wood pellet heating systems (SBU 3)

Eco-potential is given (wood is a replenishable resource, but limited in Germany). The key social objective "creating employment" is promoted (Benefit 1) because the forestry and wood processing sectors are labour-intensive. The key social objective "securing energy supply" (Benefit 2) is promoted because wood is a domestic resource.

Gas-fired condensing boilers (SBU 4)

Eco-potential is given (efficient type of heating system; can be fitted in new construction and existing buildings alike). Compared to the other options, the employment effect is far lower. In the same vein, energy security is improved only marginally.

Note: Space does not permit us to present here the classic product portfolio analysis conducted by the prefabricated house manufacturer, showing costs, market growth rates etc.

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Figure 4 – PROSA "Strategic risk minimization" product portfolio

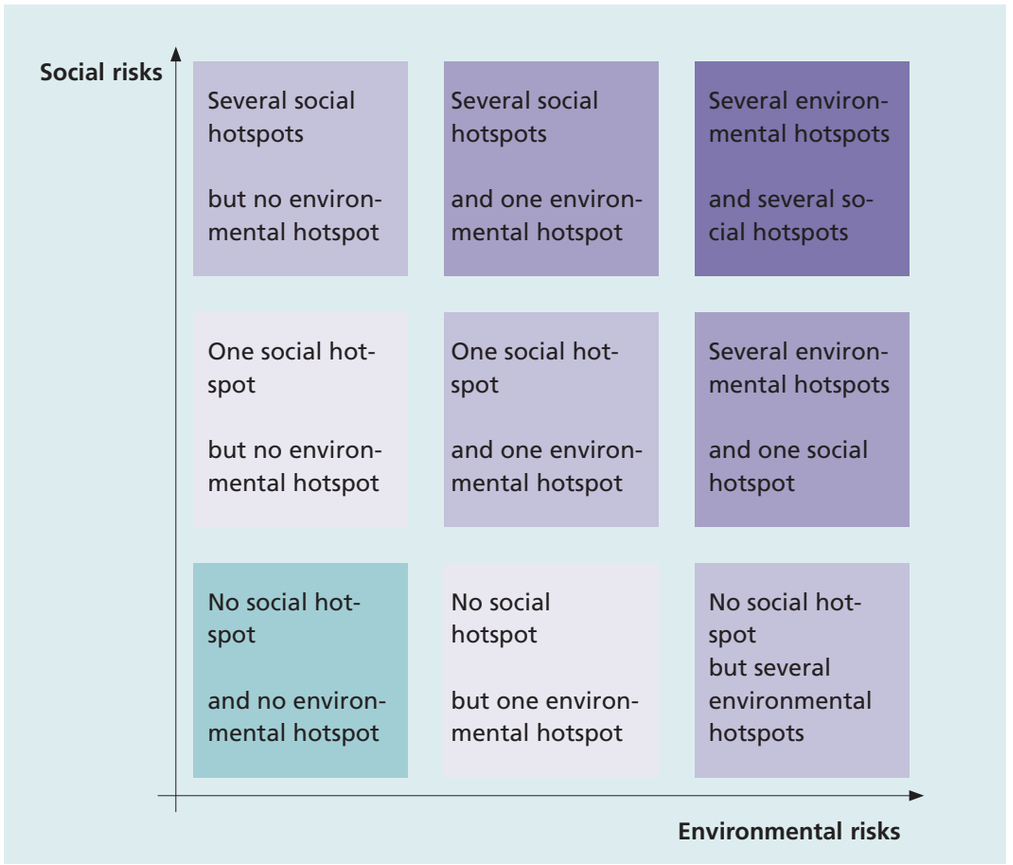
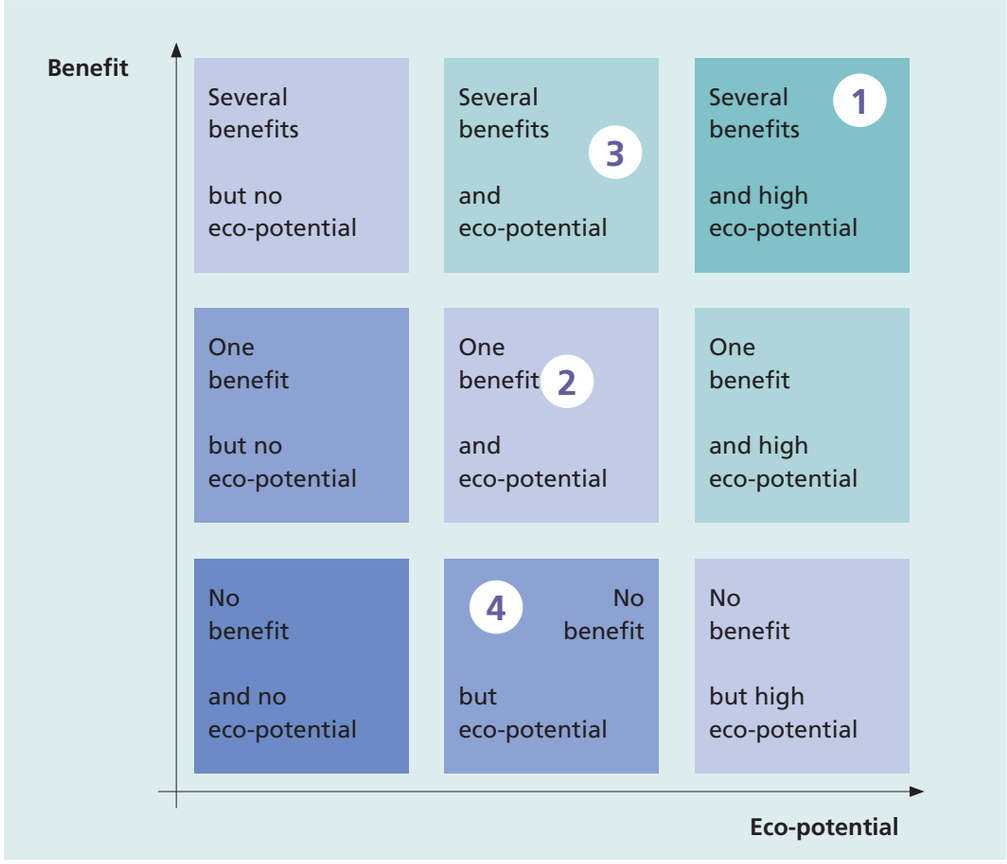


Figure 5 – PROSA "Strategic opportunities" product portfolio



o1 SBU: Standardized thermal insulation of existing buildings
o2 SBU: New construction of plus-energy houses
o3 SBU: Wood pellet heating systems
o4 SBU: Gas-fired condensing boilers

Life-Cycle Assessment and EcoGrade

Life-Cycle Assessment is standardized

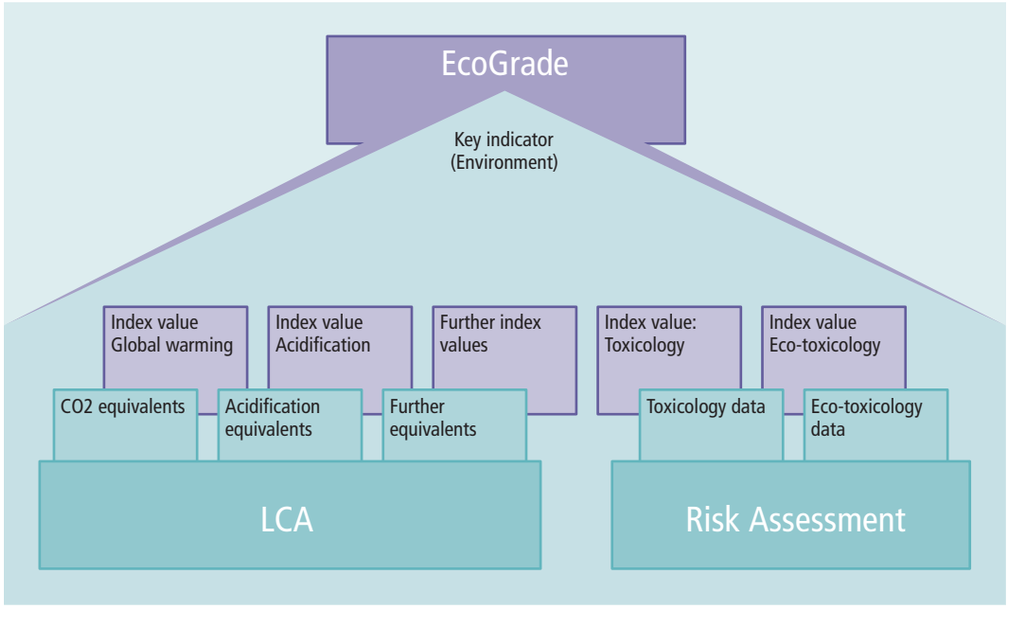
ISO Standards 14040 and 14044 set out the methodology for performing Life-Cycle Assessments in detail. Life-Cycle Assessment (LCA) has four phases and components: goal and scope definition; inventory analysis; impact assessment; interpretation. The other core tools of PROSA such as Life-Cycle Costing (LCC) and Social Life-Cycle Assessment (SLCA) employ these four phases and the basic methodological approach of LCA as directly as possible or, where necessary, in a modified form.

LCA is a widely known and proven tool, and is therefore not described in further detail here. The **case study of laundry drying systems** briefly reported here highlights the important role played by LCAs in product development and portfolio appraisal. This section further outlines two aspects of relevance to PROSA: the importance of interpretation frameworks such as **EcoGrade** and the role of **material flow analyses** as exemplified by the **EcoTopTen case study**.

Interpretation models to capture aggregate environmental impact

LCA captures the most varied types of resource consumption (e.g. energy carriers, minerals, or water) and environmental impact in the form of impact categories (greenhouse gases, acidification, eutrophication etc.) and reports these in relation to a functional unit. For reasons of practicability and in order to allow integration into an overall assessment, it is purposeful to use interpretation models that allow integration of an aggregate expression of environmental impact. In doing so, expression of the data for the specific environmental impacts should always remain possible. An aggregate environmental indicator is particularly necessary when considering several or many products, and especially so when economic and social aspects are included. ISO Standards 14040/14044, however, prohibit such overall aggregation if different product alternatives are to be compared and published. This feature of the ISO standards stands in the way of practical application – in practice, aggregation to an expression of overall environmental impact must take place outside of the LCA in formal terms if the process is to conform to the standards.

Figure 6 – EcoGrade



EcoGrade interpretation framework

PROSA uses the EcoGrade environmental interpretation framework (cf. Figure 6). Most companies have their own environmental interpretation frameworks. Only few, such as BASF (Saling et al. 2002), make their use of these frameworks public. EcoGrade, the PROSA interpretation framework, can in principle be substituted by another framework, or complemented by another to provide a sensitivity analysis.

In EcoGrade, the various environmental impacts are **weighted on the basis of socially agreed quantitative environmental targets**. Each category of environmental impact is expressed in **environmental target impact points (Umwelt-Ziel-Belastungs-Punkt – UZBP)** in accordance with its contribution to national or international environmental targets (depending upon the geographical scope of the analysis).

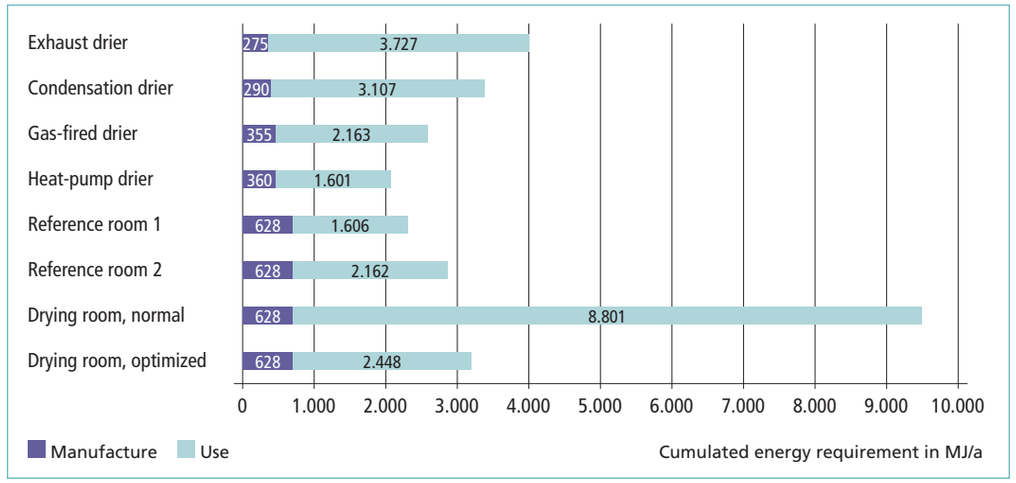
Impact categories for which no quantitative environmental targets have yet been formulated are integrated within the overall result by means of a set percentage weighting. The higher the number of points, the greater is the environmental impact.
The environmental target impact points of the individual impact categories are added without any further weighting – it is assumed that all environmental targets agreed by societal consensus or legislative statute have equal weight.
EcoGrade uses the environmental targets set by society and by the legislator to reflect societal evaluations – which is, after all, the frame of reference within which companies and product policy operate.

Case study: Laundry drying systems

In preparation for the development and marketing of new laundry drying products, a Life-Cycle Assessment was performed (Gensch and Rüdenauer 2004). Megatrend analyses and consumer research had identified interesting new developments which needed assessment: Gas-fired laundry driers for private households and heat-pump driers presented new technologies or applications promising high energy savings; laundry driers were the only type of household appliance expected to generate major growth in sales; on the other hand, because of the high energy consumption of conventional laundry driers, many target groups had a very sceptical stance towards them; there was a growing number of reports on mould formation caused by inappropriate drying in living spaces, and increasing levels of thermal insulation were expected to further heighten this problem; on the other hand, everyday experience showed that many consumers avoided mould formation problems by drying laundry even in winter with windows opened for hours on end.

The goal of the LCA was therefore to compare new laundry driers with conventional laundry driers and with hanging laundry up to dry in indoor spaces (unheated basement; heated living space). The literature cited contains the great array of input parameters considered (air change rates, heating periods, spin rates of the washing machine, drier loading etc.) as well as sensitivity analyses. Figure 7 shows the results.

Figure 7 – Comparison of the cumulated energy requirement (CER) of the systems analysed



The findings of the comparison of different drying systems were surprising in several respects: Drying by hanging laundry up in heated (living) spaces ("drying room, normal") consumes the most energy, which, as a "grey" proportion of energy used for space heating, is not noticed by consumers. Optimized drying by hanging laundry up in heated rooms (i.e. with targeted, brief airing of rooms etc.), which is practised rarely, yields an energy consumption lower than that of conventional laundry driers but above that of the new drier types. When laundry is hung in other types of room (basement, attic; calculated with different parameters as reference rooms 1 and 2) heat is lost through ventilation etc. The option with the lowest energy consumption was the new heat-pump drier, which, with its very low consumption, is close to the value needed in terms of basic physics simply to "evaporate" the water from the laundry.

Material flow analyses

When analysing product portfolios of product groups in companies, or when setting priorities for product policy (as is currently being done with the European Union's Eco-Design Directive), a need arises to use **material flow analyses** rather than an individual Life-Cycle Assessment. A material flow analysis is ultimately a system comprising several or many simplified LCAs. Here, as in PROSA's other tools, care should be taken to follow a methodologically uniform procedure.

Case study: EcoTopTen – material flow analysis of the ten key consumer product fields

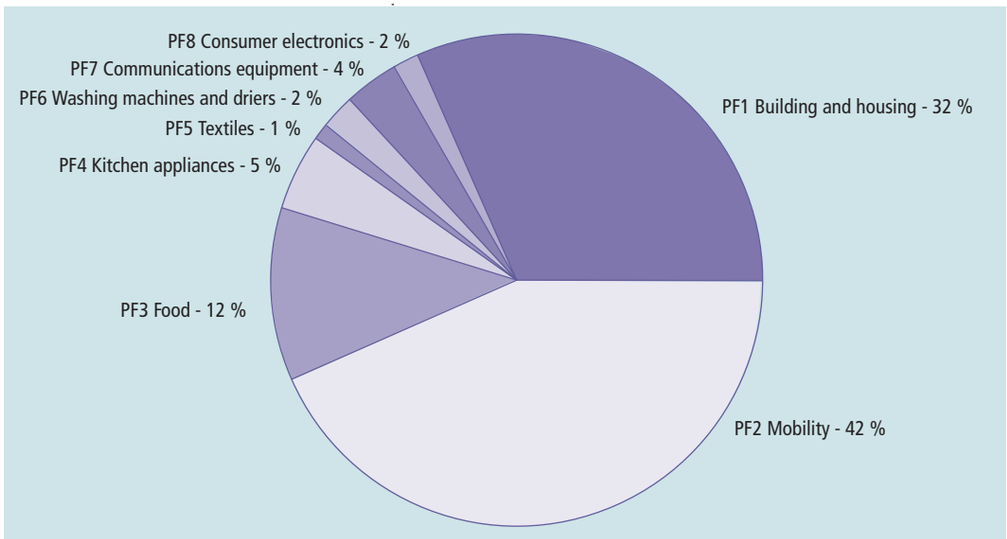
In preparation for the EcoTopTen product initiative (www.ecotopten.de) a need arose to identify the ten key product fields in order to assist the formulation of environmental policy priorities (the individual product fields such as communications equipment may contain several product groups such as computers, screens and printers). To this end, simplified LCAs were carried out according to a uniform methodology for the products coming into question, and the ten key product fields then selected.
Table 1 and Figure 8 show the results. The ten EcoTopTen product fields (with a total of 25 products) account for 58.2% of overall energy consumption in Germany (2001) and 63.6% of overall CO2 emissions (2001). These figures underscore the great overall relevance of the EcoTopTen product fields which were finally selected.

Table 1 – Environmental impacts attributable to German households

	CER cumulated energy requirement	GWP	AP	NP	POCP	Aggregate environmen-tal impact
	GJ	kgCO2eq	kgSO2eq	kgP04eq	kgETHeq	micro UZBP
PF1 Building and housing	100,0	7.065	11,5	0,93	0,98	23.858
PF2 Mobility	56,5	3.959	10,9	1,26	5,39	32.640
PF3 Food	20,9	3.758	3,8	0,11	0,61	8.686
PF4 Kitchen appliances	15,6	953	1,9	0,20	0,06	3.631
PF5 Textiles	2,0	97	0,8	0,04	0,08	935
PF6 Washing machines & driers	6,1	360	1,0	0,07	0,07	1.581
PF7 Communications equipment	14,6	462	1,3	0,29	0,07	2.713
PF8 Consumer electronics	5,2	323	0,7	0,06	0,02	1.293
Total	**220,9**	**16.977**	**32,0**	**2,98**	**7,27**	**75.338**

Note: The "electricity" product field is contained in the figures for the other product fields, through the power consumption of appliances and equipment. The tenth product field – investments and pension funds – was not included in this overview for methodological reasons, as the allocation of environmental impacts to this field presents major difficulties.

Figure 8 – Contributions of individual product fields to the aggregate environmental impact attributable to German households



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Life-Cycle Costing

Life-Cycle Costing (LCC) is used to ascertain the relevant costs arising for one or more actors in relation to a product and its alternatives in the course of a product life cycle. As yet, no standard or internationally recognized Code of Conduct exists for generating a life-cycle cost analysis.
Economic analyses are generally considered to be highly exact and objective, but in practice there are considerable problems due to the poor availability of data, different types of costs (full costs, partial costs, budget costs, actual costs, time-dependent dynamic costs, scaling-dependent costs), prices influenced by the state (subsidies, prescribed recycling quotas etc.), the assumption of varying interest rates or types of depreciation etc.
Like a Life-Cycle Assessment (LCA), an LCC can be divided up into four parts:

- study goal and scope definition,
- inventory analysis (collecting data on individual costs),
- cost assessment,
- interpretation.

Since the costs vary depending on the actor, it is necessary to determine at the start the actor/s for whom the life-cycle costs are being ascertained. While economic data have the advantage that there is a corresponding economic unit (leaving aside the issue of different currencies), it is important to remember nonetheless during the interpretation stage that costs cannot always simply be added up. It makes little sense, for example, simply to count up the wages in developing countries and industrialized countries without taking the cost of living in each case into account.
If a comparison with competitor products is conducted and published, the Life-Cycle Costing should be accompanied by a critical review.
Decisions and models that, based on experience, should be given particular attention are summarized in the check-list presented below (Figure 9).

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Figure 9 – Check list for Life-Cycle Costing

Points to be given particular attention in the Life-Cycle Costing

- ☑ Determining the actor from whose perspective costs are being ascertained
- ☑ Defining the goal and scope of the study, and the functional unit
- ☑ Prospective or retrospective
- ☑ Full costs and/or partial costs
- ☑ Actual costs and/or budget costs
- ☑ Dynamic and/or static procedures
- ☑ Prices and/or costs
- ☑ Inclusion of external or informal costs
- ☑ Inclusion of hidden costs and possible liability risks
- ☑ Market prices, prices influenced by legal regulations (subsidies etc.)
- ☑ Handling of discounting
- ☑ Handling of depreciation (linear, digressive)
- ☑ Handling of different currencies
- ☑ Handling of different costs of living in different countries
- ☑ Normalization
- ☑ Conduct of a critical review

Case study: Life-cycle costs of three cars

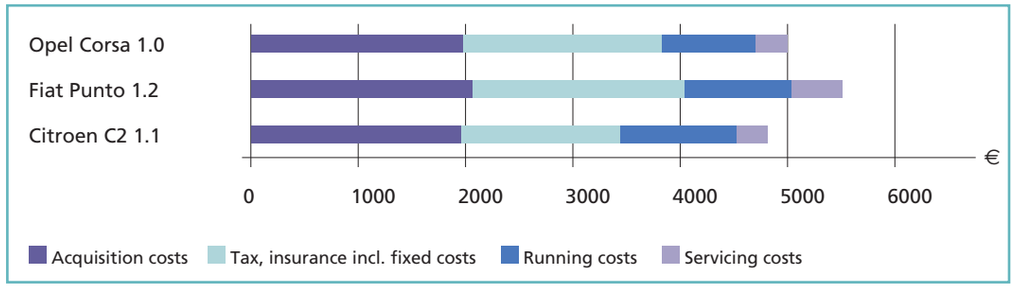
The life-cycle costs of cars in different classes were calculated for a comparative overview of the market in the context of the Öko-Institut product initiative “EcoTopTen” (study year 2005). The results are presented below, taking thee small cars as an example (Opel Corsa 1.0 Twinport, 3-door; Fiat Punto 1.2 8V; Citroen C2 1.1 Advance). The calculation was based on new cars that are driven for four years at 12,000 km a year and then sold.

The following costs were taken into account:
Acquisition (loss of value – calculated from acquisition costs and re-sale value, imputed interest rate of acquisition costs, costs of delivery and registration); fixed costs (tax and insurance, garage rent, parking, maps, costs of main inspection and exhaust emission check etc.); running costs (fuel costs, oil replacement costs, car wash and care) and servicing costs (tyre wear, service, maintenance). Repair costs were not taken into account since the calculation was for new vehicles with four years of single ownership. Examples of uncertainties, fluctuations or ranges of variation regarding costs include discount campaigns, interest-free loans on purchase and the major differences in car insurance (region, no-claims bonuses etc.).
The results are presented in the following Table 2 and Figure 10.

Table 2 – Life-cycle costs of cars

	Opel Corsa 1.0 Twinport 3-door	Fiat Punto 1.2 8V	Citroen C2 1.1 Advance
Purchase price	10.945 €	10.890 €	10.990 €
Life-cycle costs (p.a.)			
Acquisition costs	1.977 €	2.164 €	1.936 €
Tax, insurance incl. fixed costs	1.753 €	1.911 €	1.527 €
Running costs	909 €	964 €	998 €
Servicing costs	352 €	490 €	318 €
Total annual costs	**4.991** €	**5.529** €	**4.779** €

Figure 10 – Breakdown of total costs of cars



If we look solely at the purchase price, all three models cost more or less the same, the Citroen being the most expensive. Despite this, it comes off best in the annual life-cycle costing and has €750 fewer costs per year than the next most inexpensive car, the Fiat.
Alongside the acquisition costs (roughly 40% of costs), fixed costs in particular play a major role (roughly a third of costs). Running costs (fuel costs, oil and car care) come in third place, at 20% of costs. This cost differentiation also shows why it is so hard to change from car driving to public transport. When a person runs a car, their acquisition and fixed costs are 70%, while the variable costs per kilometre are low in comparison.

Eco-efficiency

Eco-Efficiency Analysis is a tool for comparative assessments of environmental and economic aspects in PROSA – and indeed in general wherever social aspects do not play a major role or data on such aspects are difficult to collect. The term "eco-efficiency" is used in different ways, for example for the eco-efficiency of national economies, of individual companies (e.g. in eco-rating schemes) or of products and services as in PROSA.

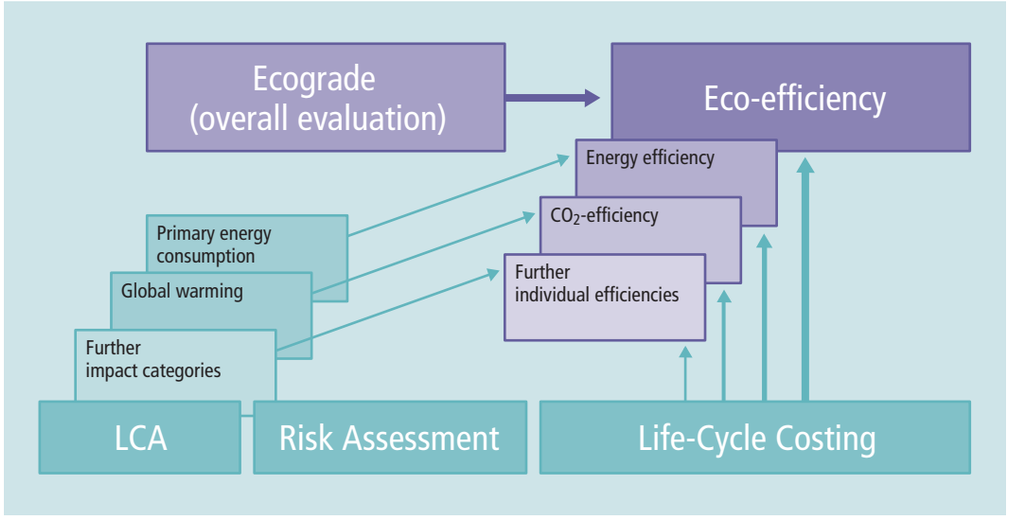
Efficiency generally describes the ratio between target (value) and input and must not be confused with **effectiveness**, which characterizes the outcome (regardless of input). In both process management and politics, efficiency and effectiveness are generally aimed at in parallel – a defined goal is to be attained fully or to the greatest possible extent (effectiveness) with the lowest possible input (efficiency). Eco-Efficiency Analysis generates information on the efficiency and effectiveness of different alternatives and actions.

The difference between Eco-Efficiency Analysis and energy efficiency analyses, CO_2 efficiency analyses and so forth is that Eco-Efficiency Analysis does not examine individual selected aspects, but all relevant environmental aspects. Eco-Efficiency Analyses thus capture the relationship between goal attainment (minimum environmental impact) and (financial) resource input.

Costs in Euros, environmental impact in ...?

In the eco-efficiency approach, costs are defined quantitatively in monetary units, while environmental aspects are defined as aggregate environmental impact determined according to a defined model which combines the individual environmental impacts and types of resource consumption.
Progress in Eco-Efficiency Analysis was impeded for a long time by the circumstance that no quantitative measure was defined for environmental impacts. Curiously, this was and continues to be due above all to the ISO 14040 LCA standard, because this standard rejects an aggregation of individual environmental impacts throughout product life cycles as overall environmental impact if different product alternatives are being compared and the findings are to be published.
To perform an Eco-Efficiency Analysis, however, it is essential to express environmental impact in one measure. It would otherwise only be possible to state individual efficiencies (cf. *Figure 6: EcoGrade and Figure 11: Individual efficiencies and eco-efficiency*).

Figure 11 – Individual efficiencies and eco-efficiency



When comparing several alternatives and considering a good dozen environmental impacts, however, this quickly becomes unmanageable and stands in the way of an integrated, comprehensive assessment.

Eco-Efficiency Analysis in PROSA

Product Eco-Efficiency Analysis is an assessment tool within PROSA. It places the findings of an LCA and those of Life-Cycle Costing in relation to each other. The LCA procedure is set out in detail in ISO standards 14040 and 14044. There is no comparable standard or internationally recognized code of conduct for **Life-Cycle Costing** or Eco-Efficiency Analysis. Nonetheless, regular exchange with practitioners using and developing similar approaches such as the BASF Eco-Efficiency Analysis (Saling et. al 2002) and others (cf. the status seminar on Eco-Efficiency Analysis, Grießhammer 2003) ensures compliance with the generally recognized methodological state of science.
When performing an Eco-Efficiency Analysis, care must be taken that when setting the goal of the study, the scope of inventory analysis, the functional unit and the allocation rules, etc., similar underlying definitions are applied (cf. also the Integration Checklist in the annex to this brochure).

Aggregation with EcoGrade

A range of different assessment models using an overall environmental indicator can be used for the aggregation of individual environmental impacts. PROSA uses the **EcoGrade assessment framework** developed by the Öko-Institut, which expresses the level of environmental impact in environmental target impact points (Umwelt-Ziel-Belastungs-Punkte, UZBP). Where required, other assessment frameworks can also be used as an alternative or supplement and to compare findings.
While the monetary unit (Euro, Dollar or others) expressing costs is a readily understandable unit, this does not apply to aggregate environmental impact (regardless of the framework used to determine it).
When communicating findings, it should be examined whether there is an individual parameter among the alternatives studied that largely follows the overall environmental impact (this often applies to energy consumption or CO2 emissions!). If this is the case, it would then be appropriate to express findings in terms of energy efficiency or CO2 efficiency.

Presentation of findings

The findings of the LCA and Life-Cycle Costing sub-studies should be presented in both numerical and graphic form for the individual alternatives (cf. table and figures on the washing machine case study). Eco-efficiency captures the ratio between goal attainment and input, whereby the goal is a dual one: to maintain equivalent utility for all alternatives studied, and to reduce environmental impacts to a minimum. Accordingly, the comparison of two alternatives places the reduction in environmental impact (expressed in environmental impact units) in relation to the additional input or additional cost (expressed in monetary units). The larger this value, the more eco-efficient the alternative is.

Case study: Washing machines

Within the context of the EcoTopTen product initiative, it was examined for the case of the washing machine product group (Rüdenauer and Grießhammer 2004) what contribution further product innovations and, respectively, more efficient user behaviour on the part of consumers when washing (i.e. lower washing temperatures, optimized loading of the machine) can deliver.

The functional unit was defined as "washing the amount of laundry arising in one year in an average private household". The costs were calculated for one private household: purchase costs of the washing machine attributable to one year of use; costs of water, electricity and detergent consumption; costs of wastewater disposal.

The following four alternatives were studied:

- **Alternative A:** Low-cost washing machine and average user behaviour
- **Alternative B:** More efficient washing machine (lower water and electricity consumption, automatic load detection) and average user behaviour
- **Alternative C:** Low-cost washing machine and optimized user behaviour (optimized loading and lower washing tempera tures than the average)
- **Alternative D:** More efficient washing machine and optimized user behaviour

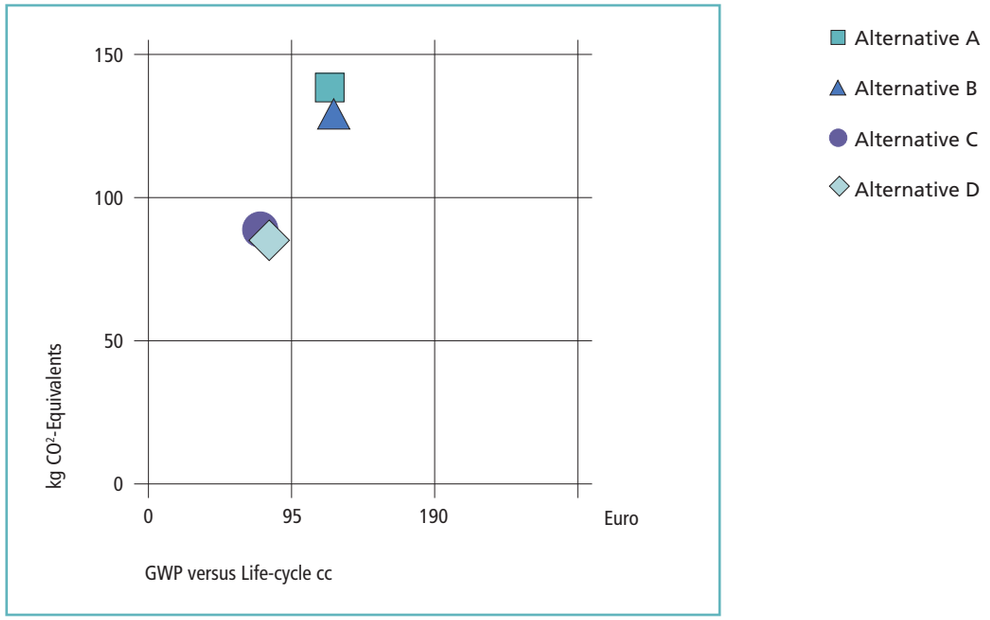
Table 3 shows the findings. Aggregate environmental impact and global warming potential are roughly proportional, so that the GWP, a more readily understandable measure, was used for the further evaluation (e.g. in Figure 12).
In addition, in order to aid comparison, the findings were normalized – i.e. greenhouse gas emissions expressed as a proportion of the greenhouse gas emissions of an average household, and costs expressed as a proportion of the annual consumer spending of an average household. The scale in Figure 12 is set accordingly.

Table 3 – Comparison of washing machines and user behaviour, annual figures

Alternative	Aggregate environmental impact	GWP	LCC	Savings (GWP) (1)	Extra cost from baseline A	Efficiency
	UZBP	kg CO2-equivalent	Euro	kg CO2-equivalent	Euro	kg CO2-equivalent/ Euro
A (reference)	812	139	117			
B	780	130	118	9	1	9
C	527	84	80	55	-37	-1,49
D	522	82	84	57	-33	-1,73

UZBP = environmental target impact points
GWP = Global Warming Potential
LCC = Life-Cycle Costs

Figure 12 – Global warming potential and life-cycle costs of various alternatives



Conclusions for product development

The Eco-Efficiency Analysis reveals that the behavioural options are substantially more eco-efficient (this is due to the circumstance that it has become usual today to wash inefficiently, using excessive washing temperatures and loading the machine poorly).
It follows that further product development should concentrate on "intelligent" washing machines, which signal the weight of the laundry when loading the machine through a display and recommend a minimized temperature. The additional cost of this function, however, should not be high, as consumers could quite well select the appropriate load or low temperature without a display, with little extra effort and at no extra cost.

The reason for the great importance of appropriate washing behaviour is that little scope now remains to further reduce water and energy consumption through technological refinement of washing machines. It is in the field of detergents that further technical optimization is still possible, for instance by introducing special low-temperature detergents.

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Social Life-Cycle Assessment (SCLA) and SocioGrade

Social aspects are of great importance. So far this has been acknowledged in corporate management by means of consumer research, issue management and – for a few years – in sustainability reporting (cf. Global Reporting Initiative). The term "social" refers generically to both social and societal aspects.

A cooperation venture between UNEP-SETAC and Öko-Institut – Institute for Applied Ecology in the year 2006 resulted in a first methodological description of a product-related Social Life-Cycle Assessment, SLCA (for details, see Grießhammer et al.). Several companies – for instance, BASF, Procter&Gamble and Deutsche Telekom – are working with company-specific tools to collect data on social aspects (see References).

Special features of SLCA

Compared with Life-Cycle Assessment (LCA), Social Life-Cycle Assessment (SCLA) has certain distinctive features which can be managed with ease provided that they are given some thought at an early stage:

- Social aspects can be highly diverse and weighted in highly disparate ways by different stakeholder groups in different countries and regions. Social evaluations also change much more quickly over time than environmental evaluations, for example.
- Major importance therefore attaches to the pre-selection of the social aspects to be considered in depth. Pre-selection is thus a part of the normative evaluation.
- So far the availability of data has been poor. Normally neither quantitative nor qualitative data alone will provide sufficient information; both kinds are needed.

The above enumeration of difficulties should not be taken as a deterrent. On the contrary: there is rarely such an opportunity to learn about one's own products, company and customers as during the completion of a SLCA.

The PROSA SLCA

SLCA is one of the core tools used within PROSA. In the course of implementation, care must be taken to coordinate the key parameters with LCA and Life-Cycle Costing (cf. *Integration Checklist* in the Annex). It is possible, however, to carry out SLCA as a free-standing analysis or in combination with (either) LCA or Life-Cycle Costing.
Social aspects are investigated throughout the product life cycle and system, normally in comparison to some alternative. Stakeholders should be involved as far as possible (cf. *"Stakeholder Involvement"* Table in the Annex). The methodological procedure corresponds to that for the life-cycle assessment (LCA) and is carried out in four steps.

1 Goal and scope definition

- Defining the goal of the study, system boundaries, reference alternatives/scenarios, etc. Three points require particular attention:
- The geographical system boundaries are normally defined so as to include countries with different social conditions and cultures.
- Product utility, and hence the functional unit, must be described with considerably more precision than is usual in the LCA (cf. also the section of this manual on Benefit Analysis). For example, there should be a description of what are known as "symbolic" utility aspects (prestige,etc).
- The selection of indicators makes special demands (see the separate discussion below), but surprisingly there tends to be rapid agreement on the selection of the most important indicators, even where stakeholder positions are otherwise highly divergent.

2 Life-cycle inventory (LCI)

Due to the poor availability of data so far, this area poses a particular challenge. Only a small proportion of quantitative data is available from statistical or comparable sources. As yet there are no module data for central processes or intermediate products (e.g. cotton manufacturing, plastics manufacturing, transport). The upstream chains are often complex and involve suppliers from many countries. Whilst small material inputs can often be disregarded for LCA purposes, when it comes to analysis of social conditions, small companies in the upstream chain can be highly relevant.
The depth of analysis can be varied depending on the question being addressed (qualitative assessment, expert judgement, if-then assumptions, semi-quantitative or quantitative data collection).

3 Life-cycle impact assessment (LCIA)

As in LCA, the key elements of this step of SLCA are: analysis of data quality; classification; characterization; and, optionally, normalization.
Qualitative data can be „translated" into a quantitative form by appliying specified methods.

- Example of classification in the employment field: categorization into full-time and part-time jobs and (e.g. in the German context) mini-jobs, state-subsidized self-employment, pseudo self-employment, etc.
- Example of characterization in the employment field: weighting of the specified types of employment and calculation of totals (e.g. full-time job at 100%, part-time job at 50% etc.)
- Example of normalization: relating the employment figure to the numbers of people in employment in the country studied.

4 Interpretation of results

As in the case of LCA, the key elements are checking for completeness, significance and consistency with the goal of the study, and carrying out sensitivity analyses.
Ideally the interpretation should be carried out in collaboration with stakeholders and will normally be qualitative-discursive. Nevertheless there are a range of situations which require the use of (semi-) quantitative interpretation frameworks, e.g. portfolio screening as an internal company exercise, product testing involving the comparison of multiple products, or the integration of many individual results into an overall evaluation of sustainability.
Quantitative or semi-quantitative interpretations are supported in PROSA by means of the **SocioGrade** interpretation framework (cf. the section on ProfitS). In this framework the indicators and weightings are user-defined.

Social indicators

Due to the sheer number of potential social aspects for analysis, the definitive task of selecting the aspects and indicators to be studied in depth is of pivotal importance. The key social aspects generally originate in three areas: hotspots in the upstream chain and the end-of-life management (e.g. wages below the minimum subsistence income, or child labour); repercussions of product use (e.g. computer games), and indirect repercussions on society (e.g. mobile phone use). In contrast to LCA, as yet and for the foreseeable future there is no universally accepted list of social indicators. PROSA provides a provisional list of social indicators, arranged according to stakeholder groups (cf. Figure 14). The list was extracted in a multi-stage process from several dozen lists of indicators running to over 3,000 proposed social indicators. In any event, it includes the indicators contained in the most important laws or codes on the theme (ILO-standards, OECD Guidelines for Multi-national Enterprises, Global Reporting Initiative, SA 8000, Stiftung Warentest core criteria, etc.).

Figure 14 – PROSA list of social indicators

Employees	
Safe & healthy working conditions	National framework Number of fatal accidents at work Number of accidents at work Number of recognized occupational diseases and reports on elevated health risks Workplaces associated with noise, fumes, dust, heat, insufficient illumination Basic measures and arrangements to maintain and increase safety at work Measures and arrangements to maintain and increase health at work Access to clean drinking water and sanitary facilities at work Policies and programmes to combat HIV/AIDS and/or other locally important health issues (dengue, malaria, alcoholism etc.)
Freedom of association, right to collective bargaining & workers' participation	National framework Voluntary commitments by the company in the field of freedom of association & right to collective bargaining Reports on hindering workers' organizations and their activities Rate of unionization Possibilities for collective bargaining Possibilities for bottom-up communication
Equality of opportunity and treatment & fair interaction	National framework Voluntary commitments by the company in the field of equal opportunities and treatment Reports on discriminatory practices of the company Proportion of women in management positions Proportion of disabled employees Reports on harassment and mobbing Reports on sexual harassment Measures and programmes to maintain and increase equal opportunities and treatment
Abolition of forced labour	National framework Voluntary commitments by the company on abolition of forced labour Reports on cases of forced labour as defined by the ILO core labour standard conventions No. 29 and 105
Abolition of child labour	National framework Voluntary commitments by the company on abolition of child labour Reports on cases of child labour as defined by the ILO core labour standard conventions No. 138 and 182
Adequate remuneration	National framework Average remuneration level Average level of performance-related incentives Level of corporate minimum wages Ratio of corporate minimum wages to local costs of living Number of employees in the lowest remuneration segment Average level of performance-related incentives in the lowest remuneration segment Application of a transparent remuneration system Payment of wages in due time
Adequate working time	National framework Duration of one standard working week Maximum weekly working hours Duration of weekly rest period (at least 24 hours in one stretch) Duration of annual paid holidays Possibility for individually arranged working hours Fundamental decisions to increase / maintain / reduce working hours
Employment security	National framework Portions of permanent, non-permanent, freelance employees, and workers provided by temporary work agencies and sub-contractors Labour turnover rate Regulations on dismissal protection (cancellation period etc.) Fundamental decisions on hiring or dismissing employees
Social security	National framework Evidence of breaches of obligatory social contributions Duration and level of wage continuation in the case of illness Occupational pension schemes Maternity protection and childcare Additional occupational social contributions
Professional development	National framework Enhancement of professional qualifications on the job Proportion of employees covered by training programmes Average number of training days per employee Quality of training (participants' feedback) Language courses and integration measures for foreign employees
Job satisfaction	National framework Company festivities and social events Workplace reachability (location, public transport etc.) Aesthetic design of workplaces If necessary: Provision of housing facilities fit to live decently
Local and regional communities	
Safe & healthy living conditions	National framework Fatal accidents connected to the company's activities Accidents connected to the company's activities Negative and positive health impacts for the local population Noise, fume, dust, heat and wastewater emissions Measures and arrangements to maintain and improve safe and healthy living conditions
Respect of human rights	National framework Voluntary commitments by the company in the field of human rights Reports on human rights violations related to the company's activities Forced evictions / resettlements related to the company's activities Human rights training for employees, particularly for security staff
Respect of indigenous rights	National framework Reports on interference with social, economic or cultural activities of indigenous groups Evidence of exploiting indigenous knowledge and cultural heritage Reports on the violation of local traditions and values Respect of indigenous development goals Measures to maintain and improve the socioeconomic basis of indigenous groups
Community engagement	National framework Information possibilities for residents System to respond to community grievances Breaches of obligations established by local political and social decision-making authorities
Maintaining & improving social and economic opportunities	National framework Influence on local resource conflicts Provision / overburdening of infrastructure facilities Provision / overburdening of welfare services Additional education facilities for local residents Impact on local economic development
Society	
Public commitments to sustainability issues	National framework Awards for engagement in social and / or sustainability issues Membership in alliances and programmes to support and promote sustainable business practices Evidence of lobbying against implementing sustainability measures Publication of a sustainability report or social report
Prevention of unjustifiable risks	National framework Use of genetically engineered products and / or promotion of activities in the field of genetic engineering of living organisms, and in relation to patenting genes, organisms and plants Handling of radioactive substances and / or support of activities connected to nuclear power and warfare Evidence of other short-, medium- or long-term risks to human security
Employment creation	National framework Labour intensity (working hours per product or functional unit) / number of employees Development of indicators 1. and 2. within the last 3 years
Vocational training	National framework Number and proportion of apprentices (in relation to the total number of employees) Enhancement of professional qualifications on the job
Anti-corruption efforts & non-interference in sensitive political issues	National framework Evidence of corrupt and / or extortionate business practices Reports on improper involvement in political activities Corporate measures to combat corrupt business practices
Social & environmental minimum standards for suppliers and cooperation partners	National framework Proven efforts to implement social and environmental minimum standards at suppliers, sub-suppliers, intermediary dealers and cooperation partners Evidence of breaches of fundamental social and environmental minimum standards at suppliers, sub-suppliers and cooperation partners
Contribution to the national economy and stable economic development	National framework Contribution to GDP Direct investments Contribution to the foreign trade balance Development of innovative products and services The sector's stability during market crisis Evidence of competition distorting business practices (monopolisation etc.)
Contribution to the national budget	National framework Contribution to the national budget (taxes paid minus subsidies received) Evidence of tax evasion
Prevention & mitigation of armed conflicts	National framework Link between economic activities and armed conflicts
Transparent business information	National framework Comprehensive and transparent business reporting and sustainability reporting Handling of inquiries on sustainability issues
Protection of intellectual property rights	National framework Reports / court sentences on breaches of intellectual property rights
Users & Consumers	
Protection of the user's / consumer's health and safety	National framework Health opportunities / risks related to product use Accidents related to product use Fatalities related to product use Findings of product safety tests (incl. any awards, labels)
Quality of product or service	National framework Quality in relation to comparable products Good service, repairability, availability of spare parts Functioning procedure to settle consumer complaints Findings of product tests (incl. any awards, labels)
Fair competition & marketing practices	National framework Evidence of agreements and practices that distort competition Evidence of fraudulent, misleading or unfair marketing strategies Prevention of high downstream costs for maintenance and disposal Proportion of advertising costs in product price Evidence of infringements of commercial advertising law (reprimands by advertising monitoring council etc.) Evidence of dubious practices to bind consumers (non-compatible software, ink cartridges etc.)
Complete & understandable product information	National framework Precise and readily understandable information (user manual, constituent substances, safe use, maintenance, storage and disposal) as basis for information-based consumer decisions
Protection of user's / consumer's privacy	National framework Indications of infringements of consumers' privacy and/or data protection rights
Enhancing the user's / consumer's social and economic possibilities	National framework Reduction of consumer costs Suitability of product to meet needs of disadvantaged groups (disabled, aged, ethnic minorities etc.) General and widespread access to products and services

The indicators proposed by PROSA, shown in Figure 14 above, can be augmented and/or replaced to meet context- and product-specific needs.
It is recommended that the number of indicators to be studied should be kept within reasonable limits (five to ten indicators). The choice of indicators may be informed by the results of other PROSA studies (megatrend analyses, consumer research).

SocioGrade interpretation framework

For the evaluation, (semi-)quantitative interpretation frameworks like PROSA should only be used if required by the special situation (multiple products, multiple indicators, etc.). All the original data and discrete stages of evaluation should – like SocioGrade – be transparent and retraceable if necessary. The goal of the evaluation and of SocioGrade is not to arrive at an absolute evaluation of particular products, but to derive possible measures for improving social problems.
SocioGrade is an Excel tool with the following elements (see Figure 15):

- Within the four groups – employees, local communities, society, and users – indicators can be freely chosen. As an aid to data entry, a click-down list of suggested indicators is provided. The recommended number of indicators to be dealt with is no more than ten.
- Optimization measures for each of the analysed indicators should be entered in free form.
- Using a click-down menu, a quantitative evaluation can be undertaken. Values can be selected from a range of 1 (high - social situation very good) to 10 (low - social situation very poor).
- The Excel tool calculates a numerical "overall evaluation", for which all indicators are preset by default to a 1:1 weighting. The weightings can be adjusted by users, however.

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To assist with prioritization, in addition to the list of indicators PROSA provides a decision matrix (cf. Figure 27 in the Annex) which is used to evaluate data availability and time requirements for data collection. Prioritization should be carried out by the strategy team and in cooperation with stakeholders if possible.
Care must be taken to clearly define the individual indicators for data analysis purposes. On the child labour indicator, for example, ILO Conventions nos. 138 and 182 contain minimum age requirements, the details of which vary according to the context and type of work: 15 years of age is standard, with 13 years for easy work; in underdeveloped countries, 14 and 12 years of age respectively; 18 years of age for hazardous or particularly strenuous work, but 16 years where strict occupational health and safety standards are applied!

Figure 15 – Extract from SocioGrade (fictional example)

Employees	Short Heading	Brief Info, Report Page No.	Measures	Gewichtung	Bewertung
Indicator 1	Freedom of association	no; p. 16	Actively support the formation of workers' representation	1	10
Indicator 2	Equality of opportunity and treatment	Women paid substantially less for equal work, p. 9f.	Ensure equal pay	1	9
Indicator 3	Safe and healthy working conditions	Pesticide poisoning same as industry average; p.15	Ensure appropriate protection and information measures	1	6
...	....	....	....	1	....
Local communities					
....	Respect of human rights	no; 16	N/A	1	1
....	....	....	....	1	....
				Overall evaluation (numerical)	....
Weighting can be adjusted. Evaluation from 1 = very good to 10 = very poor					
Date	22.03.2007	Evaluation by	Strategy Team Company		

Case study: Social impacts of the production of notebook PCs

Past discussion of the social aspects of products has concentrated mainly on agricultural products (e.g. coffee or cotton), hand-crafted products (soccer balls) and a few non-technological products (e.g. textiles). Reports and scandals on technology products like computers or mobile phones are quite a recent development. Globalization is opening up wider stakeholder access to information about complex products and highly distributed, previously inscrutable, supply chains.

Goal and scope definition

Öko-Institut – Institute for Applied Ecology was commissioned by the German Federal Ministry for Education and Research to study the social aspects of notebook PC production (Manhart and Grießhammer 2006). The goals of the study were to collect systematic data on social impacts in notebook PC production (not including software) and to derive potentials for improvement. Use and recycling were not taken into consideration due to the existence of a number of studies covering these aspects.

Notebook production

Notebook PCs consist of 1,800 to 2,000 parts. Production is distributed across a multi-stage manufacturing process and hundreds of suppliers. The ten largest brand-name manufacturers in the world (Dell, HP, Lenovo, Acer, Toshiba, Fujitsu-Siemens, NEC, Sony, Apple and Asus) no longer maintain their own production facilities, with the exception of Toshiba in some segments and certain final processes in the high-end segment. Labour-intensive manufacturing processes take place almost exclusively in the People's Republic of China. Technologically demanding components (displays, battery cells, etc.) are also manufactured in other locations. The actual production work is done by *contract manufacturers*, whilst several further layers of suppliers are responsible for manufacturing the components.
The structure of production can be seen in Figure 16. Many of the components are used in other electronics products as well, so potentially it should be possible to assemble relevant module data on social aspects throughout the electronics industry.

Involvement of stakeholders

For the study on notebook production, two stakeholder workshops were held (in Frankfurt and Hong Kong) and close contact was established with brand-name manufacturers, manufacturers' CSR initiatives (the Global e-Sustainability Initiative and EICC), the UNEP, and Asian and European NGOs (inter alia, the *Asia Monitor Resource Center, China Labour Bulletin, China Labour Support Network, CSR-Asia, Human Rights in China, Labour Action in China, Oxfam Hong Kong, CAFOD, SOMO, IMF and Oxfam Germany*).

Life-cycle inventory analysis

For the life-cycle inventory analysis (LCI), data obtained from specialist literature, journalistic reports and field research as well as information provided by corporations, industry alliances, NGOs and workers' rights organizations was evaluated and cross-checked with individual corporations and stakeholders. Due to the special political conditions in the People's Republic of China, a host of problems are associated with gathering data. Despite extensive research, the required data could not be obtained in its entirety. It was especially difficult to obtain data from remoter upstream production processes not immediately linked to the specific product, such as the manufacturing of single electronic components. In this area in particular, there are numerous indications of social problems.

Results

Hence the results relate only to manufacturing processes with comparatively direct links to the product, in supplier firms with comparatively superior social standards. But even here, a number of social problems were identified:

- Working conditions do not meet central European standards in almost any area; in particular, breaches of ILO core labour standards nos. 87 and 98 were noted (freedom of association and organization and the right to collective bargaining).
- There are a great number of short-term contracts with (female) migrant workers. The workforce consists almost exclusively of childless young women.
- As a rule, suppliers in the part of the value chain directly linked to the product keep remuneration in line with the statutory minimum wage. When it comes to payments for overtime, however, there are frequent cases of non-compliance with national and international regulations. In isolated cases, pay is also deducted illegally.
- In many cases, overtime loads exceed statutory limits. There are documeted instances of individuals working over 100 hours of overtime per month.

Of course, notebook PC production also has positive effects for China, for the workforce and the regional population on the Chinese east coast, on which data were also collected (e.g. several hundred thousand jobs, contribution to poverty reduction).
The wage costs of labour-intensive manufacturing processes in China can be estimated at less than EUR 30 per notebook, accounting for just a few percent of final notebook selling prices.

Divergent evaluations

The theme of migrant workers made it clear that even uncontroversial data can give rise to very divergent evaluations. Some actors emphasized the new employment opportunities for rural workers; others saw migrant workers primarily as victims of private enterprises. A few migrant workers also looked upon long working hours and high levels of overtime as an opportunity to earn as much money as possible during the term of their contract, which was time-limited.

Proposed measures

- Analysis of suppliers should be extended to take in the (usually) smaller suppliers who never come directly into contact with the end product.
- The hitherto less-than-transparent auditing of supplier firms by brand-name manufacturers should be supplemented with high quality independent certification. In other sectors, China already has over 100 factories certified to SA8000.
- Compliance with social standards by suppliers, and associated cost increases, should not result in the severance of business relationships with notebook manufacturers.
- Even though there is no freedom of trade union organization in China, factories may have internal worker representations, and notebook manufacturers should encourage this.
- Following the example set by the toy industry, the electronics industry should set up independent complaints bodies serving all relevant supply chains.
- A "fairly produced" label should be developed for computers and adopted by brand-name manufacturers.

Figure 16 – Structure of the notebook PC production chain

Production stages	Products and intermediate products					
6. Marketing	Branded notebook					
5. Final assembly	Notebook					
4. Assembly of complex components	Motherboard and network card	LCD display	Optical drive	Hard disk	Keyboard	Touchpad
	Batterypack	Power supply	Cooling system	Case	Other	
3. Manufacturing of single components	Microchips	Passive electronic components	Printed circuit boards	Cables	Operator controls	Plug connections
	Screw connections	Battery-cells				
2. Refining of raw materials	Silicon wafers	Glass products	Raw plastic products	Copper products	Copper-zinc products	Aluminium products
	...	Palladium products	Tantalum products			
1. Resource extraction	Quartz sand	Crude oil	Copper ore	Zinc ore	Bauxite	...
	Palladium ore	Tantalum ore	...	Scrap metal		

Benefit Analysis and BeneGrade

The benefit analysis is used to analyse and evaluate the utility of products and services from the perspective of users or – where necessary – from the perspective of product policy. Users are predominantly private households and/or consumers, but may also be commercial users, the public administration or large organizations, such as churches.
Whereas benefit or utility is recorded and defined slightly above the functional unit or the functional equivalent in the case of a Life-Cycle Assessment, in PROSA benefit/utility is analysed more intensively because it ultimately determines consumers' purchase and use decisions; furthermore, if higher social or ecological risks are involved, the assessment has to be reasoned and answered for in terms of product policy in view of relevant legislation (cf. also the socio-economic benefit analysis in the EU's REACH initiative and Eco-Design Directive).
The benefit analysis is used to analyse – depending on the issue and with the help of consumer research (see below) – practical utility, symbolic utility and societal utility. The results will be quite different and will be assessed differently in different countries and target groups. This should be taken into account when defining the scope of the study.

Figure 17 – Utility types and usefullness of results

Utility type	The users of the benefit analysis and their reasons
Practical utility	Companies: portfolio strategy, opportunities analysis; optimization of product development and marketing
	Testing and consumer organizations: basis for purchase recommendations
	Users: basis for purchase and use behaviour
	Product policy: basis for risk-benefit assessment in relation to laws and support programmes
Symbolic utility	Companies: optimization of product marketing
Societal utility ("public value")	Companies: portfolio strategy, opportunities analysis; optimization of product marketing
	Users: ethical basis for purchase
	Product policy: basis for risk-benefit assessment in relation to laws and support programmes

There are various concepts and descriptions of **practical utility**: functional utility, technical utility, main utility, (simply) utility, core performance, quality (cf. Fig. 18). One example of practical utility is the result achieved after washing laundry, in terms of hygiene and visual aesthetics. The essential elements of practical utility are measurable (performance, durability, etc.) and can be recorded in comparative product tests, quality assurance systems or ISO standards. At the same time, individual elements of practical utility may turn out differently for an individual (gain in time, for example).

Figure 18 – Practical utility checklist

- ☑ performance (core requirements)
- ☑ additional performance
- ☑ meets needs
- ☑ durability
- ☑ functional reliability
- ☑ safety/security of supply
- ☑ service/reparability/spare parts
- ☑ convenience/time
- ☑ good consumer information
- ☑ availability

Symbolic utility is also known as psychological utility or additional utility. It is conveyed via the product and its marketing and triggers feelings or moods such as prestige, a new sense of identity or the sense of belonging to a group. One example would be the metallic paint on a car.

The differences between practical utility and symbolic utility are not all hard and fast and can be variously interpreted and experienced depending on the person concerned. One used to be able to assume that practical utility was the same as the main utility for the consumer and that symbolic utility was merely additional utility. In prosperous societies and mature markets with high product quality, the perception of utility may shift in the case of some product groups, so that practical utility is taken for granted and is perceived as being a basic quality, with symbolic utility dominating people's perceptions (in the case of certain textiles, for example, more money is spent for the "brand" than for actual product quality).

Figure 19 – Symbolic utility checklist

- ☑ External appearance /design/ taste/ feel/sound etc.
- ☑ Prestige/status
- ☑ Identity/autonomy/development
- ☑ Expertise
- ☑ Safety/precaution/care for others
- ☑ Privacy
- ☑ Social contact/fostering community
- ☑ Enjoyment/pleasure/joy/experience
- ☑ Compensation/reward
- ☑ Consonance with societal, religious or ethical meta-preferences

Societal utility ("Public Value")

In a welfare-based market economy it is assumed that consumers make decisions about the utility of products and hence generate demand for particular products and services. And that is a good thing. But the state should intervene when the ecological or societal burdens of products are too high for the common good. It is also expected that the state will promote promising technologies and products for the future to ensure the sustainable development of society.
Appropriate support programmes, tax relief and laws should only come into being, however, on the basis of clear analysis and reasoned assessment. In line with a risk-benefit assessment both the risks and the benefit need to be clearly analysed and assessed. Indeed this is increasingly becoming standard in EU legislation.

PROSA is aimed above all at products that have a high societal benefit and offer companies "sustainability opportunities". The products should make an **essential** contribution to key national and international objectives, such as international poverty reduction (set out in the Millennium Development Goals), securing peace, the basic objective of the Rio Declaration (economic development and satisfaction of basic needs), climate protection (Framework Convention On Climate Change), the preservation of biodiversity (Convention on Biological Diversity), as well as jobs and societal stability. A minimum precondition in this can be that the products have a high practical utility and no contrary impacts within society.

The assessment of societal benefit depends crucially on the status of the society. For example, the satisfaction of the basic need for food is assumed to be taken for granted in a rich country.

Figure 20 – Societal benefit checklist

- ☑ Poverty reduction
- ☑ Basic need: food
- ☑ Basic need: housing
- ☑ Basic need: health
- ☑ Information and education
- ☑ Peace and security
- ☑ Climate protection
- ☑ Biodiversity
- ☑ Qualified jobs
- ☑ Societal stability

Benefit Analysis and BeneGrade

Consumer research in PROSA

There are two different research traditions and areas for practical application in consumer research: marketing-oriented consumer research and consumer-oriented consumer research. The underlying methods are the same, but the questions and analytical perspective are different.

Marketing-oriented consumer research is carried out predominantly on behalf of companies; its primary objective is to ensure that products sell successfully (“**sales research**”), although of course potential problems in the post-sale phase are also taken into account (dissonance reduction management and customer satisfaction research). By contrast consumer-oriented consumer research (“**consumption research**“) analyses from the point of view of consumers and society and also undertakes in-depth analysis of the post-sale phase – in particular the use phase, use patterns and possibilities for an environmentally sound, cost-saving and socially sustainable use of products. Both points of view should be given attention in a sustainability-oriented study.

The familiar quantitative and qualitative consumer research tools can be used for the benefit analysis in PROSA (questionnaires, interviews, empirical content analysis, observations, experiments and test situations); qualitative social research methods, such as group research, are generally given greater emphasis, however. Focus groups are especially well suited for this because complex aspects of sustainability and difficult social-psychological issues can be analysed here with limited effort. Being together in a group has the advantage that the generation of processes of opinion formation can be speeded up in the group, observed and analysed later according to specific target groups. In addition to the traditional questions (practical utility, symbolic utility, target groups) patterns of use, habits of use and aspects of sustainability are also subjected to particular study.

In focus groups with PROSA an expert is included in each group in order to answer tricky questions in an ad hoc manner in the overlapping areas of technology, ecology and use (cf. Grießhammer et al. 2004, p. 37ff). In addition to the focus groups it can also be useful to consult stakeholders and experts in mini-groups.

The results of consumer research or benefit analysis are closely coordinated with those from the Life-Cycle Assessment (LCA), the Social LCA and the Life-Cycle Costing.

The aim of the benefit analysis is not to produce an absolute assessment of products but rather to ascertain opportunities and products suited for the future and to derive potential ways of optimizing products so that they become more sustainable. For example, car sharing can be made more attractive when the symbolic utility aspects of individual cars are made clearer and this symbolic utility can be satisfied by car sharing as well.

Consumer research for the EcoTopTen campaign

In the context of the EcoTopTen initiative to promote ecological products, focus groups were conducted on several product groups (prefabricated houses, cars, computers, monitors, televisions, textiles, bicycles, electricity from renewable sources etc.). A cross-evaluation showed that “today’s“ consumers have quite different attitudes than those of consumers in the 1980s and 1990s:

- Good design instead of alternative symbols;
- Emphasis on the individual instead of the group
- Fun instead of suffering
- Experience instead of disaster
- Gain and success instead of “anti-” attitude
- Professional instead of home-made
- Fast rather than slow

In relation to ecological products there are clear (pre-)judgements that result predominantly from the weaknesses (long since corrected) of ecological products in the 1980s. Despite the existence of plenty of information, it costs even interested consumers a great deal of effort and time to gather sufficient comparative information for products which are good in every respect (that is, information about quality, price, life-cycle costs, environmental aspects, social sustainability in production or optimal use behaviour). The situation is made worse by ever shorter product cycles and the large number of new products and developments.

There were a great many surprises in the consumer research on individual products:

- committed environmentalists do not want a small car,
- cheap meat gets cooked on very expensive designer cookers,
- thirst for adventure, but fear of chan ging electricity supplier,
- people want high tech cars, ABS and side-impact airbag, but will tolerate awful brakes and poor lighting on bikes,
- prices/costs play a comparatively minimal role with some products, e.g. cars, TV sets, cookers;
- the concept of life-cycle costs is largely not understood and/or not accepted.

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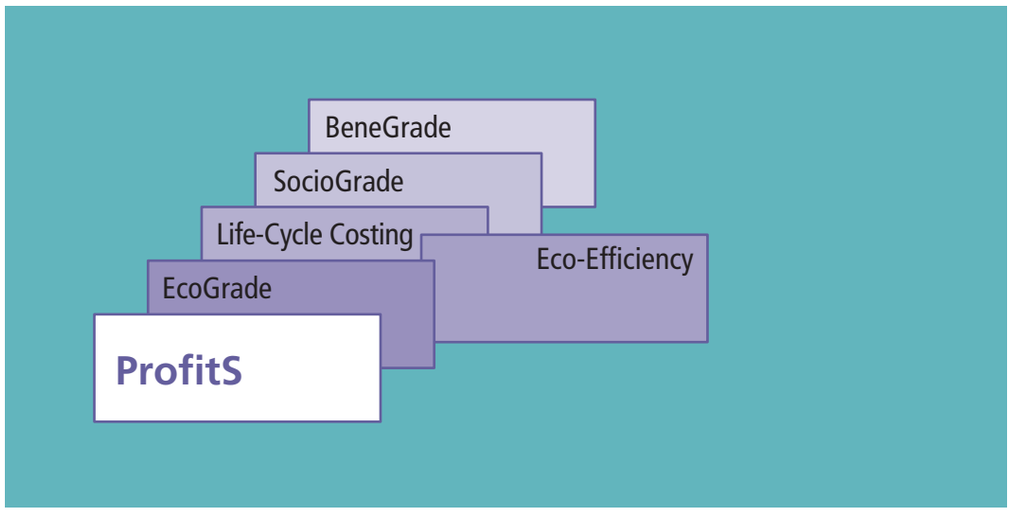
BeneGrade

PROSA provides an interpretation framework called BeneGrade for the purpose of systematically testing and compiling the various aspects of utility. BeneGrade contains the three checklists shown above on practical utility, symbolic utility and societal utility in tabular form, each with ten categories. These can be varied as required according to specific products or specific countries. Potential optimization measures are also explored.
For a comparison of different variants or to compare the assessments of different stakeholders or consumers, it may be helpful to refer to a quantitative assessment. BeneGrade contains a corresponding assessment framework for this.

ProfitS

For more than a decade now there has been debate on sustainable development – sustainability strategies and sustainability goals have been defined, sustainability reports produced and products rated as sustainable or non-sustainable, as the case may be. Surprisingly, there is little debate and little transparency as to **how in fact sustainability is evaluated and which concrete improvements are proposed and implemented**.
PROSA, in contrast, places a strong focus on a verifiable evaluation process and a clear evaluation framework. PROSA provides for this purpose the **ProfitS** (Products Fit to Sustainability) integrated evaluation framework. ProfitS is action-oriented and its outcomes can be presented in a qualitative-argumentative manner or in quantitative terms. Where required, it can be complemented or substituted by other transparent evaluation frameworks (cf. Figure 21).
In addition, for evaluations of (only) the two dimensions of ecology and economy, PROSA provides the **Eco-Efficiency** evaluation framework.

Figure 21 – The ProfitS evaluation framework



The purpose of the evaluation is generally to prepare strategic decisions and to identify sustainability opportunities and optimization avenues, and NOT to perform any absolute evaluation.
Nonetheless, ProfitS does provide opportunities for quantitative assessment,

- because this makes it possible to treat and present the great array of findings on different variants in a more systematic fashion,
- because certain assessments (e.g. that of eco-efficiency) are only possible at all if partial aggregation is performed (cf. the section on eco-efficiency),
- because, curiously, it is often only the quantitative assessment proposed in a strategy team or at a stakeholder workshop that triggers more in-depth discussion of qualitative evaluations,
- because companies with large product portfolios use indexes.

The outcome of ProfitS therefore can be aggregated and expressed as one index where required. All original data and all the individual evaluation steps, however, can be traced back.
In addition to quantitative assessment, the ProfitS evaluation framework routinely asks which measures can be taken to improve an indicator or state that has been rated poorly.

ProfitS conducts an overall evaluation of impacts in the three dimensions of economy, ecology and society, and places this in relation to product benefits. This process builds upon the (sub-)assessment tools EcoGrade, Life-Cyle Costing, SocioGrade and BeneGrade described elsewhere in this manual.

- Costs (life-cycle cost),
- EcoGrade, the environmental assessment framework,
- SocioGrade, the social-societal assess ment framework.

The ProfitS Excel tool can be used where required to perform the overall evaluation in quantitative terms. This involves taking for each dimension or each (sub-)assessment tool the average value (between 1 = very good and 10 = very poor) and aggregating these, with a 1:1:1 weighting. If required, the result can then be compared against the assessment of benefit provided by BeneGrade. The overall evaluation covering the three dimensions is presented graphically by means of a bar chart or a spider chart (Figures 22 and 23).

Figure 22 – ProfitS - Presentation as bar chart

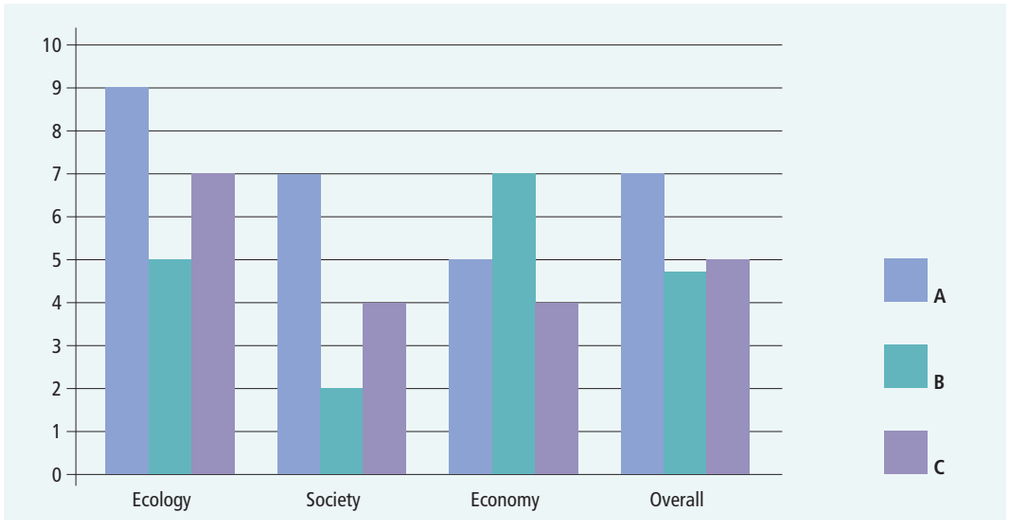
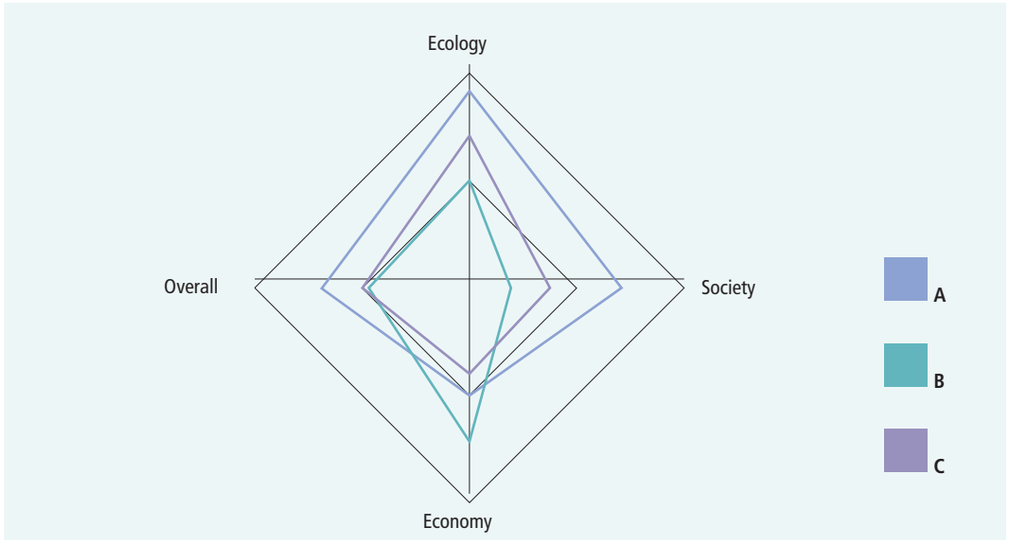


Figure 23 – ProfitS - Presentation as spider chart



The outcome of the benefit-risk assessment is presented in a benefit-risk portfolio (Figure z).

Annex

This section contains checklists and overviews intended as aids for implementing PROSA. In large companies there will generally be company-specific checklists for this, which can equally be used.

Actor Checklist

Before implementing PROSA there should be clarity about which internal and external actors play a role and in what form they are included or addressed. Particularly in large and international companies there is a danger that relevant internal actors are not included appropriately. The general Actor Checklist can help to establish the relevant external actors.

Figure 24 Actor Checklist

Actor groups in general	Actor groups relevant to the product (portfolio) under study
Production companies in the chain (primary and secondary suppliers, buyers)	
Trading companies (incl. Internet trading)	
Customers (B2C, B2B, procurers, ...)	
State / administrative actors	
Financial institutions: shareholders, banks, insurance companies, rating organizations	
Media and product testing magazines	
Local residents and local actors	
Industrial associations and standards organizations	
Consumer organizations, environmental coalitions, development organizations, trade unions, product-specific associations or initiatives (such as automobile clubs, mobile phone initiatives)	

Stakeholder Involvement Checklist

Stakeholders should be included especially in sustainability-oriented strategic processes. The different possibilities are described in the following overview.

There are also transitions between the prototypical options listed here. Options 1 und 2 should be used as preparation prior to including stakeholders directly (Option 3).

Figure 25 – Stakeholder Involvement Checklist

Options for stakeholder involvement	Advantages	Disadvantages or risks
(1) Research on stakeholder positions (Internet; publications)	■ quick ■ no problems with confidentiality ■ no obligations	□ often out-of-date publications □ little chance to assess future developments and changes in position □ not possible to ask questions about content or prioritizations
(2) Conversations with individual stakeholders on the subject	■ more direct and up-to-date information ■ initial assessment of future developments and changes in position possible (depending on extent of information provided to stakeholders)	□ depending on extent of information provided to stakeholders potential problems with confidentiality □ more an exchange of positions than jointly devising sustainable strategies
(3) Direct inclusion in strategy or product panels	■ Direct and up-to-date information ■ good assessment of future developments and changes in position possible ■ large gain in creativity ■ potential for cooperative activities that support the market	□ time consuming □ problems with confidentiality □ choice of the “right” stakeholders difficult and hard to correct □ expenses payments required, but depending on the agreement and disclosure this can also compromise the stakeholder position

Annex

Actor Cooperation Checklist

When a product portfolio is being reorganized, products developed and new marketing concepts devised, it usually requires entering into cooperative activities that may entail disadvantages as well as advantages. These should be ascertained and assessed at the start – but also during the process itself – and minimized, cf. the general Actor Cooperation Opportunities and Risks Checklist.

Figure 26 – Opportunities and risks of cooperation

Gain in know-how (know-how transfer, attainment of system expertise, common experiential knowledge etc.)	Opportunities
Sharing of staff and investment costs (sharing qualifications, apparatus, test facilities, data processing facilities etc.)	
Gain in time	
Joint setting of quality levels and standards	
Improving competitive position (access to new customers and markets, more direct and goal-specific market access, good for image due to attractive partners, mutual support of complementary products etc.)	
Coordination problems (additional complexity, danger of sub-optimization, costs of compromise, friction losses etc.)	Risks
Threat to one's own competitive situation (know-how drain, new competitors, cooperation takes on its own dynamic etc.)	
Latent conflict situations (conflicts of distribution, company culture, conflicts over trust, conflicts over motivation, resistance to change etc.)	

Decision Matrix for Indicator Selection, taking account of time requirements and data availability

It is often the case with environmental, economic and social analyses and sustainability analysis in general that too much time is spent discussing which indicators should provide the basis of the study. In order not to lose time unnecessarily here, a check should be carried out at an early stage as to whether and which data sources exist for the analysis, whether access to the data is guaranteed in the first place (e.g. data from suppliers or even competitors) and how time consuming the data research and processing will be. Once these variables have been entered in the following decision matrix, a different assessment usually emerges overall than if one merely discussed the list of indicators. Generally speaking, a compromise needs to be found between the importance of the indicators, the amount of time spent and data availability.

Figure 27 Decision Matrix for Indicator Selection (fictitious example)

	Assessment of indicator	Data source	Assessment of data access	Assessment of time spent
Economy				
wage level	very important	own data	very good	minimal
copper price	important	commodities market	very good	
…				
Ecology				
Indicator 1				
Indicator 2				
…				
Society				
Indicator 1				
Indicator 2				
…				

Integration Checklist

Interfaces and dependencies exist between the individual PROSA tools – Life-Cycle Assessment, Life-Cycle Costing (LCA), Social LCA (SLCA) and Benefit Analysis – which need to be taken into consideration when implementing PROSA and interpreting the results. This is necessary not only for methodological reasons, but above all in terms of drawing conclusions in practice.

Example 1: In the analysis of a new laundry dryer (especially good on saving energy, but more expensive), the Life-Cycle Costing shows that it is suitable only for large families who will use it relatively frequently. The intention had been, however, to calculate the LCA using an average household (statistically speaking 2.1 individuals), while the marketing intention had been to focus on a different target group.

Example 2: In the environmental policy appraisal of a waste treatment option for cars, the reduction of environmental impact is related to a single car part and extrapolated via the number of cars disposed of as a total positive impact; the costs, however, are calculated and extrapolated per (whole) car – this means that the costs are overestimated in comparison to the reduction of environmental impact.

Figure 28 – Integration Checklist

Feedback of the initial results from one tool to the input data and assessments for the other tools. Changes required?	☐
Functional unit defined equivalently? Different depending on target group?	☐
Outcome of Benefit Analysis taken into account when defining functional unit?	☐
System boundary and geographical scope defined uniformly or equivalently?	☐
Patterns of use defined uniformly?	☐
Dealing with different "cost bearers" in Life-Cycle Costing, but uniform "impact bearer" in Life-Cycle Assessment (namely, the environment)?	☐
Dealing with especially relevant qualitative results in Social LCA and less relevant but hard figures in Life-Cycle Costing?	☐
Are the LCA, Life-Cycle Costing and Social LCA based on significantly different data?	☐
Normalization to the same reference (e.g. number of products, branch of industry, whole national economy)?	☐
Fair and symmetrical overall evaluation?	☐
Fair and symmetrical communication of findings?	☐

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PRODUCT SUSTAINABILITY ASSESSMENT PROSA PRODUKT-NACHHALTIGKEITS-ANALYSE