

# Strategic Environmental Assessment (SEA) as a Participatory Approach to Environmental Planning

## Experiences from a case study with SEA in waste management

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**Abstract:** A Strategic Environmental Assessment (SEA) is conducted to ensure that the environmental consequences of plans or programs (land use programs, traffic planning, waste management planning etc.) are identified and assessed. Participation is a mandatory element of the SEA process. All affected parties are required to be represented in the process. Until today, the SEA process has been applied to waste management in only a few cases. This paper describes the assessment of a waste management plan in the province of Salzburg, Austria. The process took place in 2003. As in other cases of SEA, several alternatives were considered and assessed. Participation involved the establishment of a project team including all the relevant authorities and institutions and two expert teams. All decisions throughout the process (e.g. selection of the framework, scenarios and indicators), had to be taken by a majority of the project team. The aim of the process was to pinpoint the pros and cons of the different scenarios rather than identify the “best solution.” This paper describes the process and highlights the critical points.

**Key words:** Strategic Environmental Assessment; LCA; Participation; Waste Management

## 1 INTRODUCTION

Waste management has developed from the simple transport of waste out of the settlement areas to more complex systems including recycling and prevention of waste. As a result of the increasing complexity of waste management, adequate assessment tools have needed to be developed [Björklund, 2000]. From both a methodological and a practical point of view it is a complex task to compare alternatives with respect to environmental effects, costs and social aspects. In most cases, the antagonistic targets of cost minimisation, reduction of environmental effects and high convenience for the user (mainly of the waste collection scheme) cannot be fulfilled by one scenario. More likely is a constellation in which high costs are linked with high environmental standards and high convenience, whereas low-cost scenarios turn out to be less environmental favourable or less convenient.

A Strategic Environmental Assessment (SEA) is an approach to incorporating environmental considerations in the development of plans and programs. It can also be regarded as a decision support process, especially when applied to the development of a plan. Details on SEA are defined

under the Directive 2001/42/EC, which must be implemented by the Member States by July 2004. Participation is an essential element of the SEA process. Besides that, participatory processes have been established with the directive 2003/35/EC, the public access information directive 2003/4/EG and with the methodology of Sustainability Impact Assessment [Kirkpatrick and Lee, 1999].

SEA for waste management up until now has been conducted on a voluntary basis in only a few cases [<http://europa.eu.int/comm/environment/eia/sea-studies-and-reports/sea-case-studies.htm>]. This case study provides an overview of the SEA for waste management in the province of Salzburg, Austria. The process took place in 2003.

## 2 SEA CASE STUDY

### Initial position

In the province of Salzburg, a mainly rural region in Austria with approximately 500,000 inhabitants, a new plan for municipal waste management needed to be developed. This plan had to determine the goals and implementation of waste management for the future. To enable a broad technical and public discussion, a SEA was started in January 2003. The possible consequences for

the environment, society and economy needed to be taken into account during this process. An SEA can be applied to already formulated plans and programs as well as to plans and program in the preparatory phase. In the case of Salzburg, the SEA process was applied while the waste management plan was under development. Thus the environmental report from the SEA will serve as a basis to formulate the waste management plan.

## 2.1 Description of SEA procedure

With the use of a participatory process it should be ensured that different interests are used to build up synergies as well as partnerships and hence find sustainable solutions as a conjoint decision [Büchl-Krammerstätter, 2003]. Participation expands the programme information and it should help to clarify and stabilise communication and power relationship between stakeholders. As the decision, which stakeholders are included in the process as well as the kind of participation are critical points [Kapoor, 2000] all relevant stakeholders in all decision-making phases were included with equal say.

All the affected parties (Table 1) and two expert teams were involved throughout the process. One of the expert teams developed the waste management scenarios and conducted the LCA modelling, while the other expert team concentrated on the assessment. After defining the work program of the process, all major decisions (e.g. framework, selection of criteria and scenarios) had to be taken by a majority of the project team. Main tasks of the core group were to prepare the process, to prepare and guide the workshops and to prepare the environmental report. Tasks of the project group were to discuss and agree on the rules for the workshops, to discuss and agree to the chosen methodology and assessment criteria, to discuss preliminary results and to discuss and agree on the final results, laid down in the environmental report.

The aim of the process was to pinpoint the pros and cons of the different scenarios rather than identify the “best solution.” As described by Finnveden et al., [2003], an SEA can have the function of supporting a choice between two or among several alternatives or of identifying the critical aspects of studied alternatives. Here the latter was the case and the final decision about the future strategy will be taken by the government of the province of Salzburg.

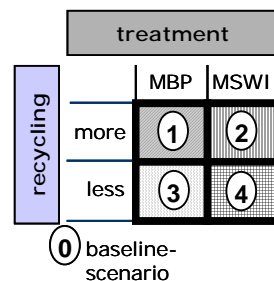
The SEA was divided into five main steps, which were each addressed in a workshop. In the first

step the scope of the SEA was defined and general rules as well as a code of behaviour for the following process were outlined. Definitions for the time and the spatial horizon were established. The waste streams to be considered for or excluded from the analysis were listed.

organisation	no of delegates	core group	project team
Provincial gouvernement	1	x	x
Provincial administration	7	x	x
Austria federal ministry of agriculture and forestry, environment and water management	2	x	x
Expert teams (researchers)	8	x	x
Federation of Austrian Industry	1		x
Economic chamber of Salzburg	1		x
Chamber of labour	1		x
Environmental ombudsman	1		x
Municipalities	7		x
Moderator	1		x

**Table 1:** participants and their representation

In a second step methodologies for the definition and selection of scenarios and for the assessment criteria were defined. For each waste stream (such as waste paper, biogenic waste, residual waste etc.), the different options were considered for collection, recycling and treatment. Figure 1 illustrates an array showing four basic scenarios (1-4), supplemented by the baseline scenario 0, built by combining more or less recycling of recyclables (like waste paper or glass) with treatment options (MBP, MSWI) for waste types like residual waste. After listing up the options by the expert teams for each of the waste streams, in close co-operation with the project team, final options were selected and assigned to the scenarios as a common decision of all parties. Thus in this context, a scenario means a combination of options for the single waste streams, including the effects on other waste streams. Here, discussions in small groups pointed out to be a very useful method. Eight scenarios were ultimately developed (step 3).



MBP: mechanical biological pre-treatment

MSWI: municipal solid waste incinerator

**Figure 1.** General framework for scenarios

Additionally, a baseline scenario was defined to represent the status quo but included a prognosis for the waste quantities in 2012.

In adjustment with the environmental authorities and based on a decision of the project team in a workshop different subjects of protection were determined. The criteria selection (step 4) and the choice of judgment criteria is variable. Individuals may differ greatly, and they may also (unknowingly) be redundant. The choice of judgement criteria and their relative weight in assessing alternatives can be delicate. Feedback in the criteria selection process is both balancing and reinforcing [Nandalal and Simonovic, 2002]. As the choice of criteria should be acceptable to all participants [Balcomb and Curtner, 2000] the whole project team was involved in this process. To identify the criteria and indicators relevant to the assessment, a as complete as possible list of potential impacts was worked out by the expert group, which could be activated by a waste management measure and which have a potential impact to the defined subjects of protection. This list was presented to the project team and a choice was taken. The subjects of protection as well as the possible environmental, social and economic impacts of different waste management procedures were afterwards merged into a so-called "relevance matrix". For each array in this matrix, the relevance of the environmental impact to the affected area of protection was screened. The arrays in which a real impact was detected on the subject of protection provided the building blocks for the rating matrix shown in Figure 2. If available, quantitative indicators (like GWP, AP, etc.) were used. In some parts it was necessary to resort to qualitative indicators. Some of the indicators were used in more than one category. For example, the amount of residues from waste treatment processes has influence both in the category "environmental effects" as well as in "social effects".

Table 2 shows the selected criteria. For the environmental effects, impact categories were mainly used from the LCA modelling (like HTP, EP, AP, GWP etc.). Quantity and quality of residues from waste treatment processes were used as an indicator for environmental effects of final storage. Additional indicators such as traffic flow (from waste transport), hazardous incidents and land use were used on a qualitative basis. Indicators like traffic flow could also have been used on a quantitative basis. But our previous research [Salhofer et al., 2003], [Wassermann 2003] showed, that it needs a somewhat detailed approach to model the traffic flow from waste transport. Regarding the available time and

resources, traffic flow was reduced to a qualitative (non quantified) indicator, whereby more recycling is related to more traffic and vice versa.

For the economic effects, we calculated the cost effects for the waste producers. Regional added value and synergy effects were included only qualitatively. Again, this was due to the time and financial restraints in the process.

For the social effects, almost no additional quantitative indicators could be used. Typical criteria -- odour, noise or user convenience -- were described and assessed on a qualitative basis. Here residues were used as indicator for landfill volume (influence on landscape) and autarky (are adequate disposal facilities available in the region?).

**Table 2:** Selected criteria by category (simplified)

Category	Quantitative criteria	Qualitative criteria
environmental effects	HTP, TETP, AETP, AP, EP, POCP, GWP, residues	traffic flow, hazardous incidents, land use
economic effects	cost effects for waste producers	regional added value, synergy effects (treatment sites)
social effects	residues, cost for waste producers	appearance, traffic flow, regional jobs provided, odour, noise, convenience, autarky

HTP ... human toxicity potential, TETP ... terrestrial ecotoxicity potential, AETP ... aquatic ecotoxicity potential, AP ... acidification potential, EP ... eutrophication potential, POCP ... photochemical ozone creation potentials, GWP ... greenhouse warming potential

After identifying the criteria, the expert teams conducted the assessment of the eight scenarios (step 5). For each array, a comparison was made with the baseline scenario. For the quantitative criteria, a range of  $\pm 10\%$  was considered neutral, while a larger difference was assessed as positive (+) or negative (-). Single criteria, which were considered as very sensible, lower threshold values were used. These cases were discussed and decided by the project team. For the qualitative criteria, a comparison was made with the baseline scenario based on arguments documented in the environmental report [Koblmüller et al., 2004].

The assets and drawbacks of each scenario should be shown in a traceable and understandable way. In most multi-criteria methods, the relative importance of criteria is made more precise by some numerical weighting. Although there are a lot of more or less objective possibilities for multi-criteria weighting within the single categories as

well as between the categories like normalisation, ABC-Method, AHP-Method, CBA and others [Saaty, 1980, Al-Kloub, 1996, Roy, 1990], in this case it seems rather difficult to evaluate among various criteria for the following reasons.

For weighting it is necessary to translate different quantitative as well as qualitative criteria in uniform quantitative terms. The chosen methodology and the often subjective determined importance of each weight will show the priority set into environmental, social and economic categories as well into the indicators itself by the responsible persons. This subjective preferences mostly depend on the decisions makers. However, each of the objectives is not necessarily equally important to different decision makers [Chambal et al., 2003]. The specific situation in Salzburg, where the SEA took place, of upcoming elections where a political change of the persons in charge

was expected, led to the decision to abandon any weighting.

Therefore it was decided to create a rating matrix for each scenario as shown in Figure 2. This allows the user to recognise the advantages and disadvantages of each scenario without a preference for one scenario as the best or worst solution. A description of the process, the assumptions made, the scenarios and the assessment results were documented in the draft environmental report. To conclude the environmental report, comments from the participants in the process are being worked out now. After this the final environmental report will be published. After that the governmental authorities will utilise the environmental report as a basis to formulate the final waste management plan.

impact of waste management measures			air pollution	liquid pollutant emission	noise	residues	traffic	utilisation of resources	sensitivity of WMS	costs	
Factors/Objectives											
environment	human beings	human health, well-being	+	-	+/-		+		+/-		
	flora, fauna	habitats, biodiversity	+/-	+/-			+		+/-		
	environment	soil		+/-			+/-				
		water		+/-	+/-						
		air		-				+	+/-		
		climate		-				+	+/-		
	resources	raw materials							+/-		
		surface area					+/-				
	ec	economy	waste producer								+
			national economy	+/-			+/-			-	
society	society	utilisation interests	+/-		+/-	+/-	+		+/-		
		landscape and cultural heritage				+/-					
		disposal autarky				+/-			+/-		
		job provision									
		convenience	+/-		+/-				+/-	+	
		local / regional practicability	+/-		+/-	+/-	+			+	

WMS: waste management system

Figure 2. Example of the rating matrix for one specific scenario (simplified).

### 3 CRITICAL POINTS

During the process several critical points occurred, which will be discussed in the following.

#### 3.1 Selection of criteria

The chosen set of criteria can be classified by their degree of quantification. In detail they are:

- quantitative criteria such as HTP, GWP etc., as generally used in LCA modelling

- qualitative, but figure-based criteria, such as waste transport-related traffic, noise or job effects and
- qualitative, non figure-based criteria, such as synergy effects, autarky and availability of facilities.

Additionally, the criteria vary in their site specifics and spatial dimension:

- local effects are covered by criteria such as land use, noise, residues, regional added value, regional job provision etc. while
- global effects are covered by GWP, HTP, AP etc.

As this list shows, qualitative criteria are used mainly for local effects, while for global effects quantitative indicators are used. The main reason for that is the choice of an LCA approach for the quantitative indicators, which commonly addresses more the global effects. For the qualitative indicators, the local conditions were respected more, but at the same time the analysis was much less detailed. For example, odour and noise were regarded only at the basis of a simple classification (more composting triggers more odour, more recycling causes more noise etc.) In summary, the selection of the indicators reflects the conflicting approaches of the involved parties in the process. While the members of the expert teams were more interested in scientifically acknowledged indicators, the other participants (industry, municipalities,...) placed more emphasis on criteria that reflected current discussions taking place in society (eg. traffic problems) and were more relevant to regional politics.

### 3.2 Method of assessment

After defining the criteria for assessment, the next important step is to decide whether to weight the criteria.

For the LCA-based environmental criteria, proper assessment methods are available. Two different methods can be distinguished: problem-oriented methods [Guinée et al., 2001] and damage-oriented methods [Goedkoop et al., 2000]. Damage-oriented methods allow for the aggregation between impact categories in terms of common factors. Problem-oriented methods such as CML aim to simplify the complexity of hundreds of mass flows into a few environmental areas of interest. Here the aggregation of results is possible through normalisation or other approaches like the Swiss Eco-factors 1997 [BUWAL, 1998] where the aggregation to one single value is possible.

For the economic effects, a macroeconomic approach is possible but includes practical obstacles, e.g. the regional breakdown of data, the estimation of the regional effects of investments etc.

For social criteria, the aggregation of criteria is possible based on methods such as a value benefit analysis or multi-criteria assessment approaches [Noble, 2004].

Environmental and economic effects can be integrated with a cost benefit analysis. Limitations include the difficulty of estimating the monetary

value of the environmental impacts [cf. Fatta and Moll, 2003] which can lead to an overestimation of economic effects and an underestimation of environmental effects.

A weighting for all the criteria in the selected categories of environment, economy and society is also possible with the use of multi-criteria analysis.

In this study as indicated before no weighting took place. As a consequence, an assessment result was obtained for each criterion and field. This led to a large number of single results, for which it was difficult to make an overview and summary. In particular, there were problems with communicating such a large number of results to all the participants in the meeting.

### 3.3 Result representation and interpretation

After assessing the scenarios, it is necessary to interpret and represent the results in a non-technical self-explanatory form. Especially in our case, where a mixture of quantitative and qualitative assessment methods was chosen, problems occurred during this step. It was decided to provide the results of the analysis in the qualitative way shown in Figure 2. For the qualitative indicators this was quite easy. However, for the quantitative indicators the classification of the results into “positive”, “neutral” and “negative” compared with the baseline scenario became a critical point. This part of the evaluation involved forming a judgement on whether or not a predicted effect will be environmentally significant.

Although different methods for solving this problem are known (like normalisation), it was decided to use threshold values. The chosen method meant that the relative differences between scenarios could be large, while the absolute effects is on a very low level. This led to discussions about the height of the threshold values. The relative importance and magnitude of the results for each system in comparison to a reference system could provide more robust results but in the end it is not as self-explanatory and requires additional time and effort.

## 4 CONCLUSIONS

In our case study, the gap between the requirements of the participatory process and a more scientific approach turned out to be the major stumbling block. Participants from local

authorities, industry etc. take a more practical approach (which is helpful in analysing the local situation and circumstances in detail) but have little interest in methodology. In this case agreements on the selected methods were made at an early stage without long discussions. Participation intensified once the initial results were visible. In that stage, some of the participants tried to influence the selection of criteria and modify the assessment method, thus influencing the result.

Summarising, the process of strategic environmental assessment turned out to be helpful, to identify pros and cons of the scenarios analysed, although not all questions could be addressed in a scientific sound way.

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