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Strategic environmental assessment as an approach to assess waste management systems. Experiences from an Austrian case study

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Abstract

Waste management has evolved from the simple transportation of waste to landfills to complex systems, including waste prevention and waste recycling as well as several waste treatment and landfill technologies. To assess the environmental, economical and social effects of waste management systems, several tools have been developed. Strategic Environmental Assessment (SEA) is an approach for integrated assessment enhancing involvement in the planning of a decision supporting process. The aim of this paper is to show how SEA can be applied in a waste management context. For this purpose a case study is described where a SEA process was undertaken to develop a regional waste management plan. The approach from this case study is compared to other methods.

Keywords: Waste management; Strategic environmental assessment; Life cycle assessment; Participation

1. Complexity in waste management

1.1. Development of waste management systems

Waste management has evolved from the simple transportation of waste out of settlement areas to more complex systems including recycling and prevention of waste. Until the 1960s municipal waste management was concentrated on the collection and transportation of waste without any separation from households to the disposal facilities, which in the majority of cases were local dumps or landfills. Processes were planned or optimised merely on the basis of efficiency in terms of costs. Environmental effects were only marginally taken into account. In a second phase, waste treatment and landfilling technologies were improved. This was triggered by the considerable environmental damage caused by dumps and landfills, by increasing quantities of household waste and changes in composition. Typical improvements were represented by the development of flue gas scrubbing technology for MSWI (municipal solid waste incinerators), the installation of base liner systems in landfills to collect sewage, etc. Additionally, research on waste recovery and recycling was stimulated by the energy crisis. For the first time therefore the aspect of waste as a resource was taken into consideration.

Complex waste management systems in industrialised countries were first introduced and further developed from the 1980s onward. These include source separation of recyclables and hazardous waste as well as facilities for recycling and composting. Specific treatment technologies for several types of waste were introduced, together with advanced landfill technology whereby barrier systems were applied in order to reduce sewage and landfill gas. Over recent years, waste strategies have been supplemented by product related regulation, e.g. the EU has passed regulations on packaging, end-of-life vehicles and electrical and electronic equipment, rendering the producer responsible for the entire life cycle of products.

Currently applied waste management systems are somewhat complex, for example in some Austrian regions up to 15 different types of waste are collected separately and transferred to different recycling and treatment facilities. From

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a citizen's point of view waste disposal has become expensive, requires additional space in the household and is time consuming. It is not really surprising that some authors, e.g. Kaimer and Schade (2002), argue in favour of a regression, once again making waste collection systems simpler and more convenient for the citizen. Overall it has become a rather sophisticated task to forecast the consequences of waste management strategies in their environmental, economic and social aspects.

1.2. Assessment of waste management systems

As a result of the increasing complexity of waste management, adequate computerised assessment tools have been developed. A first generation of models was developed in the 1970s, analysing practical aspects such as the routing of collection vehicles or location of disposal facilities. The cost issue for these models was the main decision variable.

In a second generation of models developed in the 1980s, environmental aspects were included. Björklund (2000) describes three types of model. One type of models analyses different recycling schemes, e.g. Barlishen and Baetz (1996) in terms of cost minimisation, while environmental benefits or drawbacks of recycling are not considered. A second type of model analyses the costs of technical solutions that meet the environmental constraints, e.g. Chang et al. (1996). A third type explicitly calculates environmental parameters, aiming at optimisation, scenario analysis or multi-criteria analysis.

In the 1990s, a third generation of life cycle assessment (LCA)-based models were developed and applied. The more widely acknowledged models are WISARD (Waste Integrated Systems Assessment for Recovery and Disposal), cf. Aumonier and Coleman (1997), IWM (Integrated Waste Management), cf. White et al. (1999) or the Swedish ORWARE model, e.g. Björklund et al. (1999). Typical results from these models pertain to environmental effects in 5 to 10 impact categories. In some cases, the single indicators are weighted, whilst in others this does not occur.

The increasing demand for types of models which combine environmental, economic and further aspects (like social, technological aspects) has led to the development of a latest generation of computerised models, which are similar to the LCA-based models, but include additional cost effects and/or social effects. In this case, cost effects can be regarded as an additional impact category. Examples of this type of models are GABI and Umberto, well known computerised tools especially in the German speaking community. The IWM-2 model, cf. McDougall et al. (2001) is an expansion of the IWM model. Both concentrate on Waste Management, whereas GABI and Umberto can also be applied to other LCA issues beyond that of Waste Management. A comparison of these models has been reported by Unger and Wassermann (2003).

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 met by one single scenario. It is increasingly likely that a scenario in which high costs are linked with high environmental standards and high convenience will be involved, whereas low-cost scenarios prove to be less environmentally friendly or less convenient.

1.3. SEA in waste management

With regard to waste management, the opposite interest groups are often rather relentless. Representatives from municipalities, who prefer technical solutions, are in conflict with representatives from citizen's groups or ecologically oriented NGOs who prefer waste prevention and recycling as solution strategies. Furthermore, as a general rule residents tend to object to the planning and construction of waste management facilities. A participatory process may be of help in reducing these problems in a planning process from the very beginning and contribute towards defining acceptable solutions for all parties involved.

A Strategic Environmental Assessment (SEA) is a general approach to incorporating environmental considerations in the development of plans and programs. A commonly used definition of SEA is: *''a systematic process for evaluating the environmental consequences of a proposed policy, plan or program initiative in order to ensure they are fully included and appropriately addressed at the earliest appropriate stage of decision-making on par with economic and social considerations''* (Sadler and Verheem, 1996, cited in Nilson et al., 2005). SEA can also be regarded as a decision support process, especially when applied to the development of a plan. This is the major difference to Environmental Impact Assessment, which deals with a single project and therefore is much more site specific. Details on SEA are defined under the Directive 2001/42/EC, which must be implemented by the Member States by July 2004. As a consequence, a SEA process will be mandatory for waste management plans in the future.

Compared to other methods of decision support like traditional life cycle assessment, SEA represents an approach for integrated assessment at a strategic level. For details on aspects of integration see Bond et al. (2001). Participation is an essential element of the SEA process. Furthermore, participatory processes have been established by the directive 2003/35/EC, the public access information directive 2003/4/EG and by the methodology of Sustainability Impact Assessment, cf. Kirkpatrick and Lee (1999a,b). The latter was developed to make a broad assessment of the potential impacts. The assessment process contains four main stages, including a screening (to determine which measures have a significant impact and require SIA), a scoping (to establish an appropriate coverage of each SIA), a preliminary sustainability assessment (to identify significant effects) and a mitigation and enhancement analysis to suggest types of improvements (Kirkpatrick and Lee, 1999a,b).

As SEA is a relatively new approach, the process design is not homogeneous. Finnveden et al. (2003) identified the following steps in the process:

- definition of objectives,
- formulation of alternatives,