SYSTEMATIC EVALUATION OF CRITICAL FACTORS FOR THE CLIMATE IMPACT OF LANDFILL MINING

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In Europe several hundreds of thousands of old landfills exist, which are associated with long-term environmental impacts, extensive aftercare periods, and land-use restrictions potentially interfering with regional development plans. The potential of landfill mining for mitigating environmental pollution and valorising deposited wastes via material and energy recovery was investigated in various studies addressing ecologic and/or economic implications of landfill mining. With respect to global warming, some studies identified landfill mining as a net contributor, while others indicated that landfill mining results in a lower climate impact compared to the do-nothing alternative. Although all of these studies state that the actual environmental performance of landfill mining depends on various case-specific factors, so far a systematic assessment of the importance of individual factors for the environmental impact of landfill mining is missing. This research gap is addressed by the present study, which aims to quantitatively assess the importance of specific factors and conditions for the contribution of landfill mining to global warming. Therefore, we identify site-specific factors, project settings and system conditions, which are potentially relevant for the climate impact of a landfill mining project (cf. Figure 1). Based on the investigation of the influence of these factors, settings, and conditions, respectively, on a landfill mining's contribution to global warming, we discuss the practical implications of our findings in terms of strategies and measures for implementation of landfill mining.

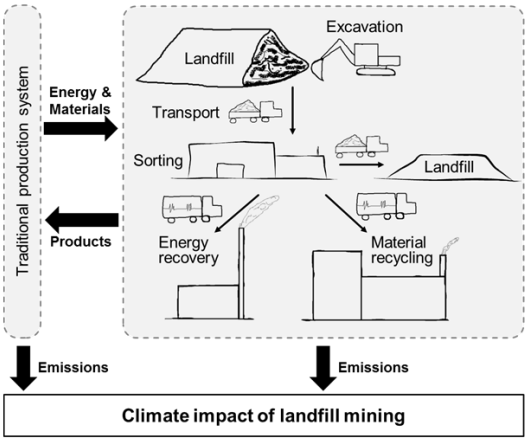

FIGURE 1 – SCHEMATIC ILLUSTRATION OF MAJOR PROCESSES RELATED TO LANDFILL

Based on existing evaluations of the environmental performance of landfill mining, eight factors are identified. Two or three data sets are defined for each factor to reflect a wide range of different circumstances and situations relevant for landfill mining projects. These datasets together with several constant input parameters form the input to the life cycle assessment model, which is used to calculate the contribution of a specific landfill mining scenario to global warming. Because there are six factors with three alternative sets and two factors with two alternatives, 2916 unique combinations (=scenarios) are possible. The scenario results represent the possible range of global warming contributions for landfill mining projects under different conditions. Consequently, the variation of the scenario results related to the choice of alternative data sets of a factor are used to investigate the importance of this factor for the climate impact of landfill mining. Apart from variance decomposition based on all the scenario results, the effect of varying parameters on the variation of single scenario results is also investigated using regression analysis. The analysis of all scenario results shows that on average landfill mining leads to a small net saving of greenhouse gas emissions. However, the actual impact of a project is largely dependent on project-specific factors and conditions. Most importantly on the reference scenario (i.e. the do nothing alternative to landfill mining), because the highest savings can be achieved for scenarios where the reference case would be associated with high greenhouse gas emissions due to significant landfill gas (LFG) potentials (i.e. younger landfills) and poor LFG management (i.e. low LFG collection rates). Therefore, from a climate perspective, strategies for enhanced landfill mining should focus on relatively young landfills with a relatively high content of organic waste and currently poor LFG management practices. The landfill mining project should be implemented using advanced material sorting technologies to maximize metals recycling and energy recovery from waste and the recovered energy should be fed into energy systems which still rely to a large degree on fossil fuels.