

ENHANCED LANDFILL MINING, CONCEPT AND CHALLENGES

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Enhanced landfill mining (ELFM) is an emerging concept that connects the vision of circular economy with the need to use land more effectively and for purposes that contribute to sustainable development. It bears on the fact that Europe holds more than 500,000 landfills of which the majority is non-sanitary municipal solid waste landfills, lacking modern environmental technology. Beyond that these poorly equipped deposits generate local, regional and global environmental impacts as well as drosscapes of urban land, they contain massive amounts of obsolete materials that could be brought back to use in society.

To prevent unwanted environmental and health effects, many of these old landfills will sooner or later need extensive remediation and aftercare. So far, however, Europe does not have any coherent strategy for their future management. The EU Landfill Directive, for instance, has no bearing on their management as most of them predate its enforcement. In many countries, the available public funding for taking care of such old landfills is also insufficient making any kind of future remediation effort financially challenging and unattractive.

For a share of these landfills, ELFM could offer a more sustainable management option. The potential of this emerging concept lies in its integrated approach, where remediation is combined with the excavation, processing and recovery of the deposited waste. In essence, such a strategy could reduce the cost for remediation of malfunctioning landfills, reclaim valuable urban

land and recover significant amounts of dormant materials and energy carriers. To this end, ELFM embraces the use of innovative technologies to transform and upcycle the extracted resources to high-value commodities such as metals, syngas, fuel-grade H₂ and low-carbon building materials.

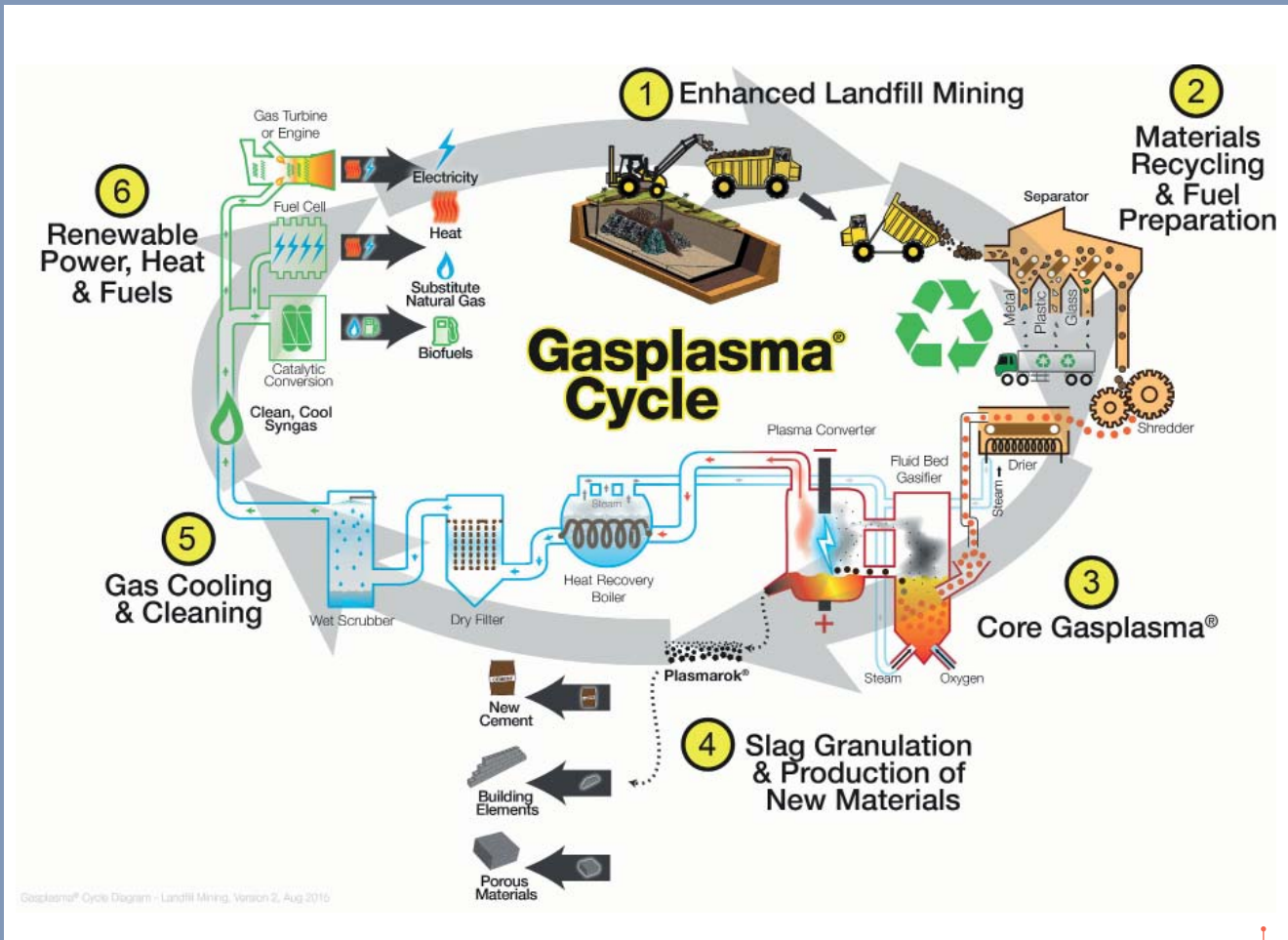
Although ELFM displays a high societal potential, there is a lack of real-life projects validating the sustainability consequences and feasibility of the concept. The so far most concerted efforts are the Closing-the-Circle project in Belgium¹ and the “NEW-MINE” Training Network². NEW-MINE involved 15 early-stage researchers working on technological innovations along the whole value chain of ELFM and multi-criteria assessments for evaluating the sustainability consequences of such yet unconventional projects.

The findings from these early-stage initiatives are promising but also point at several challenges that need to be addressed to facilitate the further development of ELFM. When it comes to the technical feasibility of resource recovery, for instance, it has been demonstrated that it is possible to upcycle and produce high-quality commodities from deposited waste in laboratory scale. However, further investments are needed to improve the technology-readiness-level of these processes before we know what high-value and marketable commodities can be recovered on an industrial scale.

Recent assessments show that developing cost-efficient and sustainable ELFM projects is indeed challenging. It is possible, but it relies on a strategic selection of suitable landfills for mining, carefully tailored project set-ups and in most cases also altered policy and market conditions. Cost-efficiency is particularly difficult to obtain, where most markets involve a low demand and willingness to pay for secondary resources.

¹ <https://machiels.com/en/division/europe/environmental-services/landfill-mining-solutions/>

² <https://new-mine.eu/>



A schematic illustration of the ELFM concept

This means that resource recovery alone cannot motivate ELFM financially, but other tangible values also need to be created such as avoided costs for extensive landfill remediation or revenues from reclamation of highly valuable urban land.

As for other sustainability-driven innovations, the further development of ELFM relies on a clear political support as current market conditions are simply not adjusted for such unconventional practices. Several potential policies to decrease

investment risks for industrial actors and improve the economic and environmental performance and public acceptance of such projects have also been highlighted in research. However, before political support can be considered, the concept of ELFM needs to be officially recognized, and for this to happen, the level of knowledge in the field needs to progress. Beyond small-scale trials, it is time to demonstrate that there is a real interest in implementing these practices on a large scale.