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Life Cycle Assessment (LCA) of a Metal Scrap Shredder Facility

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INTRODUCTION & AIM

Metal scrap recycling plays a role in the circular economy, reducing reliance on primary metal production, which uses more energy; recycled metal requires only 5% of the energy. Mechanical sorting at shredder facilities recovers ferrous and non-ferrous metals from mixed scrap, conserving resources. To achieve circular economy objectives, the waste (SR) from these processes needs to be recovered. SR, a mix of metals, plastics, rubber, and other materials, poses a challenge in achieving a circular economy in scrap recycling. The sustainability of scrap recycling depends not only on metal recovery but also on alternative SR treatment. This study applies LCA to assess the environmental performance of mechanical sorting.

METHOD

LCA was performed on a shredder facility processing 7 kt annually. Using SimaPro (version 10.2.0.1) with the CML-IA Baseline method and a 1-tonne functional unit, system boundaries included energy, emissions, and waste treatment, with recycling credits for avoided virgin production. Four scenarios were modelled: (S1) metal recovered, residues landfilled; (S2) metal and plastic recovered, remaining residues landfilled; (S3) metal recovered, residue incinerated; (S4) metal and plastic recovered, residue incinerated for energy.

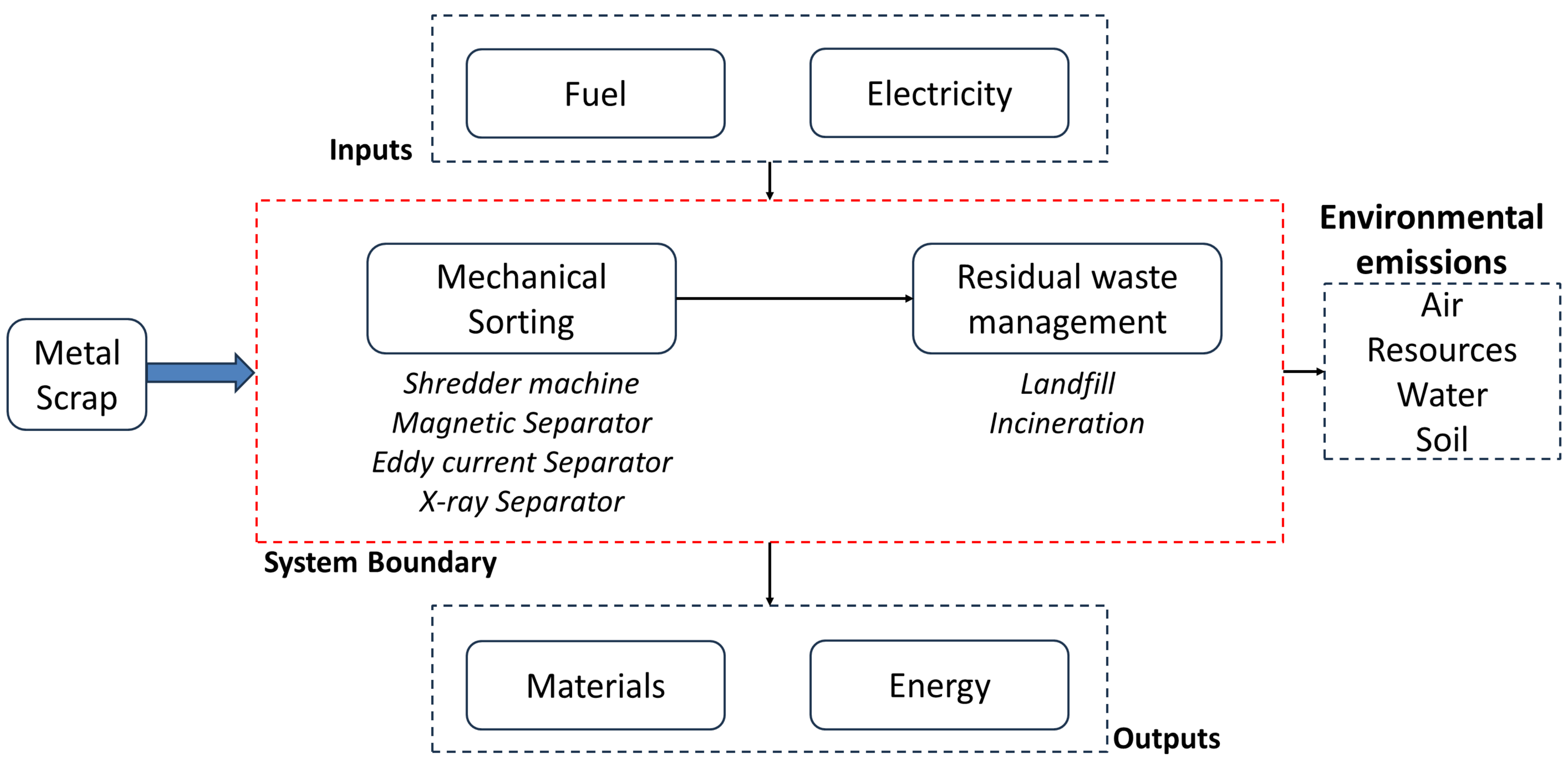

Figure 1.: System Boundary

RESULTS & DISCUSSION

Metal recovery greatly reduces the environmental impacts of sorting, and the scenarios showed clear differences across the indicators. For Global Warming Potential, S1 had the highest impact at 13.4 kg CO2-eq, while S4 performed best at -16.5 kg CO2-eq due to avoided virgin production and energy substitution. The Human Toxicity indicator followed the same trend, with S1 showing the highest impact at -16.1 kg 1,4DBeq and S4 the lowest at -19.3 kg 1,4DB-eq. Acidification showed the best performance in S2 at -0.11 kg SO2-eq and the highest impact in S3 at -0.09 kg SO2-eq. For Fossil Fuel Depletion, S2 performed best at -167.8 MJ, while S3 showed the highest impact at -113.7 MJ. The study presented the characterization of these impact categories in Figure 2.

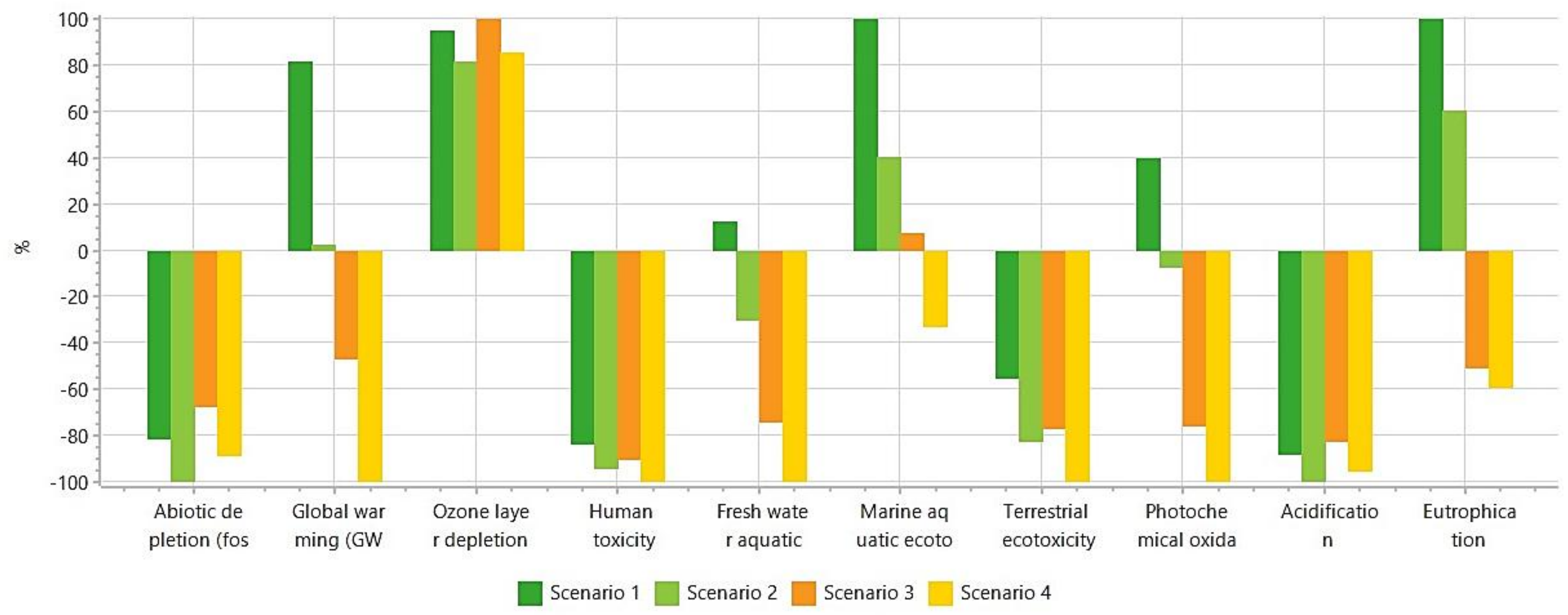

Figure 2.: Impact Categories

CONCLUSION

Optimizing sorting efficiency and managing residual fractions through material and energy recovery significantly enhances the environmental performance of the system. Key benefits include reducing landfill waste, conserving raw materials, and lowering emissions. The study confirms that the residue treatment option strongly influences overall sustainability.

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