

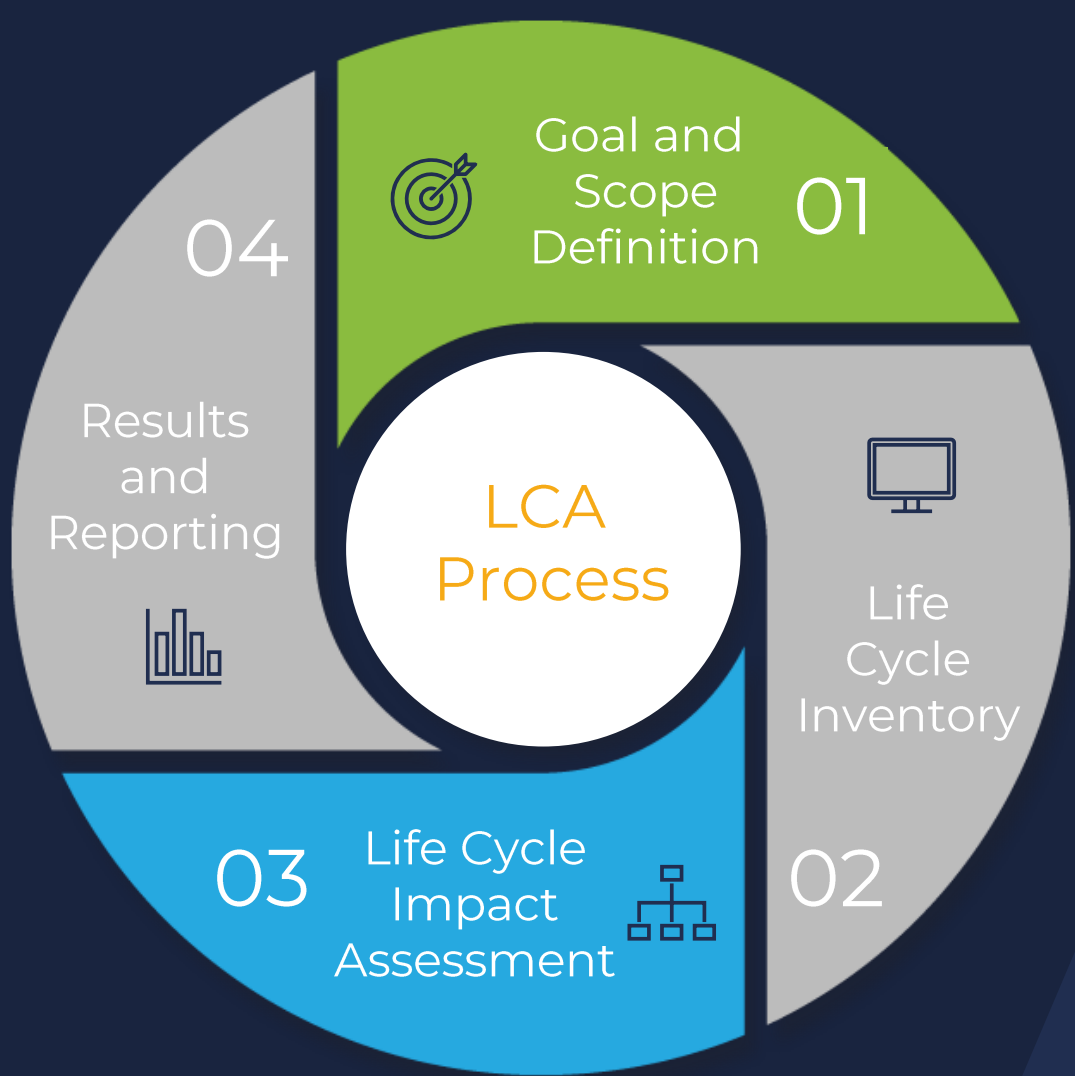
Environmental Impact Analysis of Municipal Waste Management in the City of Zadar: An LCA Approach

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Life-cycle assessment (LCA) methodology can give supports decision-making with scientific data and competence; it can be used for preliminary calculations of the contribution to global and environmental impacts as well as a qualitative screening of potential health and ecological impacts and waste management options.



Introduction

- **Municipal waste:** Significant environmental, public health, and quality-of-life impacts.
- **City of Zadar:** Urban-tourist area with seasonal pressure on waste management.
- **Study objective:** Assessment of environmental impacts using LCA IWM-EPIC/CSR.

Methods

- **LCA assessment:** Environmental impacts of the City of Zadar's municipal waste management system were assessed for five consecutive years (2020–2024) using LCA methodology and the IWM-EPIC/CSR software.
- **Scenario analysis:** Two alternative waste management scenarios (V1 and V2) were evaluated using 2024 waste data (ZD-2024), assuming reduced landfilling through improved waste treatment and recycling.
- **Comparison:** Environmental impacts and key system indicators were compared across five consecutive years and between the existing system and proposed scenarios, to identify opportunities for reducing waste generation, virgin material use, and environmental pressures.

Conclusions

- The existing waste management system is characterized by **low recycling and high landfilling rates**, resulting in significant environmental impacts.
- During **2020–2024**, increasing amounts of landfilled waste were accompanied by **higher energy consumption and emissions**, indicating continued dependence on landfilling.
- **The LCA results** confirm that both scenarios **V1 and V2** **reduce landfilled waste, GHG emissions and BOD** compared with the existing system. **V2 achieves the greatest overall environmental benefits.**
- The results highlight the need to **increase separate collection and recycling, expand biowaste composting, reduce landfilling, and modernize waste management infrastructure** to achieve a more sustainable system for the City of Zadar.

Results

- **Changes in municipal waste collection and separate collection rates in the City of Zadar** over the 20220–2024 period are presented in Figure 1.

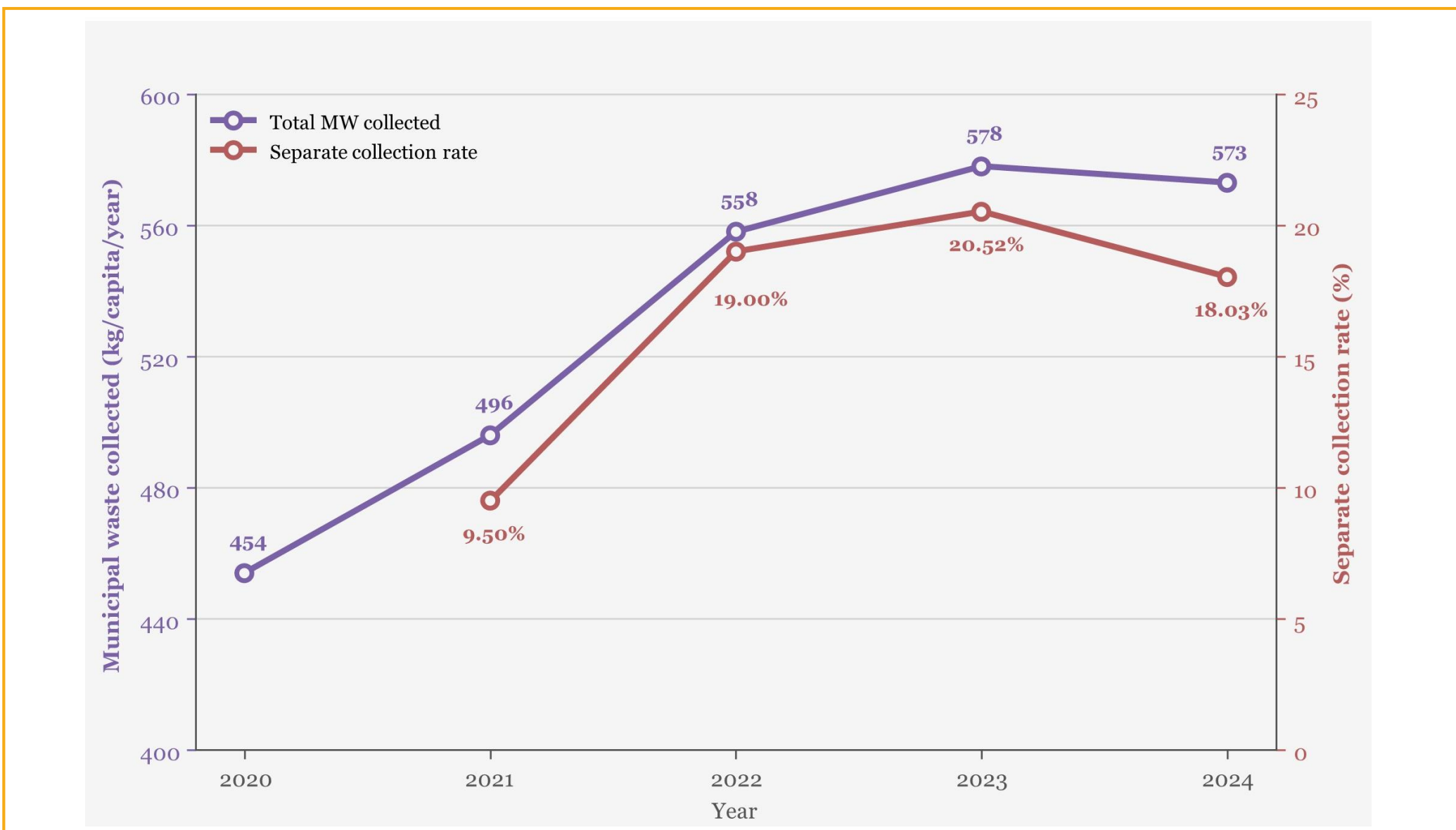


Figure 1. Trends in municipal waste collected per capita and separate collection rate in the City of Zadar, 2020–2024.

- **The LCA results**, visually synthesized through normalized radar profiling are shown in Fig. 2. **Environmental and energy performance comparison are normalized** against the baseline (ZD-2024 = 100%). The contraction of profiles toward the center indicates improved eco-efficiency, establishing **V2 as the optimal solution** due to its critical 55.8% reduction in energy demand and superior air emission mitigation.

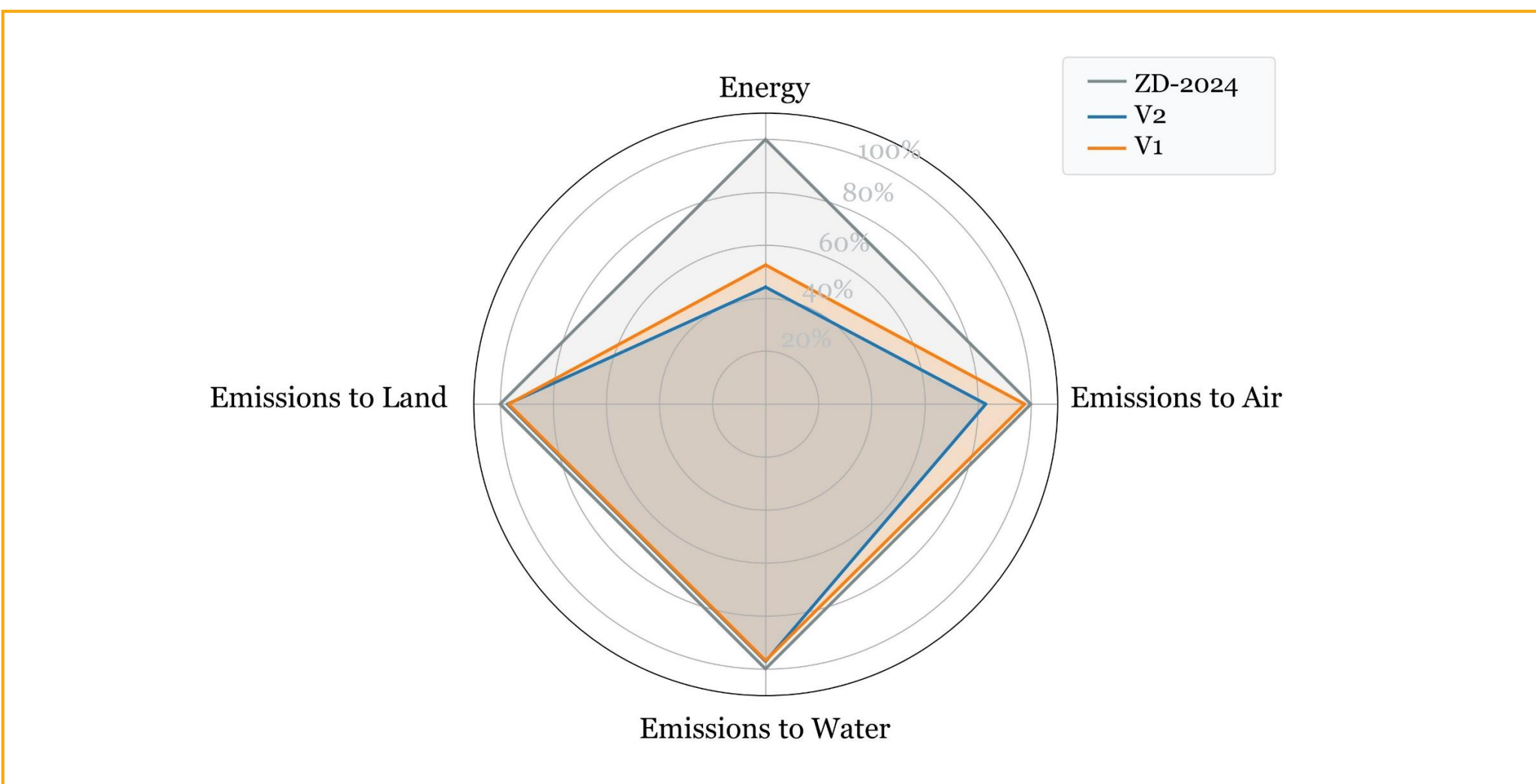


Figure 2. Comparative performance profile of V1 and V2 waste management systems of the City of Zadar against the baseline status (ZD-2024).