

## Science of the Total Environment

### Elevating Environmental Insight: Unveiling Machine Learning's Impact on Life Cycle Assessment

--Manuscript Draft--

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<b>Keywords:</b>	Life cycle assessment, Ecological footprint, Machine learning, Sustainability, Smart algorithms.
<b>Abstract:</b>	<p>The integration of machine learning (ML) with life cycle assessment (LCA) holds great promise for revolutionizing environmental analysis. LCA, a vital methodology for assessing the environmental impacts of products and processes, intersects with ML, a data-driven approach with predictive capabilities, to enhance the accuracy and efficiency of environmental assessments. LCA involves evaluating the entire life cycle of a product or process, while ML leverages data to identify patterns and make predictions. In LCA, ML can automate data collection, optimize the assessment process, and uncover hidden environmental trends. Current applications of ML in LCA include automating data entry and processing, optimizing assessments, identifying hotspots, and improving environmental footprint accuracy. However, challenges exist, such as data quality, model interpretability, and interdisciplinary expertise requirements. Ethical data use and accessibility of ML tools for LCA practitioners also need attention. In conclusion, the synergy between ML and LCA offers a path towards a sustainable future. To fully realize this potential, future research should refine ML models for specific LCA applications, foster interdisciplinary collaboration, and develop user-friendly tools. This convergence has the power to elevate our understanding of environmental impacts, facilitating informed and eco-conscious decision-making.</p>