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MUNICIPAL WASTEWATER BY-PRODUCTS UTILIZATION

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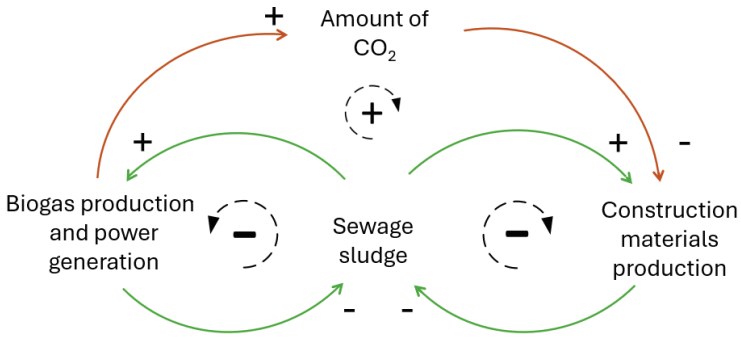
Abstract – The challenges of mitigating climate change today require innovative and sustainable solutions to reduce carbon dioxide (CO_2) emissions. Wastewater sludge, a byproduct of the wastewater treatment process, presents a valuable resource for contributing to emission reduction and the circular economy. This study analyzes the utilization of wastewater sludge with a dual-focus approach: biogas production as a short-term solution and the manufacturing of construction materials as a long-term strategy. Biogas generation provides an immediate method for energy recovery, reducing dependence on fossil fuels, while the use of sludge in cement and concrete production offers a sustainable alternative to energy-intensive traditional materials. The study evaluates the environmental and economic impacts of these methods, emphasizing their role in reducing CO_2 emissions and addressing issues such as waste accumulation and soil degradation. A system model is developed using *Stella Architect* to assess the feasibility and scalability of these approaches. The findings suggest that large-scale implementation of wastewater sludge utilization can play a crucial role in climate change mitigation and resource efficiency. However, further research is necessary to enhance technological advancements, optimize costs, and support broader global adoption.

Keywords – Bioeconomy; climate technologies; environmental solutions; sustainable municipalities; wastewater sludge



Causal loop diagram for sewage sludge management