

https://dspace.org/

Integrating energy from waste in rapidly urbanising African cities: a circular economy case for biogas initiatives

Mutezo, Gamuchirai

2021
https://hdl.handle.net/10539/32971

Downloaded from a DSpace repository. https://dspace.org/

ABSTRACT

African cities are rapidly urbanising, population growth is proliferating and so are waste generation and energy demand. Built environment practitioners play an imperative role in not only managing these proliferations within existing urban morphologies but ensuring a sustainable and efficient supply of services such as waste management and energy access. Considering demographic and waste generation proliferations as well as energy demand, this thesis sought to investigate whether anaerobic digestion technologies can be integrated into African cities for energy production. The work was underpinned by principles of a circular economy. The multi-disciplinary research covered three African metropolitan cities, namely Addis Ababa (Ethiopia), Accra (Ghana) and Johannesburg (South Africa). Mixed Methods Research methods were used, focusing on Concurrent Embedded Design. Quantitative approach comprised of secondary data on existing anaerobic digestion technologies while qualitative approach comprised of primary data collected through interviews with key-decision makers in metropolitan municipalities, using Purposive Sampling. Quantitative data was used to calculate whether anaerobic digestion is circular as a technology to determine its efficiency using urban waste, while qualitative data offered descriptive responses pertaining to factors that can encourage key decision-makers to nurture integration. Circular economic Values (CEV) were calculated for three cases and findings showed that value leaked along the energy generation process. Qualitative findings illustrated that lack of understanding and project synchronisation amongst urban planners, waste management and renewable energy decision-makers negatively impacted anaerobic digestion integration and waste value chain optimisation. Furthermore, urban planners' limited understanding of concepts such as Circular Economy, Anaerobic Digestion and Decentralised Energy play a role to intentionally plan energy access in cities. Findings were similar in each metro-municipality and differed based on unique elements of the city's current morphologies. The researcher's knowledge contribution is a conceptual Approach to Urban Energy Planning and an Urban Biogas Model which African metropolitan municipalities to use as guidance to identify value leakages. Study limitations include lack of recent or limited quantitative data across the disciplines, use of Mixed Method's Concurrent Embedded Design in the engineering and built environment and overall focus on African urban areas. Urban Energy Planning and Circular Economic Values for anaerobic digestion are emergent disciplines that present opportunities for further

research. In conclusion, a multidisciplinary approach to planning, designing and implementing Urban Biogas Systems in African cities is imperative. This study showed that it can improve access to decentralised energy and improve organic waste management in a circular manner.