

May 4, 2023

Investing in Waste-to-Energy Technologies to Meet Nigeria's Growing Waste Challenges

The following White Paper outlines the Columbia University Capstone team's key findings and recommendations concerning its academic research for the Nigeria Sovereign Investment Authority (NSIA) investment opportunities in waste management.

I. Scope

The research was conducted to help the NSIA identify and evaluate nationally relevant, scalable, and commercially viable Waste-to-Energy (WtE) investment opportunities via NSIA's National Infrastructure Fund (NIF). The team's work aims to address the growing waste challenges presented by Nigeria's rapid urbanization and existing inefficiencies around waste management. In addition to meeting NIF's criteria, such investments will address other areas of national importance, including energy access, climate change, and health.

II. Methodology

Our team conducted market research and stakeholder interviews with key waste management experts to understand: a) the **barriers** to an efficient and effective waste value chain in Nigeria, b) the **opportunities** for extracting value from waste, and c) the financial, technological, and regulatory **criteria** necessary for successful investments in such opportunities.

III. Key Findings

Our research yielded the following takeaways:

1. **Waste collection** - the first step in the waste value chain - is a complex challenge in Nigeria and places a **large burden on municipalities**. Public and private support is required to reduce this burden of waste collection and separation.
2. **Resource recovery and WtE** are **untapped opportunities** because of the lack of infrastructure investments, inadequate regulatory framework and government incentives, and a lack of prioritization of the use of waste as an alternative energy source. WtE is a strong solution to begin mitigating waste management issues and accelerating the clean energy transition.
3. **A case study of Morocco's adoption of WtE** demonstrates the **benefits of biogas technology**, whereby the potent methane produced from the anaerobic digestion of organic matter in landfills can be transformed into power for various offtakers. **Incineration** of Municipal Solid Waste (MSW), though suitable for large volumes of non-uniform waste, requires higher upfront investments and longer time horizons for

development.

IV. Recommendations

Based on our key findings around Nigeria's waste value chain and subsequent focus on WtE investment opportunities, we recommend the following action plan:

1. **Invest in a biogas pilot project:** Biogas is a strong intermediary solution for Nigeria's waste management and energy challenges. Biogas is a scalable solution that can help meet NSIA's climate targets, and act as a reliable, clean power source. To pilot a project, the NSIA should:
 - a. **Identify candidate landfills** and request an Expression of Interest (EOI) to conduct a pilot biogas project.
 - b. Undergo Carbon Vista and/or NSIA **due diligence processes** to fund the pilot project.
 - c. **Partner with** a) technology providers to develop and construct the facility, b) offtakers to buy the power, and c) third-party carbon credit verification and issuance organizations to generate credits from offset methane production.

2. **Conduct additional research around WtE combustion technology:** Waste combustion could provide a competitive power source and process a vast quantum of waste. However, evaluating the appropriate preconditions and feasibility of investing in and operating a combustion plant in Nigeria is still necessary. Beyond the team's initial technological research, the NSIA should:
 - a. Understand the **key determinants to Cambridge Industries' success** in developing a WtE combustion plant in Addis Ababa, Ethiopia.
 - b. Develop the **market and regulatory incentives** necessary for the economics for this plant to be financially feasible.
 - c. Identify stakeholders that will have **financial and technical buy-in** for a WtE combustion plant in Nigeria.