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Abstract

Waste-to-energy plants appear as an effective means of dealing with two problems of electricity access and waste management at once. In August 2018, the first waste-to-energy plant on the African continent was inaugurated in Addis Ababa. Today other sub-Saharan countries like Kenya are interested in developing waste-to-energy solutions. Could this be the beginning of a large scale deployment of this technology in sub-Saharan Africa? This policy brief describes the challenges posed by the increase of waste production and the low progress in electrifying the sub-continent. It also provides an assessment of the advantages and limits of waste-to-energy projects as a solution.

Challenge

With the expansion of modern production and consumption patterns to large African cities, population growth and urbanization, production of municipal waste has risen sharply. Unregulated dumps are becoming numerous and have strong negative health impacts by polluting the local environment. Mismanagement of waste fosters the proliferation of mosquitoes in the nearby urban areas. In recent years, the frequency of arbovirosis epidemics has increased. In addition, the degradation of waste in open dumps emits methane, a gas with a very high global warming potential.

Despite being endowed with abundant energy resources, sub-Saharan populations have the lowest electricity access rates in the world. Yet, electricity access has an important influence on the well-being of a population: it improves access to education, communication and quality health care. In the long run, poor access to energy and electricity services hampers development prospects. The weakness of sub-Saharan power grids represents a significant cost for national economies. Waste-to-energy plants appear as an effective mean of dealing with these two problems at once.

With urbanization, population growth and globalization, waste generation in Africa will increase significantly in the coming decades. It is a major health problem for the continent and could have significant negative consequences for other continents of the world and the environment. In parallel, access to electricity is a fundamental issue for economic development in Sub-Saharan Africa. Despite the region’s immense energy wealth, installed capacity remains far below levels required to meet demand. Given the climate urgency and in line with the recent pledge from the African Development Bank stopping coal financing, it is the responsibility of foreign governments and private stakeholders to propose alternative solutions to local governments to promote sustainable alternatives.

Proposal

I - The necessity to take emergency measures downstream of the waste sector

Introducing emergency measures to combat the harmful effects of waste generation in sub-Saharan Africa is of high importance. Most municipal waste is burned on site or dumped in uncontrolled landfills on the outskirts of cities or in semi-controlled landfills without adequate treatment[1]. Many landfill areas are chosen based on the immediate availability of the land on which they are located and not on objective criteria of pollution prevention[2]. This would require three main actions.

First, soil protection systems should be systematically put in place to prevent leachate from waste entering the soil. Prohibit the deposit of waste close to watercourses. Some landfills are located in sensitive areas, close to water reserves, without being provided with protective means which would prevent contamination. Thus, the leachate produced from the percolation of water or liquid through the waste can gradually infiltrate the soil and pollute the groundwater or nearby watercourses. Polluted water reservoirs then become a vector for the spread of disease with serious repercussions on the health of local residents.

Then, it would be wise to ban the incineration of waste in open spaces. Particularly in urban areas. The incineration of waste in open spaces has severe repercussions on local air quality. Incomplete and low-temperature combustion of the waste releases various particularly toxic substances such as dioxins and furans into the air. Respiratory infections in children are up to six times higher in urban areas where waste is not collected regularly[3].

Finally, given the low collection rate, priority should be given to collecting plastic waste similar to containers that allow insalubrious urban areas to proliferate mosquitoes. In the wild, mosquitoes reproduce by colonizing natural lodges filled with water where their number is naturally regulated by the presence of insectivorous predators. In urban areas, these predators are only present in small numbers and all containers of water are conducive to becoming artificial lodges. In slums and precarious neighbourhoods, residents do not have access to the water management service and are forced to store water in canisters to meet their needs. All these water reserves become potential artificial lodges which can be colonized by mosquitoes. Likewise, any uncollected waste that looks like a container can become a breeding ground once it is soaked with water.

II - The importance of a robust and holistic data waste collection system

Reliable and comprehensive data collection systems for waste composition at the local level are necessary. Before initiating an incineration project, it is necessary to have an in-depth knowledge of the composition and availability of waste at the local level. Consequently, it is essential to have reliable data collection systems on the composition of local waste over a long period of time in order to take into account their seasonal variation. This information is missing. Four different actions can be taken to address this issue.

First, it is important to collect data on the composition of waste at the local level. Collection levels are much lower than the level of waste production, with a gap strongly correlated with the level of income of the countries. In 2012, on average for the region, only 44% of the waste generated was collected, with significant differences: less than 24% of waste collected in Benin up to 96% in Mauritius[4]. Collection rates also differ between regions of a country, between cities and even, within cities, between different neighbourhoods.

[1] N. Scarlat et al., « Evaluation of energy potential of Municipal Solid Waste from African urban areas », Renewable and Sustainable Energy Reviews, october 2015.
[2] M. Coffey et A. Coad, « Collection of Municipal Solid Waste in Developing Countries », UN habitat, United Nations, 2010.
[3] « Solid Waste Management in the World's Cities: Water and Sanitation in the World's Cities », United Nations Human Settlements Programme, UN Habitat, United Nations, 2010.
[4] N. Scarlat et al., « Evaluation of energy potential of Municipal Solid Waste from African urban areas », Renewable and Sustainable Energy Reviews, octobre 2015.

Next, data must be collected on the average annual composition of the waste. The waste used as an energy source is very heterogeneous: paper does not burn like plastic, which does not burn like food waste. Each type of waste has its own calorific value. The calorific value corresponds to the thermal energy released during the combustion of one kilogram of material. The average calorific value of a heterogeneous set of municipal waste determines its combustibility, and therefore, the energy potential that can be extracted to produce electricity. This variable is not fixed, it tends to increase with the economic development of a country and the standard of living of its inhabitants[5]. When a country sees the disposable incomes of its inhabitants increase, their consumption patterns will change and the average consumption basket, therefore of waste produced, will evolve.

In addition, data must also be collected on waste composition flows. Like consumption, the composition of waste will not be the same depending on the time of year. It may change according to the seasons, and be influenced by local customs such as traditional festivals or holiday periods[6]. The number of annual precipitation is also an important factor. Precipitation does not directly affect the calorific value of the waste but its moisture content and therefore its combustibility. Humidity greatly reduces their incineration potential.

Finally, data on the influx of waste to landfills must also be put in place. In sub-Saharan Africa, the conditions that would allow continuous shipment of waste to the power plant are not always met. Added to the variability and the lack of data on the composition of the waste is the problem posed by a discontinuous influx of waste. If there is an interruption of waste influx to the plant, the operation of the plant can be interrupted.

III – Articulate waste management policies toward a more effective system and taking into account waste-to-energy's specific requirements

The implementation of incineration projects would be facilitated by sharing good practices for the development of incineration projects and more generally for the improvement of the waste management sector. Incineration is capable of reducing up to more than 90% of the initial volume of waste[7]. Considerably reducing the final mass of waste that will be buried. This makes it easier to find optimal landfills' sites, away from cities and water reservoirs. This lowers the costs of investments necessary for environmental protection such as those related to the installation of waterproof coatings on site, minerals or plastics, to waterproof the soils. Energy produced from waste could potentially replace power plants that use polluting fossil fuels and cope with the weak electricity generation capacity. Three main recommendations can be made.

First of all, it is necessary to set up development plans for the waste management sector more suited to incineration. From a financial point of view, the use of this technology to manage waste is not attractive, both in the waste management sector and in the electrical sector. The costs of incineration to treat waste are much higher than the costs of landfills, especially when the sector is underdeveloped and its organization is partly informal as is the case in Africa. In the electricity sector, the capital and operating costs of incineration are very high compared to other available technologies[8]. In addition, the risks of plant shutdown and additional costs linked to a discontinuous supply of waste are not negligible. This makes this type of project hardly viable from a financial point of view.

Waste must also be sorted to ensure that only those with the highest calorific values are incinerated. To increase the calorific value of waste, and improve the profitability of the plant, it may already be worthwhile to implement simple measures, such as separating organic waste from other waste at source. Organic waste can be used as compost, and the rest can be sent to the incineration plant. Separated from organic waste, the average calorific value of incinerated waste will increase,

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[5] D. Hoornweg et P. Bhada-Tata, « What a Waste: A Global Review Of Solid Waste. Management », Urban Development series knowledge papers, World Bank, march 2012.
[6] C. Ofori-Boateng, K.T. Lee et M. Mensah, « The Prospects Of Electricity Generation From Municipal Solid Waste (MSW) In Ghana: A Better Waste Management Option », Fuel Processing Technology, vol.110, juin 2013, & J. Marshal et al., « World Energy Resources: Waste to Energy », World Energy Council, 2016.
[7] D. Hoornweg et P. Bhada-Tata, « What a Waste: A Global Review Of Solid Waste. Management », Urban Development series knowledge papers, World Bank, march 2012.
[8] N. Menikpura, J. Sang-Arun et M. Bengtsson, « Assessment of environmental and economic performance of Waste-to-Energy in Thai cities », Renewable Energy, vol. 86, 2015.

improving the efficiency of waste-to-energy plants. In the short term, the interest of incineration projects in sub-Saharan Africa therefore does not necessarily lie in their financial profitability but in their capacity to promote the development of a more efficient waste management sector.

Finally, it would be necessary to optimize the collection of waste via collective containers. Despite the presence of collective containers in the city's districts, their number is insufficient. Too rarely emptied, they are often saturated and the waste piles up around[9]. Their low number lengthens the distance that households must travel to deposit their waste in the skips and therefore the arduousness of the task. The result is a proliferation of wild deposits in ditches, abandoned land, or on the edge of the numerous streams below the city.

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[9] A. Pierrat, « Les lieux de l’ordure de Dakar et d’Addis-Ababa : Territoires urbains et valorisation non institutionnelle des déchets dans deux capitales africaines », thèse pour l’obtention du doctorat en géographie, École doctorale de géographie de Paris, Université Paris 1.