

NAWTEC16-1928

LIFE CYCLE COMPARISON OF TWO OPTIONS FOR MSW MANAGEMENT IN PUERTO RICO: THERMAL TREATMENT VS. MODERN LANDFILLING

Giselle Balaguer-Dátiz
Earth Engineering Center
Columbia University in the City of New York

Nikhil Krishnan
Earth Engineering Center
Columbia University in the City of New York

ABSTRACT

The management of municipal solid wastes (MSW) in Puerto Rico is becoming increasingly challenging. In recent years, several of the older landfills have closed due to lack of compliance with federal landfill requirements. Puerto Rico is an island community and there is limited space for construction of new landfills. Furthermore, Puerto Rico residents generate more waste per capita than people living on the continental US. Thermal treatment, or waste to energy (WTE) technologies are therefore a promising option for MSW management.

It is critical to consider environmental impacts when making decisions related to MSW management. In this paper we quantify and compare the environmental implications of thermal treatment of MSW with modern landfilling for Puerto Rico from a life cycle perspective. The Caguas municipality is currently considering developing a thermal treatment plant. We compare this to an expansion of a landfill site in the Humacao municipality, which currently receives waste from Caguas.

The scope of our analysis includes a broad suite of activities associated with management of MSW. We include: (i) the transportation of MSW; (ii) the impacts of managing waste (e.g., landfill gas emissions and potential aqueous run-off with landfills; air emissions of metals, dioxins and greenhouse gases) and (iii) the implications of energy and materials offsets from the waste management process (e.g., conversion of landfill gas to electricity, electricity produced in thermal treatment, and materials recovered from thermal treatment ash).

We developed life cycle inventory models for different waste management processes, incorporating information from a wide range of sources - including peer reviewed life cycle inventory databases, the body of literature on environmental impact of waste management, and site-specific factors for Puerto Rico (e.g. waste composition, rainfall patterns, electricity mix). We managed uncertainty in data and models by constructing

different scenarios for both technologies based on realistic ranges of emission factors.

The results show that thermal treatment of the unrecyclable part of the waste stream is the preferred option for waste management when compared to modern landfilling. Furthermore, Eco-indicator 99 method is used to investigate the human health, ecosystem quality and resource use impact categories.

INTRODUCTION

The management of municipal solid waste (MSW) has become more challenging in the past decade. Increasingly stringent regulations and higher environmental awareness of communities are driving the applications of MSW management systems that have lower environmental footprints. There is no universal favored system for waste management. In order to minimize environmental and economic impacts, the optimal system for a given area should be determined taking local aspects into account, regional particularities in waste composition, sitting concerns for disposal options, markets for recovered resources, local energy mix and economic situations. [1].

This study focuses on the environmental assessment of two MSW management alternatives for Puerto Rico, where a high per capita waste generation and poor management practices have led to a solid waste crisis in the island. Puerto Rico has an extension of about 14,000 km² (roughly the size of Connecticut), 3.9 million inhabitants and a municipal solid waste generation of approximately 9,900 tons per day. Around 90 % of the MSW generated in the island is disposed in 32 operating landfills and the remaining 10% is recycled [2]. Many of the 32 operating landfills do not fully comply with federal landfill regulations, therefore the United States Environmental Protection Agency (US EPA) issued in the past three years consent orders to close four landfills (Vega Baja, Aguadilla, Santa Isabel and Florida) and is currently pursuing a