# An evaluation of waste management for energy recovery for the Kingdom of Bahrain.

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The Kingdom of Bahrain is a group of small islands in the Arabian Gulf with a population of approximately 1.37[1] million people. The country has a high human development index score of 0.824 (47$^{th}$ rank) and is classed as a high income country. Bahrain built its economy mainly on oil, although more recently this has changed to finance and tourism. Access to electricity and water is universal. However, with the economic expansion comes waste production, and Bahrain is considered to have one with high levels of municipal solid waste (MSW) generation in the world. It has been recorded that in 2015 a total MSW of 1057.70 kg/person/yr or approximately 4000t/d was produced, rising to an estimated generation of 1183.46 kg/person/yr in 2017. This MSW is sent to the Asker landfill site 25km from the capital city. In addition, sewage effluent for the entire island is sent to the Tubli water treatment works. Designed to cope with 200,000m$^3$ per day it now handles in excess of 300,000m$^3$ much of which goes as with secondary treatment into Tubli Bay.

In this article, we report on current waste management strategies in Bahrain juxtaposed against recognised waste hierarchy systems. We characterise waste constituents and model the energy potential of these wastes. Wastes identified include organic fraction MSW, agricultural residues, food waste, tyres and sewage. We consider different energy recovery solutions from these wastes including thermochemical technologies and anaerobic digestion. Comparisons are made to enable optimal energy returns. Based on these findings we propose a holistic waste strategy for energy recovery for Bahrain.

Keywords: MSW, energy from waste, thermochemical, anaerobic digestion, Bahrain

[1] Based on the social statistical record in 2015