

## Documents

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### **Developing waste biorefinery in Makkah: A way forward to convert urban waste into renewable energy**

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#### **Abstract**

The city of Makkah in the Kingdom of Saudi Arabia (KSA) hosts millions of Muslim worshippers every year. As a consequence, the municipal solid waste (MSW) quantities become enormous. City landfills receive about 2.4 thousand tons of MSW every day, whilst during the months of fasting (Ramadan) and Pilgrimage (Hajj), these quantities become 3.1 and 4.6 thousand tons per day respectively. Currently, there is no waste-based biorefinery or waste-to-energy (WTE) facility existing in KSA to treat different fractions of MSW as a source of renewable energy production and a solution to landfill waste problems. Therefore, the waste-based biorefinery, if developed in Makkah city, including WTE technologies such as anaerobic digestion (AD), transesterification, pyrolysis and refuse derived fuel (RDF) can be able to treat around 87.8% of the total MSW. The remaining 12.2% of MSW fraction can be recycled. The waste-based biorefinery, along with the recycling approach, can generate savings of about 87.6 million Saudi Arabian Riyal (SAR) from carbon credits. Similarly, a total net revenue of 758 million SAR can be generated from landfill diversion (530.4 million SAR) and electricity generation (288.5 million SAR). Moreover, 1.95 million barrels of oil and 11.2 million MCF of natural gas can be saved with a cost savings of 485.5 million SAR. Collectively, the waste-based biorefinery and recycling can reduce the global warming potential (GWP) of 1.15 million Mt.CO<sub>2</sub> eq. © 2016 Elsevier Ltd

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