

Generating Revenue from Waste Management

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The energy demand and waste generation have increased significantly in the developing world in the last few decades with rapid urbanization and population growth. The adequate treatment of the waste or sustainable waste management is essential not only from a sanitation point of view but also due to its economic and environmental values including its potential contribution to energy generation in the developing countries. Many of the developed nations have adopted the approach and strategies of the integrated waste management system (Figure 1) to maximize the waste-based revenues in the form of energy, fuels, heat, recyclables, value-added products, and chemicals along with more jobs and business opportunities. As a result, waste is no longer seen as refuse or discarded material, but an asset or resource to reduce not only the landfill volumes but also the dependency on fossil fuels by generating clean fuels.

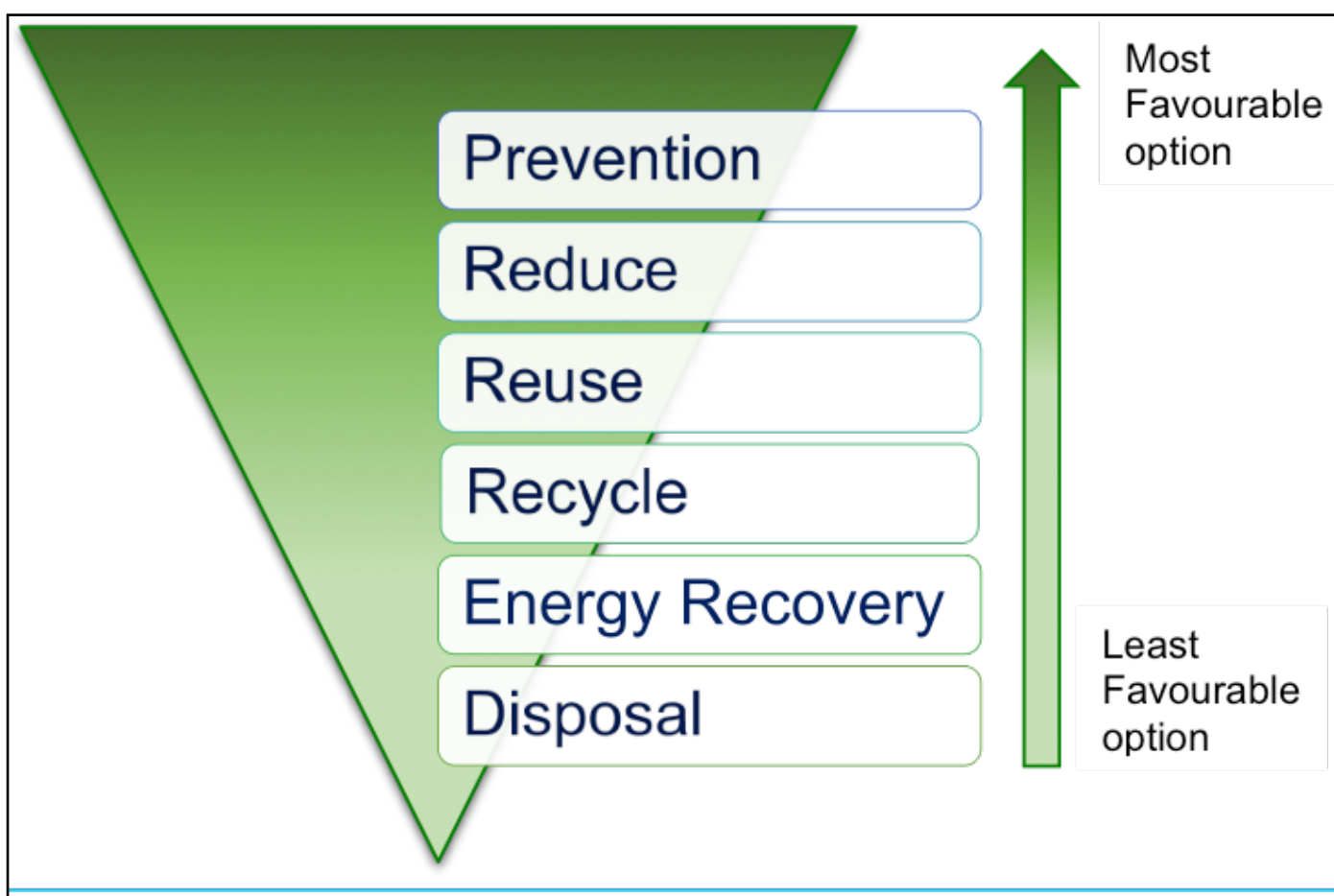


Figure 1. Waste management hierarchy

In Saudi Arabia, the new development policy of Vision 2030 is supporting the maximum diversion of waste from landfills to material or energy recovery facilities with the production of clean energy and recyclable and value-added green products (Figure 2). The produced wastes in most of the Saudi cities are rich in organics such as food waste that is up to 40 -50% of total collected municipal solid waste and plastics which are up to 16-20 % of total municipal solid waste [1-3]. Therefore, the development of waste to energy or waste biorefinery is essential as a promising solution for alternative fuels and waste disposal issues along with significant economic and environmental benefits. Most of the waste produced in Saudi Arabia is disposed to the landfills or dumpsites without material or energy recovery which may cause several environmental issues. Consequently, the need for an integrated waste management system, including waste to energy plants, and material recovery facilities is becoming imperative for the country [4].



Figure 2. Pillars of Saudi Arabian Vision 2030

We have a solid waste research unit, working on the local solid waste issues and their sustainable management, at the Center of Excellence in Environmental Studies, King Abdulaziz University, Jeddah, Saudi Arabia [5-7]. We have recently presented a detailed case study of developing an integrated waste biorefinery in the city of Makkah in Saudi Arabia, where millions of pilgrims gather each year to perform religious rituals [8]. The waste to energy technologies (Figure 3) of anaerobic digestion, transesterification, pyrolysis and refuse-derived fuel were selected based on the city's waste composition for the proposed integrated waste biorefinery. It is estimated that the waste biorefinery can treat around 87.8% of the total municipal solid waste, whereas the remaining 12.2% can be recycled at the material recovery facility. Besides the recovery of value-added products and fuels, the biorefinery can save about US \$23.4 million from carbon credits, US \$141.4 million from landfill diversion and US \$76.9 million from electricity generation. Moreover, 1.95 million barrels of oil and 11.2 million Mcf of natural gas can be saved with savings of US \$98.3 million and US \$3.0 million respectively. Similarly, waste biorefinery has environmental significance with the total reduction in global warming potential of 1.2 million Mt.CO₂ eq [8].

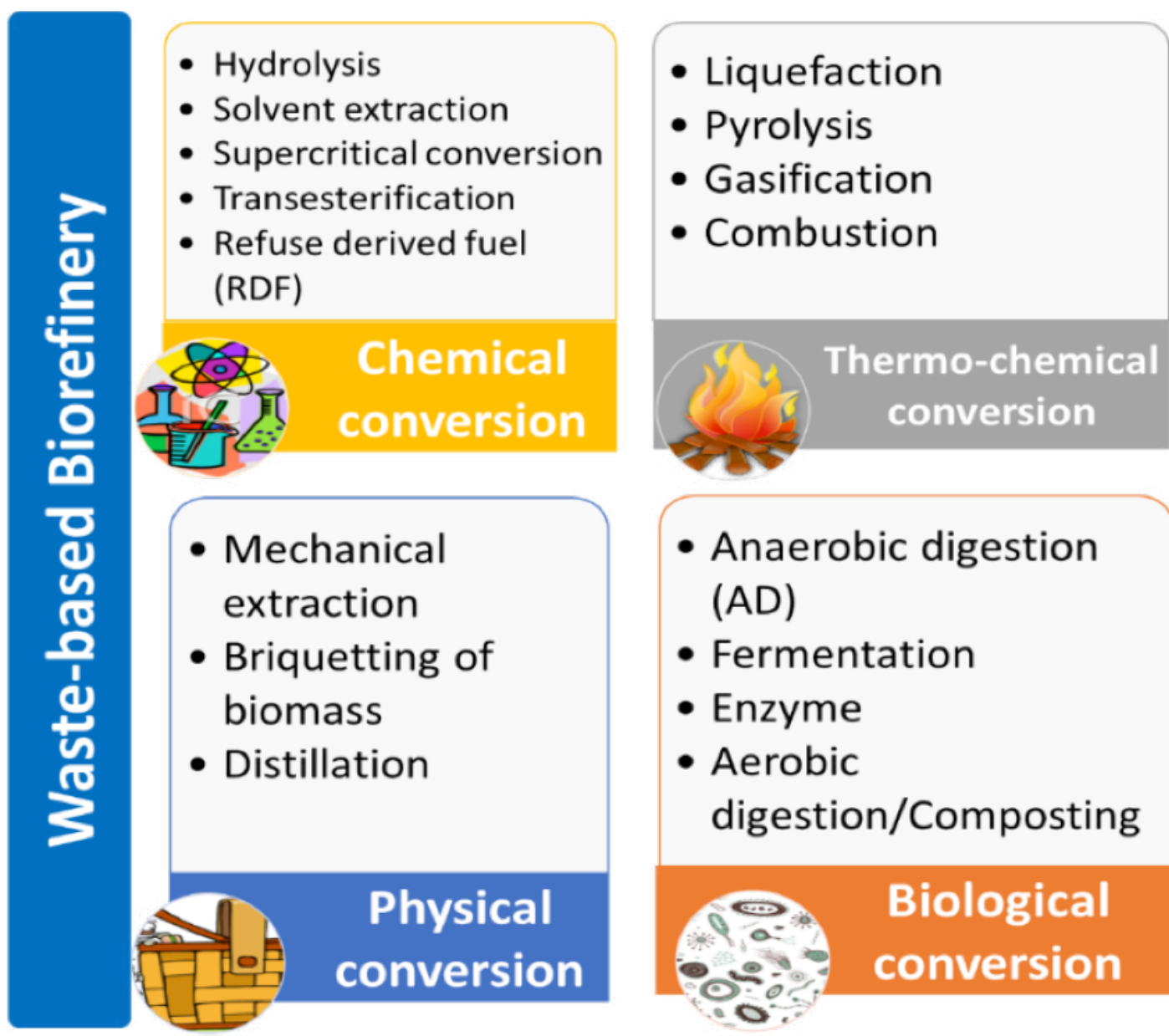


Figure 3. Classification of waste to energy technologies

A sustainable waste management must be related to the concerned country by taking into account its socio-economic situation, local waste sources and its composition along with the availability of markets for the recovered energy and end-products (Figure 4). Therefore, it is critical to understand that solutions cannot just be copied from one region and replicated in another country. In fact, all stages of waste management including waste handling, transportation, and treatment can represent a burden to a country's environment and its economics, unless they are balanced with the recovered materials and energy, greenhouse gas emissions savings and displacement of conventional fossil fuels using life cycle assessment approach.



Figure 4. Achieving circular economy through waste management

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