# Chapter 9
# Recycling Technologies for Sustainability

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## ABSTRACT

*Technology is improving every day in each aspect of daily life. This will help us to increase the sustainability rates and efficiency of recycling. In fact, waste generation is an indicator of economic activities by maintaining production output and also supplying many jobs. However, the treatment methods should also improve as the types and quantities of the wastes increase. There are many recycling technologies that are already serving mankind; however, the types of wastes are changing with composite materials. These types of "not only one origin" composite wastes make it difficult to recycle by the conventional methods. There are huge differences in the types of wastes discarded by different types of industries that make the situation more complicated. Conventional methods are no longer enough to treat and recycle all types of wastes. This chapter will discuss recent improvements and technologies about increasing the recycling rate without causing environmental impact.*

## INTRODUCTION

There has been a rapid increase in both the global population and its consumption rates. Manufacturing processes and materials have also increased. High production rates test our natural resources and destabilize sustainable development.

Waste is generated in all areas with living activity. A considerable amount of waste is being generated at a tremendous speed. Therefore, waste management and treatment are very important. It is important to establish an effective, integrated waste management process from its generation to its final disposal. This includes energy recovery.

Waste has no value to those who want to get rid of it. However, it may have significant value to another person or process. Waste classification is inevitable to preserve its value. Generation locations and materials help classify waste to increase its value and usability for other processes (Kinnaman, 2014).

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In fact, the reduction of generated waste, or integrated waste management, is better than solid waste management. This process elaborates on the cost of waste management and treatment processes, boosting the economy by preserving natural resources and preventing environmental pollution.

Recycling, in general, is the collection and separation of waste materials, as well as its subsequent processing to produce marketable products. Recycling effectively supports the use of sustainable materials. Moreover, it has the advantage of minimizing the quantity of waste by using it as a resource, reducing the need for landfill sites (Goren, 2015).

Working to minimize the quantity of waste is supported by technologies that promote decreased energy use and consumption of raw materials. Termed "green technology," these tools aim to preserve nature. Otherwise, serious problems will appear, especially in rapidly developing nations.

Economic development, industrialization, and increasing populations are causing problems related to expanded consumption and depletion of resources (no more renewables). It also increases the output of dangerous (composite) wastes. For example, waste from manufacturing processes can become hazardous. Medical and radioactive wastes are also categorized as hazardous materials. Therefore, they should have strict controls related to generation, transportation, treatment, storage, and disposal.

There are increasing problems related to the growing volume of municipal and industrial waste. Human health and the natural environment should be protected from potential hazards of waste disposal. In fact, we should adopt the motto, "the practice of treasuring and using all things as long as possible," as our economies continue to grow. This enduring spirit has motivated the development of technology for reuse, recycling, and effective use through thermal processes for energy recovery.

Technology for efficient waste transport is also needed in dense cities. This can be achieved by settling transfer stations in specific regions. With this method, it will be more efficient to collect and transport waste.

The expansion of urban areas widens the waste collection zone. Waste transfer stations can be used to transfer waste from small- or medium-sized trucks to larger trucks. The cost of collecting and transporting garbage accounts for a high percentage of waste disposal operations. Improving the efficiency of collection and transportation leads to cost reductions while maintaining or improving services to residents.

The transfer of waste to larger trucks at transport stations improves transportation and reduces fuel consumption based on per garbage volume. This reduced both cost and carbon dioxide (CO2) emissions, contributing to the prevention of global climate change. This also reduces traffic loads, oil consumption, and risk of accidents.

Generally, loading and unloading the garbage is powered by an engine. Newer trucks use electricity to perform this task while the truck continues to run. This reduces the consumption of fuel and CO2 emissions. Compressor-type trucks press the garbage to the floor with a pressing plate. After breaking and reducing the volume of the waste, the garbage slides into a storage area. Due to global warming, low-pollution garbage trucks, including electric and hybrid trucks, are being developed and put into practical use.

Many materials can be recovered and used for recycling or energy recovery. High-resolution sensors sort at a rate of 320,000 scan points per second. Coupled with exclusive and application-specific electronics, sensors lead to congruent data collection across multiple material characteristics. This ensures precise identification of a range of materials. Both large and small objects can be scanned with accuracy. As resources become scarce, these alternatives are preferable to landfills or burning.