



### Short Review Paper

## Review on recovery and recycling of post consumer waste

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### Abstract

*Over the last few decades, increasing amount of waste generated is an outcome of rapid population growth, unplanned urbanization, production pattern and higher consumption rate. This paper is a review study on how post consumer waste recycling can provide an opportunity to reduce and recover waste, that it can be converted into useful resources. In most of the situation, post consumer waste recycling could also be economically viable, as it generate resources which are in high demand. In India there is a long way to go in the current field due to the less interest of researchers in recycling techniques. The purpose of review study is to discuss mainly recycling, advantages and challenges in five types of post consumer waste products namely, plastics, foot-wears, textiles, wooden and electronic waste. As we know about conventional End of life (EoL) options of these products, these are: landfills and incineration but government as well as most of the industries are adopting 3R's policy of "Recycle, Reduce and Reuse" for the protection of environment.*

**Keywords:** Post consumer waste, End of life (EoL), Recycle, landfills, incineration.

### Introduction

This paper addresses review studies on recycling and recovery of post consumer waste material, types of post consumer waste and the major obstacles in collecting and recycling them. Recent waste management strategies, deals with integrated system based on waste management by preventing, minimizing, recycling and reusing waste and also taking care of population and environment health<sup>1</sup>.

According to United States Environmental Protection Agency report the major categories of post consumer durables are transportation equipments, air conditioners, refrigerators, computers and business equipment, building and construction materials, furniture and furnishings, kitchen gadgets, television etc<sup>2</sup>.

The high rate of raw materials, production issues and environmental legislative regulations affect the way that many industries deals with its end-of-life products. There are four main EoL options that can be used for postconsumer products, these are: incineration, landfill, recycling and reuse. But there are environmental hazardous effects and requirement of technical assistance for these EoL options. Land-filling is still a major problem having controversial concerns over increasing pollution.

Thus, 3R's method is the most significant EoL option. On commercial scale, Nike is the footwear manufacturer having footwear recycling unit. Their scheme has been developed for recycling of athletic shoes<sup>3</sup>.

### Status of recovery and recycling of Post consumer goods

**Textile Recycling:** Kishco is a four generation old business house which is well recognized in the Indian industry since nearly 80 years. Kishco is devoted to providing all kinds of services in the field of textiles including recycling industry. In the field of textile recycling, Kishco group used consumer waste (clothing waste) which is popularly known as rags. It consists normally wool, acrylic and cotton sweaters for the manufacture of blankets. Kishco group is working with approximately 40 countries worldwide in 5 continents having its head office in Mumbai, India with associate offices in UAE, China and Bangladesh and its group turnover is more than USD 25 million per annum<sup>4</sup>.

**Electronic waste recycling:** Electronic waste and electronic equipments are used to recycle various metals. Mainly printed circuit boards (PCB) have high percentage of valuable metals. The collection method and amount depends upon the type of board, source of device, and production technology. The most efficient method to selectively extract and recover metals is the chemical hydrometallurgical processing technique<sup>5</sup>.

**Footwear recycling:** In India, "Greensole" organization collects old shoes to convert them into comfortable and trendy footwears for needy people and school going village children. It was established in 2013 and now having 17 corporate partners. They organize collection drives for refurbishing the collected shoes. The recycled footwears also donated by them in villages.

Furthermore, shoes collection program also conducted by them all over the country<sup>6</sup>.

**Plastic Recycling:** Plastic recycling is the first step towards innovation and sustainability. About 3,500 plastic recycling units are organized in India. These units recycle mainly PE, PP, PVS, PS, PBT, SAN and Nylon via mechanical routes and engineering techniques. In India according to Plastic Industry Report, recycling of plastics is 3.6 MTPA (million tonnes per annum) and provides employment to approximately 1.6 Million people<sup>7</sup>.

**Wooden waste recycling:** Based on the report to a Nordiac Cooperation project on "Environmental consequences of different recycling alternatives for wood waste", particle boards can be prepared from wooden waste material<sup>8</sup>.

In the field of recovery and recycling, ITC strategy is based on 'Segregation at Source' and 100% recycling. They ensure maximum reuse and recycling through their engagement with Central Institute of Plastic Engineering and Technology (CIPET) for research. They also encouraged use of post consumer waste as a source of fiber in their paper board industries and paper units. Thus, promoting for green and clean environment in collaboration with local municipal corporation.

### Challenges related to recycling of Post consumer waste

**Textile Recycling:** The clothes that have been used consist of a blended mixture, for example- poly cotton mix. It is a mixture of polyester and cotton and it is a great challenge for textile industry to find a way for the separation of blended fiber materials so they can be recycled according to their own method

of recycling. Also while recycling of cotton and wool mechanical methods are employed for chopping, which degrades the quality of fibers thus only limited amount can be reused<sup>10</sup>.

**Footwear Recycling:** Footwear recycling also deals with collection of metallic products used in the form of metal eyelets, decorative parts and buckles. Other embedded structural parts are steel shanks, toe caps and heel supports. But the removal of these metallic parts is a great challenge for footwear recycling units.

**Plastic Recycling:** Plastic recycling includes collection, dismantling, separation techniques which affected economically due to high expenses. Besides these specific obstacles of plastic recycling are – i. Lack of developed infrastructure for collection- The attraction of Major proportion of population is to collect metal. All the established systems are working in metal collection rather than plastic. ii. Lack of economical dismantling techniques- Due to the lack of economical dismantling techniques, it is now manually operated only for those valued parts that can be removed easily. iii. Difficulties in identification- Consumer goods mainly contain mixture of different plastics. Parts of machineries are manufactured by mixing two or more resins to improve their quality. Thus their separation and identification process became more complex. iv. Inconsistency between designing criteria and recyclability- Designing of consumer goods is carried out to make them light weighted as well as durable. But now this type of product designing is inconsistent with recyclability. For example: In road transport vehicles, metallic body is replaced by light weighted plastic having mixture of different resins, which makes it more difficult to identify, sort and reuse.

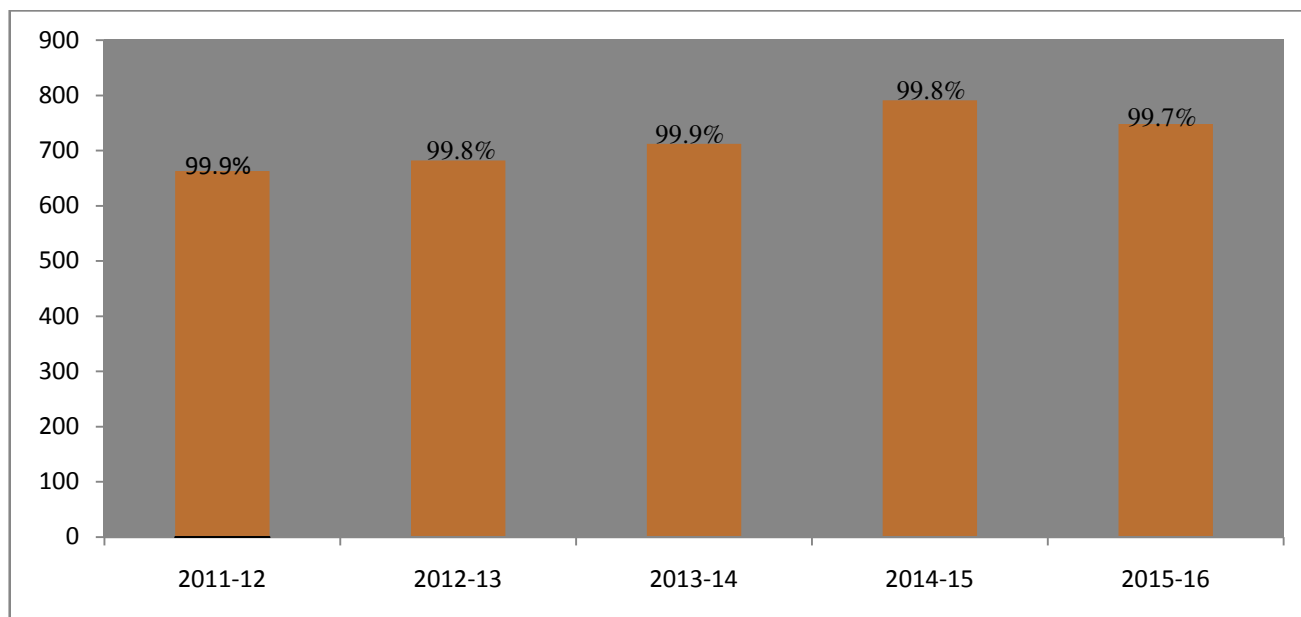


Figure-1: ITC Sustainability Report-2016<sup>9</sup>.

**Wooden waste Recycling:** Our government induces for electricity generation from renewable resources. It is an issue of competition for panel board industry. Local authorities want to recycle wood but there is high demand of wooden waste for fuel production. Sometimes wooden waste arising are labeled with hazardous substance such as that treated with chromate copper arsenate (CCA) and creosote<sup>11</sup>.

**Advantages of recovery and recycling:** It reduces incineration and landfills method and conservation of timber, water and mineral resources increases economic security of nation. The lowering incineration and pollution reduction saves energy as well. Recycling also increases economy of nation by creating new jobs.

**Economic Overview:** Post consumer waste recycling system is based on specific factors such as market status, revenue facilities, local and geographical factors including transportation, cost of labour etc.

According to Recycling Economic Information (REI) 2016 report, recycling and reuse of materials create jobs, and also generates local and state tax revenues. In 2007, in the United

States recycling benefits considered: i. 757,000 jobs, ii. \$36.6 billion in wages; and iii. \$6.7 billion in tax revenues.

In the field of construction waste materials having the largest contribution to jobs, wages, and tax revenues, followed by collection of ferrous metals and non-ferrous metals such as aluminum<sup>12</sup>.

## Conclusion

The increasing population demand for virgin material, producer responsibilities and increasing landfill activities necessitates appropriate recycling management in manufacturing sector. In waste electrical and electronics sector, there is rapid growth in collection of valuable metal. There is very much requirement of sustainable recycling system for economic growth and progress in the field. Although, there is implementation of new techniques but care must be taken for manufacturing of new products and to maintain its purity up to 95%. It must be noted that this level of purity should be maintained for progress in the field. Further investigations of technical feasibility and economic as well as environmental impacts are required. In India there is still inadequate awareness, necessary to change the behavior of people to promote reduce, reuse and recycling of waste.

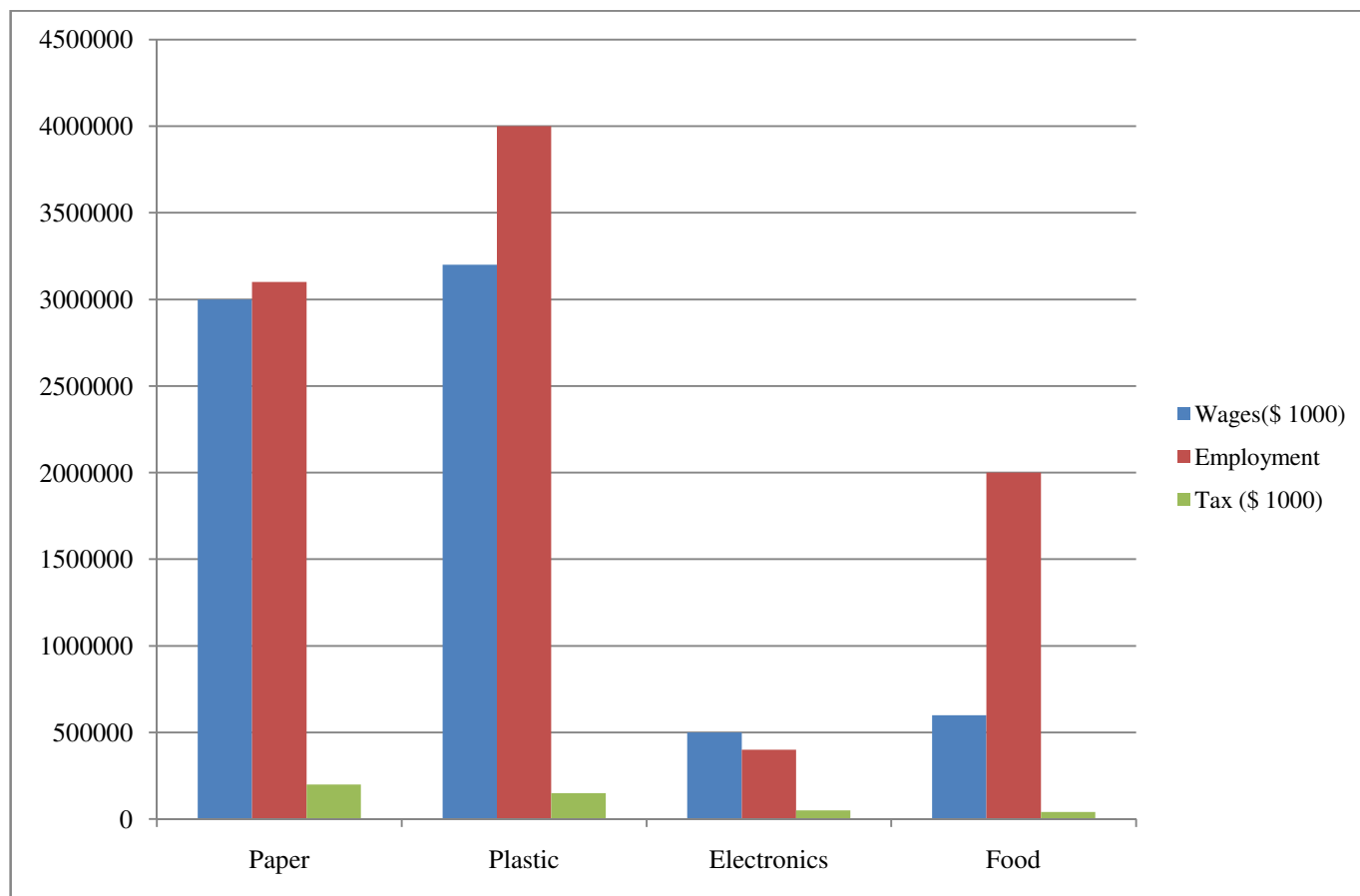


Figure-2: Wages, Tax and Jobs Attributable to Recycling by EPA<sup>12</sup>.

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