Research Report

EXECUTIVE SUMMARY: Electronics Recycling and E-Waste Issues

Recycling and Responsible Disposal of Consumer Electronics, Computer Equipment, Mobile Phones, and Other E-Waste

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Published 2Q 2009

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Section 1

EXECUTIVE SUMMARY

Throughout human history, the residuals of daily activities have been disposed of in the easiest and least expensive manner possible, thus ingraining a perception of “no value” toward the stuff we call waste.

Worldwide population is approaching 7 billion people and growing at about 80 million people per year. The superhighways of commerce in the industrialized countries are now filled with the consumer goods of a global economy. However, solid waste management in many of the developing countries today is at a point where the industrialized countries were a hundred years ago. Methods that were acceptable back then (open dumps and burning trash) are currently being utilized around the developing world and there is still unabated discharge of hazardous and solid waste into the ground, rivers, and oceans.

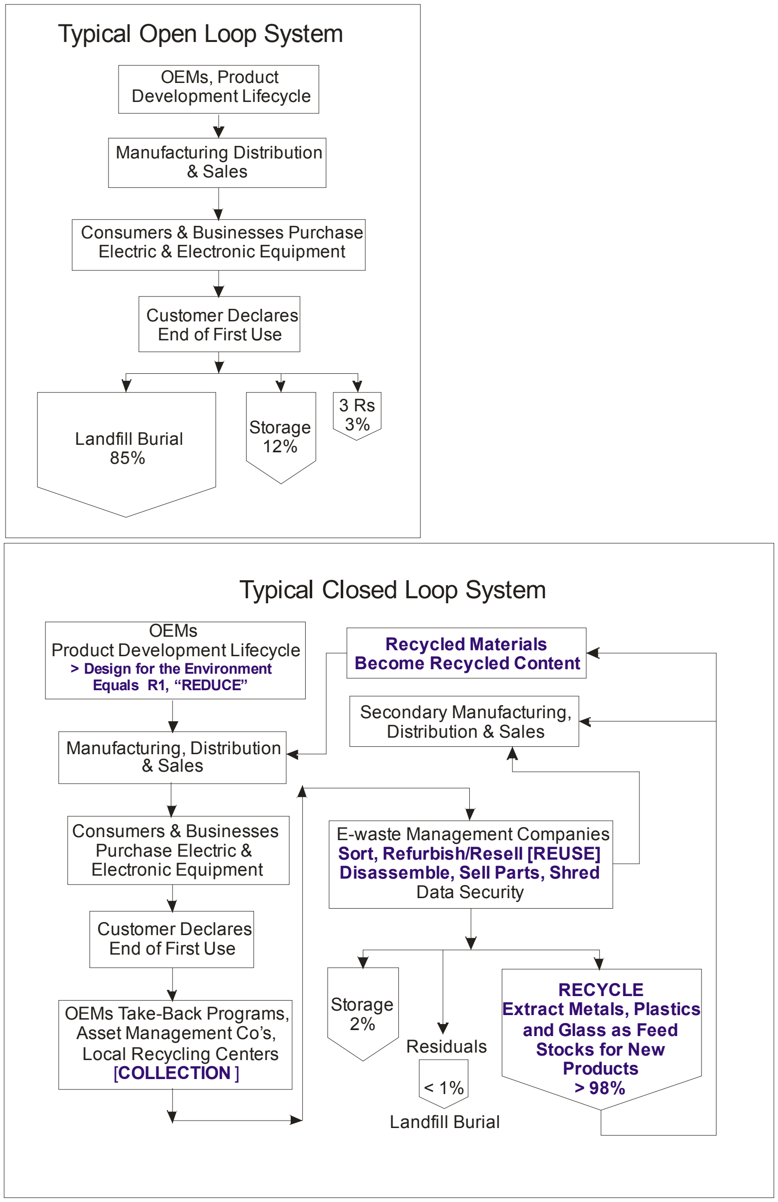
E-waste has been around since the widespread use of electricity and product innovation created the first appliances, radios, and TVs. Typically, e-waste has been a component of municipal solid waste, easily and inexpensively disposed of by landfill burial. This process is described as an open loop, single pass system and is shown in Figure 1.1. Today, an increasing number of options are available for e-waste management. Both electrical and electronic equipment that has served its intended first use can now be processed for reuse, recycling, and/or end-of-life management in a closed loop, multiple pass system similar to what is shown in Figure 1.1.

There are two attributes of e-waste that define its management issues around the world. The first is the number and variety of toxic materials present in the enclosures and components of electrical and electronic equipment. The second is the value and volume of reclaimable materials (metals, plastics, and glass) available for use in new products, which reduces the quantity of virgin, non-renewable, raw materials mined to keep up with ever-increasing consumer demand.

The e-waste process has many key players with multiple interactions. Original equipment manufacturers (OEMs), consumers, e-waste management companies, logistics companies, non-government/non-profit organizations (NGOs), and government agencies all play a role in the e-waste segment. E-waste is the fastest-growing segment of municipal solid waste; it accounts for between 3% and 5% of incoming materials.

E-waste management’s two primary processes are refurbish/reuse/resale and recycling. However, approximately 75% to 85% of electrical and electronic equipment at the end of their first useful life are sent directly to landfill burial or incineration. Another 10% is stored, passed down, or donated to charity and an optimistic estimate of up to 15% is diverted for reuse and recycling.

Figure 1.1 Open and Closed Loop Systems



(Source: Pike Research)

Government intervention has created a framework for e-waste management that is now being replicated – with numerous modifications – around the world. Such intervention has taken shape in the form of laws and regulations, beginning with the European Union's Waste Electrical and Electronic Equipment (WEEE) Directive and subsequent amendment banning the export of WEEE to non-OECD (Organization for Economic Cooperation and Development) countries. In addition, the Reduction of Hazardous Substances (RoHS) Directive, implemented first in the EU during 2003, is influencing the design processes of OEMs. RoHS has become the de facto standard to encourage the removal of toxic materials from electrical and electronic equipment. Many of the large OEMs are taking credit for their efforts to reduce the number and quantity of toxic materials, which they balance with the needs of the customer for price/performance and reliability.

E-waste processing technology has increased efficiency and capacity for some of the largest e-waste management companies that can make the necessary capital equipment investments. The ability to separate constituents in a mixed stream into distinct classes of materials is increasing with each new generation of equipment. However, the first steps in the reuse/recycle system are manual. It takes people and manual dexterity to disassemble a piece of electrical or electronic equipment to extract hazardous constituents, valuable components or subassemblies prior to automated processing. The true value of e-waste materials sent for recycling is as feedstock for other new products or for direct reuse as recycled content in similar products.

Issues associated with the processing of e-waste in developing countries and the inconsistent enforcement of government-mandated requirements around the world have raised the awareness of OEMs, consumers, e-waste management companies, and government agencies. The largest OEMs have had internal requirements and control systems related to government-mandated environmental programs in place for a number of years. The risk of enforcement, bad publicity, and customer reaction (with a little help from the NGOs) is far greater than the cost to handle and dispose of these industrial materials in an appropriate manner. Yet, there are opportunities for improvement throughout the reverse logistics supply chain related to audits and tracking system transparency.

Governments, particularly those in global leadership roles and those whose economies generate a significant percentage of e-waste, must participate in the process by supporting existing treaties, helping to develop new and better ones, and taking enforcement action.

The export of e-waste, in and of itself, is not inappropriate. It supports the closed loop, multiple pass processes of reuse and recycling in close proximity to the demand for raw materials. The majority of new manufactured goods of all kinds are being made in developing countries because labor rates and regulations are more favorable than in other parts of the world. Raw materials for manufacturing all of these products are being delivered through a global supply chain. This supply chain should include materials recovered from recycling operations around the globe and should benefit from the same lower labor rates. Moreover, safe working conditions and appropriate environmental protection and disposal of residuals must be minimum requirements for contracting for e-waste processing services in the developing countries.

We, as citizens of the world, are consuming ever-increasing quantities of raw materials to make new and more functional electrical and electronic equipment that must be dealt with at the end of their first, second, or “nth” useful life. Appropriate recycling can provide an increasing percentage of that demand. The projections for e-waste are increasing, on average, 3% to 5% per year with a lag time equal to the first product lifecycle (1.5 to 2 years for handheld devices, 5 to 7 years for PCs and TVs, and a variable lifecycle in the business sectors using networking and electrical control equipment). Pike Research estimates there will be over 60 million tons of e-waste at the decision point for reuse/recycle or landfill in 2013. The recycle rate could go as high as 50% or more, depending on government intervention and economic incentives provided to consumers. Assuming a recovery rate of valuable materials at 45% of the gross quantity of e-waste available, approximately 14 million tons of raw materials could be available for new product manufacturing during 2013.

Purchasing power parity (PPP) will continue to favor the developed countries where the standard of living is high enough to support the purchase of new equipment on a periodic basis. In the developing countries, PPP will not support the purchase of new computer equipment. However, the availability of refurbished equipment available for resale is a huge opportunity for asset management and e-waste management companies that focus on resale. The barrier to entry for handheld devices is decreasing and demand is increasing, which means there will be more new cell phones sold than computers. Still, the resale market for these devices will also flourish.

Consumer behavior needs to be modified via a combination of awareness, incentives, and constraints to begin to change ingrained habits. Surveys by OEMs and advocacy groups indicate a majority of consumers do not know what their options are when a piece of equipment reaches the end of its useful life. Success will be enhanced by the perceived degree of convenience in getting WEEE into the recycle processes. Money continues to be a great motivator in terms of handling e-waste. This factor has led to solutions in the form of landfill bans, OEMs with individual producer responsibility (IPR) requirements, and advanced recycling fees (ARFs) in some locations.

Table 1.1 E-Waste Management SWOT Analysis

Strengths	Weaknesses
• Virtually unlimited supply of electrical and electronic materials available for closed loop processing by reusing or recycling • Awareness of the e-waste management issues by consumers and companies is changing the processes used to monitor and control the disposition of e-waste • Some of the larger electronics OEMs are developing and deploying products with alternative materials to those declared unacceptable by RoHS • Some of those same companies and others are changing their designs and adding materials identification to make dismantling and separation of recyclable materials easier at e-waste management facilities	• Government regulation, to date, has been uncoordinated at the national and regional level; too much freedom for individual government entities • Different compliance requirements from country to country and state to state adds unnecessary costs • Traditional disposal by landfill (too easy and too inexpensive) has not been addressed • Consumers are typically not aware or provided effective incentives to reuse or recycle WEEE • Too many groups with good intentions are working on fixing the e-waste problem • E-waste management companies are not certified/audited by third parties that their processes are in compliance and appropriate
Opportunities	**Threats**
• Implement an international system to report, quantify, and control the movement and disposition of WEEE by mass balance (transparency) or declare it to be hazardous waste • Utilize the framework of an existing international organization to mandate the implementation of the fundamental and minimum global requirements for e-waste management • Make landfill disposal of e-waste unacceptable (ban it) or significantly more expensive (minimum 2X) than actual reuse and/or recycle costs and make it more difficult (require separation from other trash) • Cooperate, communicate, and enforce e-waste management requirements across political boundaries and geographical regions • Create an e-waste export fee, based on the tons shipped to each non-OECD country, that is earmarked as capital (money) for investment in infrastructure, equipment, and environmental controls necessary to process e-waste appropriately	• Insufficient resources or political will to enforce government and treaty requirements, including financial and legal penalties for non-compliance • Insufficient capital investments in processing equipment and training in both industrialized and developing countries • Secondary markets for recovered materials or feedstock for primary markets significantly exceeds the demand for raw materials in manufacturing processes • Commodities prices decline below the price point for e-waste management companies to make a profit • Generators and exporters have too many methods/ways to circumvent the intent of control regulations, which undermines the integrity of the processes

(Source: Pike Research)

Section 8

TABLE OF CONTENTS

Section 9

TABLE OF FIGURES

Section 10

SCOPE OF STUDY

The focus of this study is on the companies and processes associated with the generation, collection, processing, and final disposition of used, unwanted, and/or nonfunctional consumer electronics equipment. Using historical data and calculated CAGRs for both specific and generic product types, Pike Research has devised forecasts from the most current information available to 2008, then from 2010 to 2025 in 5-year increments.

SOURCES AND METHODOLOGY

Pike Research's industry analysts utilize a variety of research sources in preparing Research Reports. The key component of Pike Research's analysis is primary research gained from phone and in-person interviews with industry leaders, including executives, engineers, and marketing professionals. Analysts are diligent in ensuring that they speak with representatives from every part of the value chain, including but not limited to, technology companies, utilities and other service providers, industry associations, government agencies, and the investment community.

Additional analysis includes secondary research conducted by Pike Research's analysts and the firm's staff of research assistants. Where applicable, all secondary research sources are appropriately cited within this report.

These primary and secondary research sources, combined with the analyst's industry expertise, are synthesized into the qualitative and quantitative analysis presented in Pike Research's reports. Great care is taken in making sure that all analysis is well-supported by facts, but where the facts are unknown and assumptions must be made, analysts document their assumptions and are prepared to explain their methodology, both within the body of a report and in direct conversations with clients.

Pike Research is an independent market research firm whose goal is to present an objective, unbiased view of market opportunities within its coverage areas. The firm is not beholden to any special interests and is thus able to offer clear, actionable advice to help clients succeed in the industry, unfettered by the technology hype, political agendas, or emotional factors that are inherent in cleantech markets.

NOTES

CAGR refers to compound average annual growth rate, using the formula:

CAGR = $(\text{End Year Value} \div \text{Start Year Value})^{(1/\text{steps})} - 1$.

CAGRs presented in the tables are for the entire time frame in the title. Where data for fewer years are given, the CAGR is for the range presented. Where relevant, CAGRs for shorter time frames may be given as well.

Figures are based on the best estimates available at the time of calculation. Annual revenues, shipments, and sales are based on end-of-year figures unless otherwise noted. All values are expressed in year 2009 US dollars unless otherwise noted. Percentages may not add up to 100 due to rounding.

Published 2Q 2009

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