

SURVEY

Inside the U.S. Electronics Recycling Industry

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IDC OPINION

Electronics recycling has shown tremendous growth over the past 10 years. Hundreds of organizations and tens of thousands of workers are active in the sector, figures that have been growing over the years as the use of electronics equipment becomes ubiquitous and generalized. Yet targeted incentives and strategies could further stimulate growth. There is a significant opportunity to increase the recycling rates of used electronics, in particular among the residential/household segment. Meanwhile, electronics recyclers continue to operate in a changing business landscape. Key figures based on a survey include:

- ☒ Approximately 3.5 million tons of electronics were treated by the recycling industry in the U.S. in 2010. More than 62% comes from PC and IT-related equipment. The survey indicates that almost 70% by weight of the 3.5 million output in tonnage was processed domestically into commodity grade scrap, such as steel, aluminum, copper, precious metals recovered from circuit boards, glass, and plastic. The US geography remains the biggest market for survey respondents' direct output in both weight and value. 78.66% reported that their output was traded, sold and/or transferred within the U.S.
- ☒ While residential users accounted for the bulk of electronics purchases, their contribution to electronics recycling input was alarmingly low in 2010. Indeed 74.1% of the total input tonnage associated with the survey respondents' electronics recycling business originated from businesses and commercial entities.
- ☒ From an economic perspective, the industry employs at least 30,000 workers. These are workers active in companies that are defined as "recyclers" or in the recycling units of OEMs. In 2010, the total estimated combined revenue for the industry was \$5.2 billion. These figures concern only recycling enterprises, not taking into account the contribution of not-for-profit entities, government agencies, etc. By including these entities, the broad electronics recycling impact is much bigger, with employment potentially as high as 45,000. Yet, the industry faces a set of challenges, including the challenge of stimulating the household/residential sector. For the individual recycling companies it is about managing in a tough economic environment in which operating costs are a problem and the competition to secure adequate volumes of used equipment is often tight and competitive. For the industry as a whole, the challenges include regulatory uncertainty and increased demand for companies to obtain third-party certification. For the recyclers' upstream customers, whether it is the OEMs or electronics end-users, it is often about downstream accountability.

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IN THIS STUDY

Methodology

This report is the result of a survey conducted in April and May 2011, further enhanced with IDC data tracking databases. The survey was sponsored by the Recycling Research Foundation (RRF), a 501(C)(3) organization affiliated with the Institute of Scrap Recycling Industries, Inc. (ISRI).

A total of 182 U.S. organizations took part to the survey. The sample yields statistically accurate and unbiased survey results. This document highlights the key findings of the tabulated results.

From a data source perspective, 67% of the respondents originated from a list shared by the survey sponsor, RRF, and 33% from IDC's own list of recyclers.

From a methodological standpoint, IDC used the responses to the survey to build a profile of the industry labor, revenue and other metrics. Assumptions were built to extrapolate approximate sizes for the U.S. market using survey results, IDC databases and third-party listings and directories of electronics recyclers. For tonnage and output distribution analysis, we leveraged the IDC Tracker databases relative to IT equipment. Using survey respondents as to the relative position of IT equipment, extrapolations were made in other electronics segments not tracked by IDC. They include TVs, industrial and medical equipment.

SITUATION OVERVIEW

The purpose of this survey is to assess the state of the U.S. electronics recycling industry. It is meant to provide both a fresh set of metrics and demographic profile of industry players. To make an objective assessment, IDC focused on four distinct groups to solicit responses to the survey. These groups are:

- Electronics Recyclers
- Scrap Recyclers who also handle electronics
- Original Equipment Manufacturers (OEMs)
- Non-Profit/Not-for-Profit Organizations

IDC believes these groups account for an accurate representation of the electronics recycling activity in the US.

Respondents' Profiles and Demographics

As one would expect in the diverse electronics recycling sector, the respondents' profiles are varied with some similarities and many differences among the organizations that took part to the survey. For example, given the source lists, we

found that 49.5% of the respondents are members of ISRI, while 50.5% are not. In analyzing the types of organizations responding to the survey, we found that they met IDC's profile and understanding of the leading players in IT equipment recycling, as a subset of the electronics recycling industry, and by extension the entire electronics recycling sector given that IT equipment recyclers also recycle TVs, industrial and medical equipment. Indeed the seven OEMs responding to the survey represent the majority of IT equipment manufacturing and are involved in customer interfacing in hardware asset recovery in the United States. Broadly, this group of companies represents a substantial share of IT equipment manufacturing, also a major subset of the broad electronics market. By IT hardware, IDC means electronic systems used to power information technology in the commercial and consumer markets. They include desktop computers, notebook computers, printers (excluding consumables), servers, tablets and other IT assets.

Likewise, IDC has identified in the survey 104 core industry players that are designated as "electronics recyclers." These are for-profit businesses that specialize in the handling of used and end-of-life electronics equipment that includes related services from data security to reverse logistics. Given the nature of that industry, the 104 players who contributed in the survey provide a statistically accurate and comprehensive representation of the market.

Twenty-nine not-for-profit organizations that contributed to the survey, providing insights on how this sector operates an electronics recycling operation. Table 1 provides the breakdown of recycler categories surveyed for this report.

TABLE 1	
Recycler Category	
Category	Percent
Electronics Recycler	57.1%
Other Scrap Recycler	15.9%
Original Equipment Manufacturer (OEM)	3.8%
Non-Profit/Not-for-Profit Organization	15.9%
Other	7.1%
Total Percent	100.0%
N responding to this question	182

Source: IDC, September 2011

Organization Sizes

The survey indicates that the industry comprises of a relatively large number of small recyclers, with 50.5% employing 10 or less workers. However, 14.6% of the respondents employ more than 100 employees (see table 2). Medium-sized organizations (11 to 100 workers) represented more than one third of the base (35%).

TABLE 2

Organization Size

Size	Percent
1-10	50.5%
11-20	7.8%
21-50	17.5%
51-100	9.7%
101+	14.6%
Total Percent	100.0%
N responding to this question	103

Note: Removed outliers include those responding "zero" or "Don't Know"

Source: IDC, September 2011

As far as the number of years in electronics recycling, we calculate the mean and median to be 9 to 10 years both. Table 3 shows the distribution among the ranges selected for years of operation. We note that owing to the strong growth of the recycling sector, some 58.7% of the companies surveyed got into the electronics recycling sector over the past 10 years.

TABLE 3

Years in Electronics Recycling Business

Years	Percent
1-5 Years	31.6%
6-10 Years	27.1%
11-15 Years	24.5%

TABLE 3

Years in Electronics Recycling Business

Years	Percent
16-20 Years	9.7%
21-25 Years	3.2%
26+ Years	3.9%
Total Percent	100.0%
N responding to this question	155

Source: IDC, September 2011

Estimated Volumes Moving into the Recycling Stream and Estimated Volumes Ready for End-Of-Life (EOL) Management in 2010

In order to assess the size of the "addressable" market, IDC begins its analysis with its PC retirement model using current available statistics from IDC databases. The details of this analysis could be found in the Annex section, with the following summary findings:

2010 Recycled Volumes

- ☒ In the IT equipment category alone, a subset of the broad electronics recycling industry, IDC found that about 2.1 million tons were recycled in 2010, which accounts for 62.6% of all electronics recycling input reported by the survey respondents.
- ☒ Using the remaining shares of other categories, namely, Telecommunications Equipment (cell phones, switching systems, phones), Consumer Electronics (TVs, music players, cameras, phones, stereos), Industrial (manufacturing, monitoring, test and measurement), Medical (scanners, medical/laboratory equipment) and Other, *we conclude that the total volumes of electronics equipment recycled in 2010 was estimated at 3.4 million tons.*

2010 Estimated Annual Volumes Ready of EOL Recycling Management

While it is no trivial exercise to estimate the addressable market, often referred to as "Products Ready for EOL Management," IDC estimates that such volumes may have exceeded 6 million tons in 2010. Such extrapolation exercise is much more complex than estimating input into the recycling industry, given that recyclers and the industry at large share data that provide an accurate picture of the recycled volumes. Yet, there are a few ways that allow us to reach a wide range on the possible volumes of decommissioned electronics available for recycling each year, although most results

would lead to approximations. For an analysis of how we estimated volumes ready of EOL, please refer to the Annex section.

The Industry's Economic Profile

In this section, we highlight the electronics recycling industry's economic profile. To do so, we use three metrics that provide key indicators of economic impact. They are the number of companies involved, employment and revenue.

Companies Involved in the Electronics Recycling Sector

There are between 600 to 1,000 companies active in the electronics recycling space. Because a substantial percentage of organizations involved in the electronics recycling industry are small scale operations, they tend to remain outside of the scope of the various industry listings and directories, including associations and government sources.

In our first approach in assessing how many companies operate in electronics recycling, several sources were used and then compared with our respondents' list. Using a variety of publically available directories and industry lists, we found that the number of active companies is between 600 and 1,000. When merging the various listings and removing duplicates, IDC found 980 unique organizations. Of the 980 organizations listed, we have selected only those defined as recyclers and refined the number of active, legitimate companies down to 642. However, given those listings were updated three years ago, and considering the industry's consolidation over the past three years, it is possible that the figure would drop to 600. This reduction is necessary to take into account the wave of mergers and acquisitions we witnessed over the past few years.

Balancing the facts that the number of industry players may be under-reported with the industry consolidation of the past few years lead us to a possible range of 600 to 1,000 companies active in the recycling space.

Per-Company Full-Time Employment

In assessing the size of the workforce involved in the electronics recycling industry, we use two data points for the purpose of approximation. The first is the average employment figure reported by the respondents. Given the survey participants were provided with value ranges, we have selected mid-points as estimates for each specific range, with the highest employment figure of 150 for the open-ended range of 101+ employees, acknowledging that one respondent reported 550. We have also eliminated respondents that provided 'zero' and 'Don't Know' as answers to avoid biased results. As such, we estimated the average number of employees reported for 2009 to 36.2 workers involved in electronic recycling, then growing to 39.4 in 2010 as the industry expanded, calling for a 2011 outlook of 44.1. See table 4.

TABLE 4**Employment figures: Average Full-Time Employment Per Company**

Year	Mean employment
2009	36.2
2010	39.4
2011	44.1

Note: 2011 is calculated based on respondents' intentions

Source: IDC, September 2011

Industry Employment

Our assessment of industry employment takes into account two variables. The first is the number of companies involved in the industry, with a range of 600 to 1,000. The second is the average employee figures reported in the above section. As such, we determined that the employment range for full-time workers is 23,616 on the low end of the possible range, and 39,359 on the high end. Averaging these two ranges leads us to an approximate employment figure of 31,487 in 2010.

In keeping the same range of companies of 600 to 1,000 for 2009, we conclude that employment in 2010 may have expanded by 8.6%, from 28,998 to 31,487. The 2011 outlook calls for a growth of about 12% to 35,296, a figure that may be too optimistic given the state of the US economy, yet it confirms the industry continues to see growth in the foreseeable future. See table 5.

TABLE 5**Estimated Nationwide Electronics Recycling-Related Full-Time Employment**

Years	2009	2010	2011
Full time employment	28,998	31,487	35,296

Note: the number of recyclers is based on the Intl Association of Electronics Recyclers directory listings

Note: the calculated employment figure includes only the industry category called "Recyclers". It does not include employees of other entities such as not-for-profit and charities.

Source: IDC, September 2011

Estimated Industry Revenue for 2010

Because of the heterogenous nature of the sector, providing full accuracy on industry revenue is challenging. However, using survey results and publically available listings

of companies involved in the sector, we begin to build a profile that provides a better understanding of the industry's economic impact. We have used a variety of methods to calculate industry revenue, most of which lead to the same conclusion. In broad terms, a simplified approach of calculating the 2010 revenue figure is to simply multiply the total input that the industry has treated in 2010 by the average revenue per ton. The survey results show that the respondents' combined revenue was \$999.1 million. Their combined input was 620,000 tons. This yields an average revenue per ton of \$1,500. Then by applying this average per-ton revenue to our calculated 3.5 million tons, the estimated industry revenue in 2010, using this simplified approach was \$5.2 billion. See table 6.

These results were triangulated with other methods that reach the same industry figure, based on the results that the volume recycled by the survey respondents amounted to some 20% of total calculated industry volume. These various methods provide the same results in terms of industry revenue.

TABLE 6	
Industry Revenue Estimates: Key Points	
Average revenue per ton	\$1,500
Input in Tons	3.5 million
Estimated Revenue	\$5.2 billion

Source: IDC, September 2011

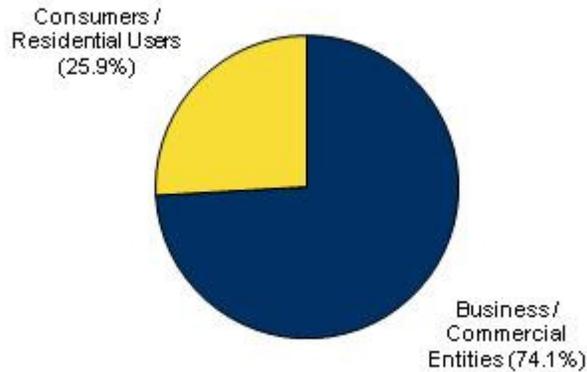
Electronics Recyclers Input and Output Analysis

An assessment of both the input and output in the electronics recycling industry is conducted using the survey results. We note the following:

- ☒ **Consumers/Household Contribution is Minimal in Recycling Input:** As stated in introductory sections, the consumer/household and residential contribution is problematic. It represents a market share of less than 26% of what recyclers receive, yet the consumer market is the largest in terms of electronics purchases. See figure 1. The very likely implication of this finding is that a substantial volume of systems retiring from consumers/households may actually end up in landfills and not recycled. Therefore improving household collection and access to the recycling infrastructure is critical in any future recycling strategy debated by stakeholders. An increase in consumers/household contribution will not only contribute in greater environmental protection, but it would inevitably spur economic growth and job creation with an expanded industry.

FIGURE 1

Share of consumers/residential users and business/commercial entities in recycling industry input



Note: 140 companies responded to this question

Note: BUSINESS/COMMERCIAL ENTITIES include manufactures/OEMs, industry users, financial and leasing organizations, government agencies, schools/universities, etc.

Note: CONSUMERS/RESIDENTIAL USERS include retail returns, manufacturer/OEM takeback programs, collection programs, direct from consumers, etc.

Source: IDC, September 2011

- ☒ **Commodity Grade Scrap is Bulk of Recyclers' Final Output:** Almost 70% by weight of the 3.5 million in tonnage was processed into commodity grade scrap, such as steel, aluminum, copper, precious metals recovered from circuit boards, glass, and plastic (Q14A). This figure includes the directly reported 49.1% of commodity grade scrap in table 7, with an additional 60% output sent for recycling from reuse, refurbishment and repair.
- ☐ The second largest output comes in form of equipment, essentially representing equipment for reuse/resale, repair, refurbish or recycle. That category gathered a 38.9% share of output volumes, equivalent to 1.24 million tons. As pointed out above, about 60% by volume of this category is then directed to recycling.
- ☐ Third largest source of output are parts (for reuse/resale, repair, refurbish, recycle), accounting for 8.4% of total volume, followed by 2.1% for disposal (including alternative daily cover, waste to energy, landfill and incineration) and another 1.5% coming out in form of other type of output.

TABLE 7**Output Categories by Weight**

Output Type	Output share mix	Volumes in tons
Commodity Grade Scrap (including ferrous and non-ferrous metals, glass, plastic, printed circuit boards, etc.)	49.1%	1,571,656
Equipment (for reuse/resale, repair, refurbish or recycle)	38.9%	1,244,529
Parts (for reuse/resale, repair, refurbish, recycle)	8.4%	267,719
Disposal (including alternative daily cover, waste to energy, landfill and incineration)	2.1%	67,025
Other	1.5%	47,984
Responding to the question	119	3,198,913

Note: Some 60% by volume of the category "Equipment (for reuse/resale, repair, refurbish or recycle)" is then directed to recycling.

Source: IDC, September 2011

Regional & International Markets

Still using the survey results, we learn that the US geography remains the biggest market for survey respondents' direct output in both weight and value. 78.66% reported that their output was traded, sold and/or transferred within the United States. Subsequently, much of this output is further sold into the US and global marketplace, of which 70% by weight (of the 3.5 million output in tonnage) is resold as commodity grade scrap, such as steel, aluminum, copper, precious metals recovered from circuit boards, glass, and plastic, 10% is resold as functioning equipment and components for direct resell, and less than 18% is resold as equipment and components for further repair and refurbishment.

FUTURE OUTLOOK

IDC believes recycling is facing sustained growth going forward. As we move to a multi-device per user environment, where it is no longer about a single PC per household, or even one laptop per consumer but many devices per user, the need to recycle retiring equipment will expand drastically. In the foreseeable future, older systems will have to be handled on the downstream to make way for new designs and concepts. This is going to be the immediate short-term challenge of the recycling industry before adjusting to new designs and new generations of products.

But as opportunities grow, challenges abound. Among the most interesting areas to consider:

- ☒ **Incentive Policies to Influence Residential/Household Recycling Would Boost Industry's Economic Contribution:** The industry contribution of \$5.2 billion in revenue shows a Compound Annual Growth Rate (CAGR) of approximately 24%. However, this growth still does not match the performance of many other industries. Households, residences and small quantity generators continue to significantly under-recycle their electronics. A significant increase of recycling in these sectors could double the value of the market. What is needed is a set of incentives to encourage greater recycling of used residential and household electronics equipment. Such incentives would also convince investors to commit further resources needed to sustain the current US electronics recycling infrastructure and boost the economic profile of the industry. In addition, the industry is characterized by too many small to very small players that are often less sophisticated and difficult to assess. Without scale, stability may be difficult to attain and market growth potentially compromised.

- ☒ **Downstream Diligence on Environmental Practices and Data Security Important to Recycling Customers:** The survey shows that of the 6 major OEMs responding to the survey, virtually all of them (88.3%) consider downstream diligence as their top priority when selecting a recycling partner. This is consistent with the position of corporate end users who seek protection against data security issues and liability related risks such as negative impacts related to environmental pollution and unsafe worker conditions. The fear of making the wrong decision from an environmental and compliance standpoint is widespread, hence the need to insure that recyclers are well prepared to handle growing volumes of used and end-of-life electronics equipment in a responsible manner. Half of the OEMs reported data and facility security as a priority, with the same rate applied to pricing.

- ☒ **Importance of Certification in Electronics Recycling:** One third of the OEMs surveyed said certification is a priority for them when selecting recycling partners. And the recyclers are responding appropriately. Indeed 50.5% acknowledge that without certification, it may be difficult to compete. Almost half (48.6%) say their own customers are requiring certifications. See table 8. Given the critical position of certification in recyclers' share of mind, we expect certifications to expand going forward.

TABLE 8	
Reasons to Obtain Third-Party Certification	
Competitive advantage	50.5
Customer requirement	48.6
Operational improvement	22.9

TABLE 8

Reasons to Obtain Third-Party Certification

Competitive advantage	50.5
Regulatory/legislative mandate	17.1
It is not important to my business	16.2
Industry recognition	12.4
Risk mitigation	12.4
Other	1.0
Unweighted Valid N	105

Source: IDC, September 2011

- Expect More Volumes in the Future:** Recyclers are anticipating an increase in their own volumes. Indeed, table 9 indicates that those expecting an increase of volumes next year accounted for more than 79% of the respondents. Those with "significant" expectations accounted for a solid 39.3%. Anticipating such growth means a more organized sector has to emerge to insure a more positive economic impact. From IDC's perspective, because of the continued growth in electronics recycling, certifications will also become increasingly critical to ensure that a common set of best practices are utilized throughout the marketplace.

TABLE 9

Volume Expectation for Next Year

Expectations	Percent of respondents
Significant Decrease	0.9
Modest Decrease	2.8
About the Same	16.8
Modest Increase	40.2
Significant Increase	39.3
Unweighted Valid N	107

Source: IDC, September 2011

- ☒ **Consumers (Residential Users) Under-Recycle:** While residential households continue to absorb a majority volume of new product purchases, from PCs to smartphones, and from tablets to television sets, they remain a minority contributor to the recycling volumes. To illustrate the issue, just on the PC side, IDC's PC Tracker database shows that 53.07% of the computers sold in the United States were absorbed by residential households. Yet, the residential household sector contributed by with only 25.9% of the input tonnage associated with the respondents' electronics recycling business. Enterprises and the public sector (e.g., federal, state and local governments) accounted for 74.1% of the reported input. With the proper incentive policies that would address the residential/household electronics recycling sector, economic and environmental concerns are likely to improve as a result.

- ☒ **Operational Costs and Input Origination Top Recyclers' own Business Challenges, Regulation and CRTs seen as Key Industry Problems:** For the industry, the challenges however are much more standard and similar to what we see in other businesses. Half of the respondents consider the cost of their own operations as being a critical issue. That is followed by the problem of procuring input and sufficient volumes of equipment for recycling, reported by 47.7%. Table 10 shows that all other challenges are generally the concern of less than 20% of the respondents. When considering the whole industry, irrespective of their own business, the respondents pinpoint to the thorny issue of the CRT glass markets, followed by regulation as indicated in table 11

TABLE 10

What are the major CHALLENGES facing YOUR electronics recycling operations or programs in the next year?

Issues	Percent of respondents
Cost of operations	50.5
Sources of equipment, parts, materials	47.7
Markets for outputs	19.6
Certification	15.9
Lack of Capacity	14.0
Prices for materials & parts	14.0
Other	20.6
Unweighted Valid N	107

Source: IDC, September 2011

TABLE 11

What are the major CHALLENGES facing the electronics recycling industry in the next year?

Issues	Percent of respondents
CRT Glass Markets	40.2
Legislation/regulations	32.7
Costs to process low valued consumer electronics	29.0
Non-repairable equipment exported as reusable goods	25.2
Logistics/transportation	23.4
Export bans eliminating markets	21.5
Commodity prices	20.6
Certification	15.0
Product take-back programs	15.0
Plastics recycling	11.2
Other	9.3
Post shredder separating technology	6.5
Lack of Capacity	4.7
Unweighted Valid N	107

Source: IDC, September 2011

ESSENTIAL GUIDANCE

Although small compared to other sectors, the recycling industry has the opportunity to expand and become an even bigger contributor to the economy. With the rise of new standards and certifications, the industry is moving in the right direction, though additional incentives could effectively stimulate the household/residential sector. On the commercial front, while best practices are spreading rapidly, the recently released report titled "A National Strategy for Electronics Stewardship," provides further steps in insuring best practices. Spearheaded by an Interagency Task Force led by the White House Council on Environmental Quality (CEQ), Environmental Protection Agency (EPA), and General Services Administration (GSA), the report issued recommendations that seek to improve the outcome of recycling of electronics assets retired by federal agencies, as well as provide recommendation on product design

with environmental stewardship in mind. The report highlights the need to use certified recyclers and design products that meet environmental standards.

LEARN MORE

Sizing the Electronics Recycling Volumes

This section provides a description of the methods used to assess the size of the volumes recycled and the addressable quantities as well.

Estimated Volumes Ready for End-Of-Life (EOL) Management in 2010 and Estimated Volumes Moving into the Recycling Stream

In order to assess the size of the "addressable" market, IDC begins its analysis with its PC retirement model using current available statistics from IDC databases. See table 12 for summary.

- ☒ **PCs' Central Processing Units:** In 2009, IDC PC Tracker estimated that the installed base of computers (desktops and laptops) in the US amounted to 182.3 million units. In 2010, that figure increased to 186.2 million. IDC further estimates that 2009 to 2010 retirement rate of those above listed systems just in the consumer (home) market was 19% or 35.87 million units. The equivalent figures in the commercial sector is a retirement number of 33.6 million units, or 22% of the 2010 installed base of 152 million systems in the commercial market. With its desktop averaging 25 pounds in weight and the laptop at 6 pounds on average, we calculate that the total weight of the 69.5 million retired PCs to be 1.338 billion pounds, equivalent to 694,282 tons. By retirement, we mean decommissioned and no longer used but which have not necessarily moved into the recycling stream, as a sizeable percent of those volumes is not necessarily recycled in 2010 but is stored.

- ☒ **Decommissioned vs. Recycled PC CPUs:** This distinction is very critical in that it differentiates between what is available to recycle that year from the installed base, versus what is actually being recycled, augmented with volumes from the previous five years. In the CPU context, two additional variables are applied to make the analysis more logical. The first is that not all volumes retired from the 2010 installed base are recycled. IDC calculates that of the 338 million units in the 2010 installed base, 69.48 million were retired, equivalent to 1.388 billion pounds, an estimated 19.6% moved into the recycling stream. The rate is calculated using a variety of end-user surveys that ask respondents a series of questions about their recycling practices and strategies. The four broad groups surveyed by IDC are Enterprises, SMBs, public sector entities, and consumer users. Each group has its own recycling requirements that are factored in into the recycling rate. A combined view shows that for the systems decommissioned in 2010, 19.6% found their way into some sort of recovery, disposition and recycling channels. This figure is consistent with what EPA reported for 2006-2007 recycling rates that address the Municipal Waste Stream – predominantly driven by consumer/residential sources. This means that while almost 20% of those IT systems found their way into the recycling industry, the remaining 80%

(predominately household/residential streams) are moving into the non-hazardous waste stream, most likely sub-title D landfills. Furthermore, our model had to take into account the systems that have been retired in the previous years but then moved out of "storage" and into recycling. IDC selected a 5 year lifecycle model to account for systems coming out of earlier years. For 2010, we have added an average of 236 million pounds for each of the previous five years of systems moving into the recycling channels. In all, for 2010, the estimated CPU volume was 1,452,738,422 pounds, equivalent to 726,369 tons.

- ☒ **PC Displays and Monitors:** In addition to the above CPU units, IDC counts that 44.6 million PC displays, that is CRT and flat panel monitors were decommissioned in 2010. The figure is lower than the 66 million CPUs for a number of reasons. Firstly, not all CPUs carry a display given the majority share of notebooks. Secondly, monitors' retention rates and lifecycles are longer than CPUs. Enterprises in particular tend to keep displays far beyond the life of the PC. Assuming a 30 LB average, considering the heavy weight CRTs at 50.5 pounds EPA estimate and light weight flat panels at 24.6 LB EPA estimate, we estimate the total weight of the 2010 retired displays to amount to about 1.34 billion pounds, equivalent to 669,468 tons. Unlike the PC CPUs, displays and monitors covered this section, as well as subsequent products below are considered as products moving into the recycling streams.
- ☒ **Basic Input Devices:** In this category, we would include basic input devices such as mice and keyboards, as well as cables. The first category (input devices) is assessed at 3% of total CPU weight, or 43.6 million pounds, equivalent to 21,791 tons. With 1% CPU weight equivalent, cables would amount to a volume of 14.5 million pounds or 7,264 tons.
- ☒ **Core PC Totals:** In combining CPU, display, basic input devices and cables as described above, we estimate that the core PC volume moving into the recycling space as we exited 2010 to be 1.424 million tons.
- ☒ **Other IT Equipment:** Similar analyses were performed on the various IDC datasets and Trackers, namely x86 servers, MFPs, and mobile phones. For the first category of products (x86 servers), the volumes are relatively limited since retired units were just equivalent to 61.0 million pounds or 30,509 tons. No EPA estimate is available for this type of product that would allow triangulation. MFPs or multi-function peripherals such as printers and copiers generated 185,854 tons in 2010, versus an EPA estimate for 2005 of 198,300 tons (the EPA estimate does not account for large quantity business/commercially generated material). The lower volume from 2005 to 2010 is probably due to hardware consolidation initiatives and companies reducing their spending on printing infrastructure. For mobile phones, IDC estimates 54,760 tons moved into the recycling stream in 2010, versus an EPA high-range estimate of 18,600 tons in 2005. This increase in volume is attributed to the high growth of mobile phone adoption, and a fast consumer move from standard phones to smart phones prompting an accelerated decommissioning of older phones.
- ☒ **Products Tracked by IDC but not Subject of a Retirement Model:** Within the IT space, two mass market products were assessed arbitrary volumes based on

specific assumptions. For storage devices, IDC estimated it to be about the size of the x86 server market or about 30,509 tons in 2010. Digital cameras, although tracked by IDC, are also not assessed a retirement model. We have measured it as equal to 40% of the mobile phone volumes. Thus, the equivalent weight for digital cameras is 21,903 tons. We do recognize the limitations of these figures, but given their small volumes, they do not have a major statistical influence on the data. Those arbitrary estimates are meant to fill the blanks of missing variables.

- ☒ **Products Not Tracked by IDC:** In its coverage of the IT space, IDC does not track medical and industrial equipment, as well as key sub-sets of consumer electronics such as TVs and stereos. To assess these products, IDC uses the results from the survey to extrapolate approximate volumes recycled by the recycling industry. Table 13 and the following section provide the results of the extrapolation exercise.

TABLE 12

IT Equipment Volume Assessment: Recycled Weight in 2010			
Tracked/Partly Tracked by IDC	Categories	2010 in LB	2010 in Tons
Tracked by IDC	PCs	1,452,738,422	726,369
	x86 servers	61,018,292	30,509
	PC monitors	1,338,935,792	669,468
	MFPs	371,708,547	185,854
	MobilePhones	109,519,131	54,760
	Sub-Total Tracked by IDC	3,333,920,184	1,666,960
Tracked without Retirement Model	Storage	61,018,292	30,509
	Keyboards, mice	43,582,153	21,791
	Cables	14,527,384	7,264
	Digital cameras/cams	43,807,653	21,904
	Sub-Total Tracked without retirement mode	162,935,481	81,468
	Total Mass IT	3,496,855,665	1,748,428
PCs, displays, accessories ONLY			1,424,892
Considering networking and enterprise IT at 10% of total weight, total weight is			2,185,535

Note: The 2.19 million tons represent the combined 80% of calculated IT equipment weight, added with a 20% of networking equipment and enterprise IT such as data centers

Source: IDC, September 2011

Quantitative Extrapolation of Volumes Recycled by the Recycling Industry

The survey asks recyclers to provide a distribution of the total input tonnage associated with their electronics recycling business. Five options were given to select as follows:

- Computer Equipment and Peripherals (e.g., laptops, desktops, printers, networking, enterprise IT)
- Telecommunications Equipment (e.g., cell phones, switching systems, phones)
- Consumer Electronics (e.g., TVs, music players, cameras, phones, stereos)
- Industrial (e.g., manufacturing, monitoring, test and measurement)
- Medical (e.g., scanners, medical/laboratory equipment)
- Other

The responses for all the respondents are in table 13, with their respective estimated volumes.

Of the IT products tracked, we are able to identify 1.748 million tons of products recycled by recyclers within the sub-category called *Computer Equipment and Peripherals (laptops, desktops, printers, networking, enterprise IT)*. This figure includes the 19.6% recycling rate just for the assets that are retired from the 2010 installed base, augmented by volumes coming from the previous five years.

Given the missing products in that sub-category, namely networking equipment and large enterprise IT such as data center electronics; we have uplifted that main category so that the missing products would amount to 20% of total volume. The missing products would include critical components of data centers and large enterprise IT. Therefore, we are now assuming that the *Computer Equipment and Peripherals (laptops, desktops, printers, networking, enterprise IT)* would weigh 2,185,535 tons, which will be used as the equivalent of 62.6% of global recycling input. Using this figure as equal to 62.61% based on the input used by the recycling industry, we calculate other inputs as reported in table below (table 14).

2010 Estimated Annual Volumes Ready of EOL Management

While it is no trivial exercise to estimate the addressable market, often referred to as "Products Ready for EOL Management," IDC estimates that such volumes may have exceeded 6 million tons in 2010. Such extrapolation exercise is much more complex than estimating input into the recycling industry, given that recyclers and the industry at large share data that provide an accurate picture of the recycled volumes. Yet, there are a few ways that allow us to reach a wide range on the possible volumes of decommissioned electronics available for recycling each year, although most results would lead to approximations.

In our analysis of IDC data related just to desktops and laptops, we found that in 2010, a total of 1.388 billion pounds were decommissioned. From previous years, assuming a 5-year lifecycle, we added 1.181 billion pounds, volumes essentially migrating from earlier years. In all, the combined figures would be what the addressable market (or volumes ready for EOL management) would represent for the year 2010, or a total of 2.569 billion pounds. Knowing that 1.453 billion pounds moved into the recycling streams, the recycling rate for PCs that year only was 56.5%.

Using the same approximate figure for the total electronics products covered in this report, it is possible that the addressable volumes would be about double what moved into the recycling stream as calculated in table 13, or in this case more than **6 million tons**. This figure is very approximate, in particular when one considers that life cycle management and EOL are different from one category to another. This figure merely says that it is possible that the addressable weight opportunity was 6 million tons in 2010.

TABLE 13

Recycling Input in Weight

Input	Percent split in survey	Estimated tonnage recycled by industry
Computer Equipment and Peripherals (laptops, desktops, printers, networking, enterprise IT)	62.6%	2,185,535
Telecommunications Equipment (cell phones, switching systems, phones)	9.9%	346,105
Consumer Electronics (TVs, music players, cameras, phones, stereos)	15.5%	540,640
Industrial (manufacturing, monitoring, test and measurement)	4.4%	155,151
Medical (scanners, medical/laboratory equipment)	2.0%	68,923
Other	5.6%	194,535
Total:	100.0%	3,490,888

Source: IDC, September 2011

Related Research

- ☒ *IDC Sustainability Service: Visit <http://www.idc.com/research/greenit.jsp>*
- ☒ *ICT for Sustainability Blog: <http://idc-insights-community.com/resources/aa8b24e5c3/summary>*
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- ☒ *(<http://www.epa.gov/osw/conserves/materials/ecycling/manage.htm>)*

Synopsis

Electronics recycling has shown tremendous growth over the past 10 years. The US electronics recycling industry positively contributes to the US and global economy, saves energy and conserves valuable natural resources. Hundreds of organizations and thousands of workers are active in the sector, figures that have been growing over the years as the use of electronics equipment becomes ubiquitous and generalized. This document reports some key findings of a survey conducted by IDC in April and May 2011.

"Approximately 3.5 million tons of electronics were recycled by the recycling industry in the United States in 2010, employing more than 30,000 workers with estimated revenue of over \$5 billion," says David Daoud, IDC's Research Director.

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