

the lower stratum shows a higher percentage of not having had a TV; the rest keep it in use.

TABLE 5. ACTION TAKEN WITH PREVIOUS TV SET, BY STRATUM

		Stratum			Total	Total Percentage
		Low	Medium	High		
What did you do with the old TV set?	Given it away	24	35	6	65	38
	Sold it	8	1	1	10	6
	Abandoned it	4	10	0	14	8
	Kept it to use	6	19	3	28	16
	Kept it without use	11	8	0	19	11
	Did not have	17	8	0	25	14
	Left it in repair shop	1	1	0	2	1
	Given it as payment	5	0	0	5	3
	Other	1	3	1	5	3

The economic value given to the TV set and the perception that it is still working, contribute to motivating respondents to keep, give or sell it to a relative or somebody that needs it, typically a person who has worked for the household. If respondents keep it for themselves, the purpose is to provide entertainment to other members of the family. This also has to do with the increased variety of uses; watch TV, watch DVD movies, play video games, view photos, and even play music. Respondents would donate their TV set without getting anything in return, since they perceive this as compensation for other services received, or as an act of generosity. Alternatively, respondents require money for their old TV set in order to recover part of the invested money. Respondents who try to sell it, but finally keep the TV set, believe that it could be used later in a specific situation; for example, in case the current TV set is damaged or if a relative needs it. Other reasons to keep it are that the monetary compensation is not considered high enough. Availability of space also affects whether a respondent will keep their old TV set.

The Post-Consumption Phase

A share of 86 per cent of the surveyed population would recycle their TV set, yet 96 per cent of the respondents do not know companies that offer a recycling service, denoting insufficient communication of recycling strategies. In Colombia, there are companies such as “Lito Ltda” which are authorized to manage biphenyls or polychlorinated biphenyls (PCBs), and mercury and sodium lamps, as well as electronic wastes (computers); “Gaia Vitare Ltda” handles some WEEE from the telecommunications sector, and SLI Colombia S.A. (Silvania) handles and disposes of neon lights. However, there are no companies that offer such services for TV sets. Lito has processed approximately sixteen televisions between all branches of the company, for an approximate total weight of 500 kg. They have studied alternatives to the end of life and the disposal of CRTs and LCD, and reported that so far in the country there are no acceptable alternatives. They, therefore, addressed their actions in a research project and meanwhile sent the CRTs abroad for recovering.³³ Companies that offer export services of hazardous waste are Bayer (Germany), Veolia, (France), OCADE (Germany, Belgium, and Brazil), and TREDI

(Canada).

Respondents mention several reasons why TV sets should be recycled, and these vary somehow between the different strata. The first reason is to avoid health problems, followed by component reuse, treatment of hazardous components, and achieving economic benefits. Other reasons are deemed less relevant, such as avoiding saturation of landfills and recovering space at home, as shown in table 6. The foregoing shows that there is awareness of the risks associated with inadequate handling of waste. This awareness can be used as a motivation for the recycling of TV sets.

TABLE 6. REASONS FOR RECYCLING A TV SET, BY STRATUM

		(in per cent)			
		Stratum			Total
		Low	Medium	High	
Why recycle a TV set?	Avoid health problems	26	32	32	90
	Components can be reused	24	20	37	81
	Components are hazardous	24	18	9	51
	Economic benefit	12	20	13	45
	Landfill saturated	8	7	9	23
	Recover storage space	5	3	1	10

The first part of table 7 shows how much respondents are willing to pay for recycling a TV as a percentage of the cost. The second part lists the preference for a system for making such payment. The high preference for a bonus may be associated with a governmental initiative aiming to replace refrigerators produced before the year 1999 due to their content of ozone-depleting substances. The campaign was conducted between 30 April and 31 August 2008. Here, a bonus system was used and as a result of the campaign, 1,900 refrigerators were collected in four months.³⁴ This has set the precedent that giving back an EEE means a bonus for a new one.

TABLE 7. PREFERENCES CONCERNING RECYCLING, PER STRATUM

		Stratum			Total	Total Percentage
		Low	Medium	High		
How much would you be willing to pay to recycle the TV set?	0	51	47	8	106	61
	1-5 per cent	14	20	2	36	21
	5-10 per cent	5	15	1	21	12
	10-20 per cent	4	4	0	8	5
	20-30 per cent	1	1	0	2	1
	More than 30 per cent	2	0	0	2	1
Would you buy a TV that included the recycling cost in the price?	Yes	41	54	6	101	57
	No	37	33	5	75	43
Would you prefer a discount bonus for recycling the old TV when buying a new one?	Yes	73	84	11	168	95
	No	5	3	0	8	5

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Estimation of Flow of TV Sets

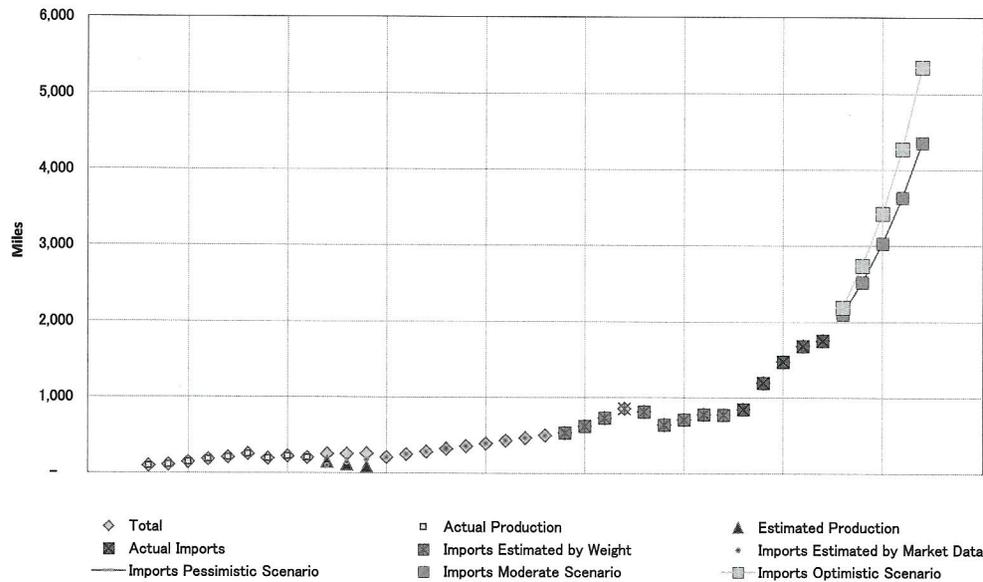
In Colombia, there are three stages associated with television technologies present in the country. The first one is characterized by the black and white (B&W) CRT TV. In this period (from 1973 to 1981), locally assembled TV sets outnumbered those imported. In the period 1982-2003, the colour CRT TV was the predominant technology. National production (assembly) diminished and percentage of imported sets increased. Finally, from 2004 to 2008, new technologies such as LCD and plasma appeared in the market; these are mainly imported TV sets. Currently, there is only a Colombian manufacturer (assembler), Challenger, and the rest are international suppliers.

B&W TV set production was undertaken by firms including Sharp, Hitachi, Philco-Sylvania, National, Spartak, Phillips, Toshiba, NEC-Challenger, and Zenith. These were mostly Colombian enterprises with international franchises. In the second stage, only six of the above companies remained, predominantly those backed by strong international brands. According to the figures from the Colombian Electronic Federation, from 1973 until June 1981 there were approximately 2.6 million B&W TV sets; whereas, according to the Home Appliances Chamber of ANDI (National Association of Manufacturers of Colombia), domestic production for the period was 1.5 million TV sets. Therefore, imported ones totaled approximately 1.1 million. There is no available data for the period from 1981 to 1994, therefore a linear-extrapolated function is calculated and contrasted with data from the index of imports of this period.³⁵ From 1994 to 2008, there is information available in the database of DANE.³⁶ A second source, the Home Appliances Chamber of the ANDI, has information from 2003 to 2008. The information from different organizations is in units and in weight (kg), so that the weight of each TV set can be estimated using the information of the City Council of Bluff³⁷ to convert units to kg. Moreover, by 2003 the duty item was not discriminated by TV screen technologies and from this year on, colour CRT, LCD, and plasma technologies are considered the same. Figure 4 shows TV sets existing in Colombia after consolidation and extrapolation of information from 1973 to 2008. The authors estimate that, in total, there are approximately 18.9 million TV sets in Colombia.

The trend of TV set purchase will continue to rise by the entry of the digital broadcast television and obsolescence, as well as a result of mass events such as the soccer World Cup.³⁸ The entry of digital television can affect between 11 per cent and 24 per cent of the consumption pattern, since it is one of the reasons for changing the TV set (13 per cent), although it may have a damping effect because some consumers will stall purchase until its full deployment (11 per cent). This is related to the governmental introductory campaign that announces the coexistence of the two systems until 2019, which lowers the pressure for a quick substitution. It is expected that the first transmissions will take place in the middle of 2010, coinciding with the Soccer World Cup. On the other hand, according to another study in 2008 which explored Colombian spending habits,³⁹ internet access increased by 74 per cent, mobile phones fell 16 per cent, and the purchase of plasma and LCD TV sets declined. Since the previous measurement was made just after the World Cup in 2006, it has lower figures but maintains the intention of purchasing TVs over 20 per cent,⁴⁰ corroborating the 24 per cent in the survey. Although this spending figure is considered moderate, due to the high family debt that grew by 44 per cent, it had the highest growth in stratum 2 with 337 per cent.⁴¹ Given the above, three scenarios have been considered: a moderate one where sales growth is 20 per cent, an optimistic one where maximum sales growth is 25 per cent, and a pessimistic scenario

where growth is expected to be just 15 per cent, as shown in figure 4.

Figure 4. Flow of TV Sets in the Market



To determine the flow of TV sets at the end of its useful life, not only the number of TVs sold in the market (sales) is taken into account, but also factors such as time of use, which contemplates the life span of new equipment (dn), time of reuse (ds), and storage time (dk).

$$WEEE \text{ generation } (t) = \text{sales } (t-dn) + \text{reuse } (t-ds) + \text{Storage } (t-dk)$$

Where: Sales (t) = Imports (t) + domestic production (t) - Exports (t)

dn: lifetime of the new TV

ds: lifetime in reuse

dk: storage time

The trend in the generation of WEEE is influenced by the rate of change in technology (ct) and the possible introduction of management systems for WEEE (I_{WEEE}).

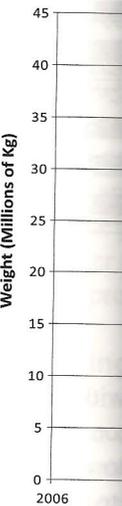
$$\text{Trend WEEE Generation} = \text{WEEE Generation } (t) * (ct) * (I_{WEEE})$$

The average lifespan of a TV in Thailand is eighteen years,⁴² in China eight years,⁴³ in Viet Nam seven years,⁴⁴ in India eight years, and three to four years for reuse and storage,⁴⁵ and Mexico is ten years.⁴⁶ In Colombia, based on the findings of the study reported in the previous section, the authors assume the average lifespan to be eighteen years because CRT TVs (B&W, curved screen) are given away, sold, or kept in use in another part of the house or even without use, thus extending life span. However, from 2003 it is estimated that TV sets have a shorter lifespan, ten years, since changes happen faster due to new technologies and scheduled technical obsolescence. A very long lifetime will slow the generation of waste. On the other hand, the introduction of an initiative of WEEE management that includes TV sets, which is expected to become operational in 2011, would increase the number of devices for recycling. The devices that

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Figure 5.



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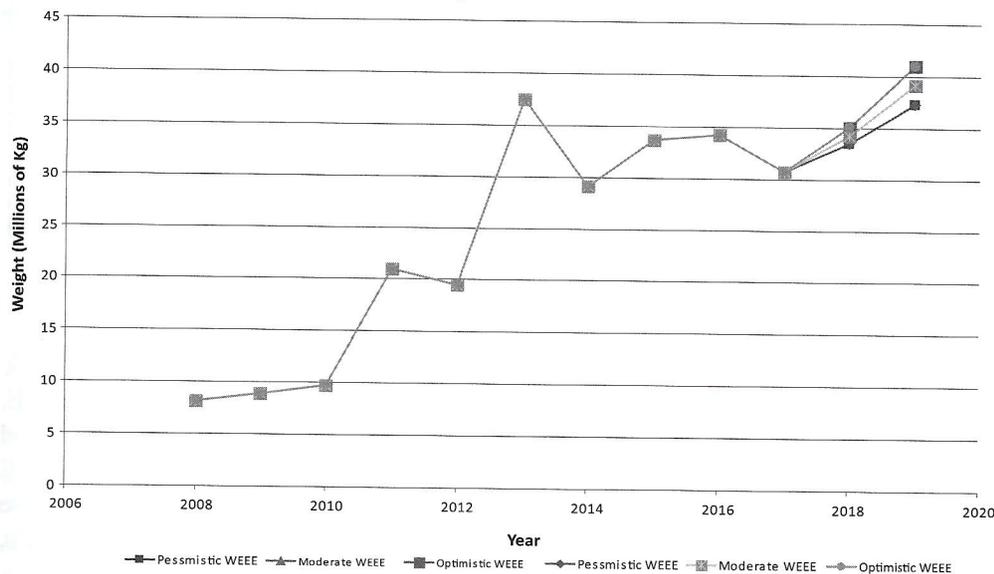
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The physical and management of TV sets of part of the system and institutionally decide to repair cost is custom remain participate in ally department Figure 6 shows occurs between waste dumps the implement

initially will be discarded are the oldest TVs or those slightly damaged, but will be mostly systems from CRT technology, both B&W and colour, since the LCD and plasma TV sets recently appeared on the market and LED technology is not yet at a commercial level.

Applying these factors to the volume of TV sets and presenting the data in kg, the authors would expect to collect 0.2 kg/year per person by 2011 and rise to 0.35kg/year per person by 2019, as shown in figure 5.

Figure 5. WEEE Potential of TV sets, in Tons

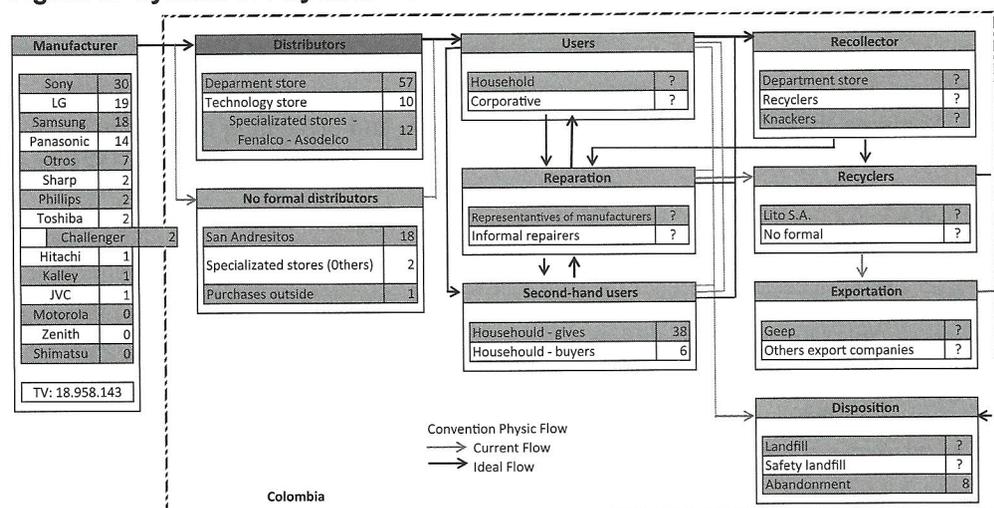


The peak in 2013 corresponds to the end of life of most of the colour CRT and establishment of the formal WEEE system.

Physical Flow of WEEE

The physical flow of EEE in the value chain involves manufacturers, distributors, users, and managers of end-of-life products. Manufacturers are identifiable through the brands of TV sets on the market. Importers, wholesalers, retailers, and department stores are part of the supply chain, which connect producers to consumers. Users are households and institutional or corporate actors, both in the private and public sectors. Users generally decide to repair TV sets that are slightly damaged or broken, especially when the repair cost is much lower than the cost of the new EEE. However, the most common custom remains reuse in its various forms. In the end-of-life stage, there are actors who participate in various voluntary recycling initiatives, including collectors who are usually department stores, recyclers, and exporters of WEEE, who ensure proper disposal. Figure 6 shows the physical flow of TV sets. It shows how in the current situation reuse occurs between different users, the flow of repair, and the deviation of these flows to waste dumps. It also shows how flows should be if each actor fulfills their role through the implementation of a WEEE management system.

Figure 6. System of Physical Flow of TV Sets



CONDITIONS FOR THE COLOMBIAN WEEE SYSTEM

The Colombian Government currently seeks to develop a system for dealing with WEEE. Introducing an integral management system for WEEE requires that socioeconomic and cultural aspects are taken into account, including the practices of reuse, storage, EEE life span, and the willingness to pay the fees. This system can be generalized to the entire urban region, since there are no significant differences by stratum. Based on the study, the authors present a number of conditions that such a system should fulfill.

Increased Flow of WEEE from TV Sets

The amount of WEEE is increasing as the number of TV sets per household grows, and the TV now provides individual rather than family entertainment. In addition, the market is not yet fully saturated. The size of TV sets also tends to increase and replacement with new technologies may be expected. WEEE quantities depend on Colombian population inflow, since in this region there is no record of incoming EEE for repair and WEEE from other countries.⁴⁷ Thus, a WEEE system is desirable, and should be supplemented with a governmental policy that prevents the emergence of an inflow of WEEE from other countries. Such an inflow can easily come about with the excuse that they are EEE to be refurbished and not WEEE; however, in other countries they have proven to cause high environmental and social impacts.⁴⁸

Dealing with Reuse

From the perspective of waste prevention, the high level of reuse in Colombia may be seen as positive. Consumer-to-consumer (C2C) reuse can continue outside the formal WEEE system because it occurs among family members or close friends. The practice usually occurs in the lowest strata.

Reuse/refurbishment should be established within the system that can build on the experience of a successful computer project that was recently implemented.⁴⁹ There is a market for this considering the socioeconomic condition of the population and low

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The Colombian government's implementation of WEEE on a national scale,⁵³ because the user and orphan products and have already to extend the formation of the WEEE in the development

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penetration rate of the EEE. Refurbishment assures the quality of EEE, if it is to be performed by a trained person, and for that reason could be preferable over C2C reuse. Business-to-consumer (B2C) reuse also plays a role; some services companies such as hospitals, which use TV sets as part of their service, usually perform an internal sale whenever they decide to renew their EEE inventory, with prices well below 5 per cent of purchase price.⁵⁰

However, reuse has a downside because older equipment is relatively inefficient in the use of energy,⁵¹ and has not been designed using eco-design principles. Moreover, there are three possible situations as follows:

- (a) The cost of the new EEE is less than the old refurbished EEE, so the consumer will not repair it and, instead, have it recycled;
- (b) Though the old and the new EEE are of similar cost, the consumer will still buy the new one from the perception that the refurbishing process would be adding value to a product that will soon be WEEE, since the refurbished EEE will not have a demand in the market; and
- (c) If the price of the new EEE is higher than a recently refurbished EEE, the consumer will choose the refurbished TV set, avoiding the use of resources involved in the production of a new EEE.

Assigning Responsibility

The Colombian TV market is currently dominated by a few manufacturers. The implementation of extended producer responsibility is thus feasible and is aligned with the government's intention.⁵² Producers may collaborate to take advantage of economies of scale,⁵³ because considering individual responsibility would result in a higher tariff for the user and discourage recycling. Also, collective responsibility enables dealing with orphan products of no longer existing brands. Manufacturers are mostly international and have already implemented similar schemes in developed countries, making it easier to extend their experiences to other countries.⁵⁴ Also, a collective system enables the formation of a larger company that can acquire the technological capabilities to deal with the WEEE in a manner that reduces environmental and social impacts. As a consequence, the development of an informal sector is prevented.

On the other hand, to encourage producers' individual responsibility, tariffs could be differentiated according to how easy it is to disassemble a product and the amount of hazardous substances it contains. This promotes the prevention of environmental impacts in the design stage. The authors conclude that a mixture of collective and individual responsibility is the best option.

How to Pay for the System

Establishing a fee would be difficult given the high percentage of people (61 per cent) who are not willing to pay for it. It is noteworthy that 95 per cent would be willing to receive a bonus of purchase for new equipment when discarding the old one. The precedent set with the refrigerator programme must be broken since such a business model is financially unfeasible.⁵⁵ The option that might work is an advanced fee at the time of purchase, as most people would not be willing to pay at the end of its useful life. Also, given the high levels of reuse of equipment among persons with lower economic resources, the inability to pay this fee may create a leak in the WEEE system. If the fee is paid in advance, the reuse would not be affected because only the first purchaser has

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