July 6, 2004

Mr. Sergio Musmanni
Centro Nacional de Producción Más Limpia
Apdo. 10003-1000
San José, Costa Rica

Dear Mr. Musmanni:

Enclosed is our report entitled Managing Waste from Mobile Phones in Costa Rica. It was written at Centro Nacional de Producción Más Limpia during the period March 30 through July 6, 2004. Preliminary work was completed in Worcester, Massachusetts, prior to our arrival in San José. Copies of this report are simultaneously submitted to Professors Lew Yan Voon and Salazar for evaluation. Upon faculty review, the original copy of this report will be catalogued in the Gordon Library at Worcester Polytechnic Institute. We appreciate the time that you have devoted to us.

Sincerely,

Jeremy Dugan Andrew Frascotti Richard Richter

Report Submitted to:

Professor Lok Lew Yan Voon
Professor Guillermo Salazar

Costa Rica, Project Center

By

Jeremy Dugan _____

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In Cooperation With

Sergio Musmanni, Director

Centro Nacional de Producción Más Limpia

MANAGING WASTE FROM MOBILE PHONES IN COSTA RICA

July 6, 2004

Abstract

Centro Nacional de Producción más Limpia seeks to establish a recycling plan for cellular phones and batteries in Costa Rica. This project had four goals: researching worldwide efforts in reducing e-waste, estimating the size of an effective recycling program, identifying key stakeholders in a recycling program, and proposing a model to reduce cellular waste in Costa Rica. By analyzing data from interviews, questionnaires, and archival research, we concluded that a recycling plan is feasible and have proposed an implementation scheme.

Authorship Page

All writing and research for this report was accomplished in equal measures by Jeremy Dugan, Andrew Frascotti, and Richard Richter. Each member of this team was responsible for writing the Introduction, Background, Methodology, Results, Analysis, and Conclusions and Recommendations.

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Executive Summary

Our project, managing waste from mobile phones in Costa Rica, consisted of the completion of four main objectives that the Centro Nacional de Producción más Limpia (CNP+L) outlined for us at the outset. First, we assessed the needs of key stakeholders that would benefit the most or be most affected from this work. Then, we evaluated models that other countries have used to reduce their e-waste. Third, we estimated the amount of waste that cell phones and batteries create to help us better understand the current trends in Costa Rica and the necessity of a nationwide cell phone and battery recycling program. Finally, from all of the information gathered, we proposed a model to reduce the cell phone and battery waste in Costa Rica, and made recommendations using that model to CNP+L for implementation.

In gathering information, it was crucial that we use the correct methods. After our background research and literature review, new data needed to be collected. We used the methods of interviews, archival research, and questionnaires. Interviews were used to evaluate the opinions of executives in environmental organizations, cell phone service providers, waste management companies, waste management consultants, representatives of large corporations that are potential collection sites, legal consultants, and representatives of the Costa Rican government offices. Archival research was used to further delve into the intricacies of legal documents, as well as to ascertain background information on key stake holding organizations. Additional archival research was done with respect to an existing cell phone and cell phone battery recycling program in the United States. Questionnaires were distributed at highly trafficked, high-population areas

in San José to better understand the public opinion of cell phone waste and recycling in general.

We have determined that it is not financially feasible to propose a recycling plan exclusively for cell phone batteries, and that cell phones must be included in this plan to produce a profitable volume of waste. It is also necessary to have a legally binding document that obliges manufacturers and importers to be legally, financially, and morally responsible for the waste that is entering Costa Rica on their account. This allows for fees and tariffs to be imposed, creating the necessary funding for a recycling program, including consumer incentives, funds for collection, transportation, sorting and packaging, as well as creating a financial base for advertising and public education. Cell phone owners are not philanthropically motivated to recycle cell phones for their own good or the good of the environment. Instead, they must be encouraged by the economic value of old cell phones and spent batteries that is reclaimed as a consumer incentive.

The problem with a recycling program does not lie with the technical aspects, but with the collection and transportation of the waste. There are a multitude of companies willing to turn a profit by salvaging and processing cell phone parts. The difficulty is in the transport of these parts from the consumer to these waste management companies. In our recommendations, we suggest that CNP+L, and other organizations promoting this recycling program, investigate a combination of public and private companies that could work together to accomplish this goal. For a recycling program to be successful, the route of the electronic waste must be planned from the owner, to a regional drop box, to a transport truck, to a sorting, dissembling and packaging station, to a national exporting site, and finally, to a recycling facility.

In our research and analysis, we have also discovered that public participation is a huge aspect in the success of any recycling program. To be willing to participate, the public must be both educated as to the dangers of cell phone waste and the benefits of recycling, as well as financially motivated to recycle via a discount or some other sort of economic incentive.

Chapter 1: Introduction

The rate of purchase, use, and subsequent disposal of cellular phones has increased rapidly in the past 10 years. Consequently, this boom in production has created a large volume of products which results in a large amount of hazardous waste for developed and developing countries. For instance, there were 132.8 million cell phone units sold worldwide just in the third fiscal quarter of 2003 alone. This amounted annually to over 500 million units in the whole year of 2003 (Krazit, 2003). If more units are sold then more are discarded, and more waste is produced. Since most cell phones weigh over 3.0 oz, more than 45 thousand tons of potential waste was produced in 2003. This has created significant problems for countries that have not invested in plans to reduce the waste when the battery dies.

Costa Rica does not have a waste management plan for cellular phone batteries. From 1999 to 2002 Costa Rica has seen a 400% increase in cellular phones (Costa Rica, 2004). Because of a lack of regulation, the batteries from these phones are, at best, disposed of in a landfill. Oftentimes, due to the inconvenience of proper disposal, they end up being disposed of hazardously or inefficiently. Problems that have arisen from the massive amount of cell phone waste are that toxic chemicals, namely Cadmium (Cd), contaminate the soil and ground water. Such contamination can affect human health, according to the Environmental Protection Agency (EPA) (2004). As the number of users increases over the next few years, Costa Rica will confront increasing problems from spent cell phone batteries, and the more imperative it will be to reduce the amount of cell phone batteries entering the waste stream.

Recycling is an effective method of reducing the waste entering an environmental system. Even though this problem of waste from electronic applications, or e-waste, is increasing, the government and public in Costa Rica, in general, have not taken an active role in recycling. Frequently the country has put aside environmental waste problems for greater or more immediate concerns (e.g. education, health, et cetera) (Estada Nacion, 2004). To paraphrase a statement from the Office of the United Nations High Commissioner for Human Rights, steps need to be taken (internationally) in order to introduce the public to recycling and increase the public's awareness of the benefits of recycling (UNHCHR, 2004). Individuals are not being informed on the proper ways of recycling e-waste, and cellular phone batteries in particular. The Costa Rican federal government has not set a regulation on cell phone batteries or publicly encouraged recycling of the batteries. Also the development of these policies has been slow in Latin America as a whole (UNEPTIE, 2004). Therefore, the Costa Rican public is not as aware as they could be of the hazards the chemicals in the batteries can cause for human health and the environment.

However, other countries have taken a proactive role in recycling Ni-Cd and Lead-acid batteries. For example, both the United States and Germany have seen significant increases in cellular phone usage, but have tried to curb the amount of waste going into local towns and dumps through each of their own approaches. The United States, for instance, has made a public law on the issue: "Public Law 104-142 (1996): 'Mercury-Containing and Rechargeable Battery Management Act.'" This law is designed to encourage recycling and make labeling of the batteries mandatory. In Germany, companies will "buy-back" spent batteries and sell new ones at a discounted

price. In Costa Rica, none of these innovative methods have been tried, but we feel that Costa Rica can benefit from cell phone battery recycling efforts made by other countries.

Centro Nacional de Producción más Limpia (CNP+L) is a non-governmental Costa Rican organization devoted to, as its translated name suggests, cleaner production on the national level. The e-waste generated from cell phone batteries is a concern of theirs, and they seek to implement a plan to reduce or eliminate the problems generated by cell phone batteries. Throughout the course of our research, we have discovered that it is financially unfeasible to focus solely on cell phone batteries, as originally intended, and have adjusted our project to include the actual cell phones as well. To help CNP+L achieve their goal of organizing a recycling plan for cell phones and cell phone batteries, we worked to accomplish four main objectives. First, we evaluated models that other countries have used to reduce the e-waste in their country. Second, we estimated the amount of waste that cell phones create to help us better understand the current trends in Costa Rica and the necessity of a nationwide cell phone and battery recycling program. Third, we assessed the needs of key stakeholders that would benefit the most or be most affected from this work. Finally, from all of the information gathered, we proposed a model to reduce the cell phone and battery waste in Costa Rica, and make recommendations using that model to CNP+L for implementation.

This report was prepared by members of Worcester Polytechnic Institute Costa Rica Project Center. The relationship of the Center to the Centro Nacional de Producción Más Limpia and the relevance of the topic to the Centro Nacional de Producción Más Limpia are presented in Appendix A.

Chapter 2: Background

2.1 Introduction

This chapter provides an overview of cell phone battery waste in Costa Rica and on a global scale. Discussed in this chapter are the topics of what a cell phone battery is, hazards of cell phone batteries, government policy in Costa Rica and the United States, waste management, industrial trends with cell phones, and economic and social implications.

2.2 Overview of the Cell Phone Industry in Costa Rica

Cell phone service in Costa Rica is unique. Costa Rica has one company which is government run and has a monopoly over the cell phone industry. This company is named Instituto Costarricense de Electricidad, or ICE. This institute was created by the Decree-Law No. 449 on April 8, 1949 (Instituto Costarricense de Electricidad). It has financial, administrative, and technical independence. But in 1963, the legislative assembly passed law No. 3226 which allowed the establishment, improvement, extension and operation of the services of telephone, radiotelegraphic and radio-telephone (Instituto Costarricense de Electricidad, 2004). Any control of cell phones or telecommunications goes through this company. They provide public service for the country and have total control over it. According to the company,

> ICE promotes the economic and social development of the country by means of the provision adapted of electrical energy and services of communications, staying to the technological vanguard, promoting the excellence in the use of the resources, the attachment to the ethical norms and the service to the client (Instituto Costarricense de Electricidad, 2004).

The excellent use of resources can be seen through the electricity grid. ICE provides coverage to approximately 94% of the country and of this 90% is renewable

energy (Musmanni, 2004). This is just one action the ICE has taken to help the environment. In short, ICE helps the country in both economics and developing socially by being its supplier in electrical resources and electrical services.

In Costa Rica the cell phone market has been following the same increasing pattern as the worldwide market. The increase in cell phones in Costa Rica over the four year span between 1999 and 2002 is shown in Table 1. Currently, it is estimated that there are 900,000 cell phones in use in Costa Rica, with an expected 1.6 million active by the end of the year 2005 (Gonzalez, 2004).

Table 1: Number of Cell Phones in Costa Rica

# of Cellular Telephones	Year	% of Population with Cell Phones
430,000	2002	9.50%
216,936	2001	5.55%
139,643	2000	3.66%
121,239	1999	3.34%

(Costa Rica Telephony and Telephones), (Historical Demograhical)

This pattern shows the increase in the amount of cell phones in Costa Rica. There are over 100 million cell phones in use in Latin America (Siemens, 2004). However, due to the rate of increase that number is expected to double over the next five years. As seen in Table 1, Costa Rica has followed the same trend lately of seeing an increase in the amount of cell phones in the country.

However, the amount of cell phones does not always mimic the amount of waste produced by cell phones. With the popularity of the cell phones on the rise, many people have been discarding old cell phones for newer, more stylish ones. Also the cell phone

system itself has led to an increase in environmental hazards. ICE decided to switch its phone system from analog to digital causing over sixteen thousand phones to be retired (Gonzalez, 2004). This is a large problem because the technology usage and disposal is increasing more rapidly than the initiative for waste control (Musmanni, 2004).

2.2.1 Worldwide use of cell phones

Worldwide cell phone usage has been dramatically increasing over the last twenty years. That is mainly due to their availability and their low cost. The number of cell phones throughout the world has been estimated to be 1.3 billion by 2005 (Cell Phones-Convenience, 2004). Since the cell phone market is increasing in size, a trend has developed with an expected fall in prices. Lower prices and easier availability leads to an expectation of more users of cell phones. As the worldwide market for cell phones increases, so will the waste that is produced by unused cell phones.

Furthermore, an increase in cell phone numbers also means that there will be an increase in cell phone batteries. In 1995, the worldwide market for nickel-cadmium batteries was estimated to be around 2.4 billion dollars; about one billion pieces per year (European Ecolabel, 2004). About 800 million of these batteries were for portable usage. The average life for one of these cell phone batteries is approximately 200-400 recharges (Cell Phone Battery FAQs). The sales figures for these harmful batteries have also been increasing. Due to improper disposal, these harmful batteries can quickly become environmental hazards.

2.2.2 CNP+L

Centro Nacional de Producción más Limpia (CNP+L) is a national organization which was instituted to promote the cleaner production of goods at a national level,

including the evaluation of the risks and hazards of cellular phone battery disposal in the environment. CNP+L is taking steps to prevent the further destruction of the environment.

CNP+L has set forth to follow a list of objectives and rules to remediate the environmental problems caused by battery disposal. An objective which they have set in place is to notify people of the need to set restrictions on battery disposal. The restrictions and laws which are in place for the disposal and recycling of cell phone batteries are inadequate to sustain a clean environment. CNP+L has also made an attempt to implement a few measures to help with the reduction of the harmful nickel and cadmium metals. CNP+L has been trying to advocate the use of rechargeable batteries in portable devices. This is in an attempt to drastically reduce the volume of waste of portable devices.

Another measure that they have been trying to use is the pricing of toxic batteries. CNP+L is proposing to use economic incentives to decrease the use of toxic batteries. They want to raise the prices of more toxic batteries and lower the prices of less toxic ones. This would eventually promote the consumer to purchase the less toxic batteries decreasing environmental risk. CNP+L also believes that the importer should be responsible for the recollection transport and recycling of cell phone batteries (Reporte Nacional, 2001).

Along with the recycling of the batteries, CNP+L believes there should be a national standardization of the recycling process and information which is distributed to the consumers about the hazards of these products. In correlation to this, CNP+L wants to put the responsibility to acquire information in the hands of the consumer and for the

consumer to return all batteries to the cell phone companies. Finally, one of the measures that CNP+L wants to promote is to make all the companies, which use the heavy toxic metals, so widely used in batteries, contribute in their disposal and cleanup. CNP+L has the desire to make an impact on the Costa Rican culture and environment by taking steps towards reducing pollutants (Reporte Nacional de Manejo de Materiales).

2.3 Economic Impact of E-Waste

In order to understand more about the recent increase in the number of cell phones in Costa Rica, it is necessary to understand the economics of Costa Rica. Also understanding the economy will allow for a greater understanding of why the issue of cell phone battery pollution is important because of its impact on the economy. Some aspects of the economy are directly affected by pollution in the environment. Costa Rica's economy and its relation to cell phone battery pollution will allow for a better understanding for incentives to recycle.

The Republic of Costa Rica has a stable economy that is based on agriculture, tourism, and some electronic exports. They have a Gross Domestic Product (GDP) purchasing power of $32 billion with a growth rate around 2.8% (The World Factbook, 2004). Their GDP per capita was $8,300 in 2002. In the year 2002 Costa Rica showed an inflation rate on consumer prices of 9.1%.

Furthermore, tourism has played a large role in Costa Rica's revenue. Costa Rica has a highly developed and strong tourist market. In 1993, over 640,000 visitors came to Costa Rica. Tourists were estimated to spend around $577 million during their time in Costa Rica (Lesson in Tourism Development, 2004). According to Table 2 the number of tourists and the amount of money they spent has drastically increased.

Table 2: Tourism in Costa Rica

Year	Number of Visitors to Costa Rica	Tourism Revenue (Millions of Dollars)
1998	943,000	884
1999	1,032,000	1,036
2000	1,100,000	1,138

(Ecotourism in Costa Rica)

These figures show the importance of the tourism market to the economic stability of Costa Rica. Costa Rica is heavily dependent on its rich and vast environment. Costa Rica's landscape provides tourists with beautiful rainforest views and some of the best ocean waves in the world.

The dumping of batteries and other hazardous waste along the countryside and in landfills has lead to environmental problems due to the hazardous chemicals they contain. Costa Rica is dependant on the environment for its economy to be stable. An example of how the improper disposal of batteries can be harmful to both the environment and human life can be seen in the United States. The state of Illinois generates 100 million batteries a year most of which are disposed of by incineration or in landfills. Studies have been conducted to view the environmental effects of the batteries on the environment. They have revealed that in the landfills alone .2 to 10 gallons of toxins are being leaked into the drinking water and the environment each year due to battery waste (Why are Batteries Bad?). While Costa Rica is seeing a growing battery population due to a lack of a proper disposal system, problems like those in Illinois are likely to occur. The environmental problems caused by battery waste directly impact the economy

(Handling Waste, 2004). The environment plays such a large role in the economy of Costa Rica that any tainting of it with battery pollution may cause a decline in revenues.

By the promotion of ecotourism Costa Rica has been able to combat other environmental problems, in order to better the economy. Guidelines are being put into place in order to preserve the profitable market of ecotourism. With a country heavily dependent on its tourist attractions, people of the nation have been able to realize the importance of preserving their very profitable environment. 4% of all living species on the planet are located within the borders of Costa Rica, which is a nation which only comprises 0.01% of the earths land area. This, by itself, draws in many tourists to the area trickling profits to even the smallest vendors (Ecotourism in Costa Rica, 2004). With the impact of the environment on its national and local economies, it augments the importance of preserving their ecological stability.

An organization that has helped the promotion of a better environment for the tourist economy is the Certification for Sustainable Tourism, CST (Certification for Sustainable Tourism). They have four main goals to help promote environmental safety for tourism and the economy: 1) To evaluate how a company interacts with its surrounding environment. 2) To evaluate the company's infrastructure and management policies. 3) To evaluate the company's interaction with its clients. 4) To evaluate how the company interacts with local communities and the general population (Certification for Sustainable Tourism). CST provides a good service in helping to promote tourism and a cleaner environment.

2.4 Impact of Culture on E-Waste Disposal

Costa Rican culture also has an impact on the improper disposal of cell phone batteries. However, Costa Rican culture also plays a key role in attempting to fix the cell phone pollution problem. By looking into Costa Rica's culture reasons for electronic pollution can be seen.

Costa Rica is quickly catching up to the electronic world. Electronic components are one of their major exports. Costa Ricans have been acquiring cell phones at a rapid rate as seen by Table 1. Currently, Costa Rica has a lack of e-waste treatment services and facilities (Musmanni 2004). This is leading to the improper disposal of hazardous cell phone batteries. Due to the improper disposal of cell phone batteries there is a need for the knowledge of how cell phones can potentially be harmful to be spread throughout the Costa Rican culture.

Costa Rican culture plays a major role in adding to the amount of cell phone waste produced. Cell phones are becoming more technologically advanced and more fashionable. Vendors can sell all kinds of accessories and additions for cell phones. Also the styles of cell phones are rapidly changing causing people to discard their current cell phones for newer, more fashionable ones (Musmanni 2004). Some Costa Ricans have also acquired cell phones and numbers illegally from another country adding to the ever growing cell phone population (Gonzalez 2004). The growth of a cell phone's availability and fashion has led to a rise in the number of cell phones and their waste. Costa Rica has made an attempt to increase environmental awareness throughout the nation to combat ecological problems. One attempt to disseminate knowledge about pollution and its dangers to the environment was a study conducted by the Tropical

Science Center of Costa Rica. They had three goals in mind with their study: 1) analyze the number of natural resources and associate a value to them according to their economic worth, 2) treat the resources as capital in order to count any type of resource depletion as a capital loss, and 3) to adjust any current national accounts (A National Account System). This study was able to find a relationship between natural resources and the economy and show how damaging the environment would hurt the economy. However, this economic data was used with the intent of raising the public awareness of the Costa Rican people on the importance of the environment.

2.5 Cell Phone Batteries

According to Merriam Webster's Online Dictionary, a battery can be defined as "a group of two or more cells connected together to furnish electric current" (2004). A cell is a unit that can hold and release an electrical charge. Batteries for cellular phones have many cells, and most have the additional characteristic of being rechargeable, whereas some batteries designed for cell phone use are non-rechargeable, and are for one-time use only. The Rechargeable Battery Recycling Corporation (RBRC), a not-for-profit organization devoted to recycling rechargeable batteries, lists the four most common types of batteries that they recycle (RBRC, 2004). These are Nickel-Cadmium (Ni-Cd), Nickel Metal Hydride, Lithium ion (Li+), and small-sealed Lead batteries. Each of these types of battery can be rechargeable and commonly used in the United States, where the corporation is based. However, of the four main types of rechargeable batteries, only Ni-Cd and lithium ion batteries are commonly used for cellular phone applications, as well as for other small appliances like camcorders and remote-controlled cars. They perform much like each other, with a few minor differences.

2.5.1 Nickel-cadmium batteries

In a Ni-Cd battery, the nickel and cadmium are placed at opposite ends of the battery and are separated by a hydroxide solution, oftentimes potassium hydroxide (Repair FAQ, 2004). When the positive and negative terminals are connected, the circuit is complete allowing electrons to flow from the anode (the electrode in which oxidation occurs) to the cathode (the electrode where reduction occurs). This will continue until the chemical reaction is exhausted.

In the case of rechargeable, or secondary, batteries, electric charge is simply forced through the positive terminal of the battery. If the negative terminal is not connected, the energy has no outlet, and thus is stored in the battery for reuse. Of course, this cycle is not 100 percent efficient, and so there is some energy wasted in the discharging and recharging of the battery. Eventually, the inefficiency of the battery will be too great, and it will no longer retain energy, becoming useless and ready for disposal. In Ni-Cd batteries, this period of time can last anywhere from six months to three years, depending on the frequency of usage.

2.5.2 Lithium Ion Batteries

Lithium ion batteries work in much the same manner, where lithium is the anode, and a carbon substance usually makes up the cathode. As stated by the Asian Technology Information Program (ATIP), lithium ion batteries have two distinct advantages over their more common Ni-Cd counterparts. Lithium ion batteries can operate at about three times the voltage, as well as having more than twice the capacity for storing energy. This contributes to a much higher energy-to-density ratio, and subsequently much smaller and lighter batteries to perform the same duties.

Unfortunately, these lithium ion batteries are more expensive to manufacture, and therefore are purchased less frequently (ATIP, 2004).

2.6 Hazards of Cell Phone Batteries

As with the disposal of all materials, problems arise when batteries are removed from cell phones. Cell phone batteries contain a variety of components, some of which are toxic, and each of these can cause pollution to the water supply, the atmosphere, the soil, and eventually impact humans.

2.6.1 Hazardous waste

In efforts to safeguard the public, legislation has been introduced in local and federal governments all over the world to encourage the reduction and elimination of these toxins from the waste stream. In the United States, the EPA is responsible for setting minimum national standards of legislation that states are required to meet. However, should the state government so choose, it is welcome to pass even stricter legislation. For instance, in Massachusetts State law, hazardous waste is defined from the state government website as:

A waste, or combination of wastes, which because of its quantity, concentration, or physical, chemical or infectious characteristics may cause, or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible illness or pose a substantial present or potential hazard to human health, safety or welfare or to the environment when improperly treated, stored, transported, used or disposed of, or otherwise managed (2004).

Cell phone batteries certainly fit this definition. Currently, cell phone batteries are composed largely of plastic and common metal casings (aluminum and steel), and

contain small amounts of internal wiring to connect terminals. These materials are non-toxic and can be recycled easily, or thrown away without introducing toxins to the environment. This is not an option, however, if the hazardous chemical parts of each battery are not separated and dealt with separately. It is not safe to dispose whole cell phone batteries because of the toxic chemicals contained within them.

2.6.2 How hazards affect humans

For the most part, mobile phones consist of only a couple hundred grams of materials. The batteries make up a large part of this weight, and the heavy metals (cadmium and lithium) contribute to most of this. Each battery contains quite a few grams of hazardous waste. Although a few grams are a small percentage of the entire weight of the cell phone, this small mass of potentially hazardous waste can cause large problems. If mishandled, this waste can enter the environment directly and consequently into humans.

Certainly the people working daily with these chemicals (i.e. the manufacturers and others who are in direct contact with cadmium and lithium) are the highest at-risk population, but what about the average citizen? How could anyone be exposed to such toxins? This is where the problem of disposal becomes key.

If cell phone batteries are not carefully disposed of, they will decay with time and allow their hazardous components to be spread away from where they were once contained. The easiest way for chemicals to be ingested by the population is when a body of water becomes polluted, because the water will eventually become drinking water, and atom-by-atom, the cadmium or lithium will be consumed if the water cannot be properly purified. Airborne particles are also produced mainly by the battery

manufacturers, but are for the most part contained at their point of origin by air filters and other factory safeguards. The ones that escape the filtration measures, however, can be later inhaled. According to the Centers for Disease Control and Prevention (CDC) in the United States, the largest source of contamination is via the soil. Supposedly safe and secure landfills allow the battery to decay just the same as it would anywhere else, and rainwater and seepage will again convey the pollutants to the watershed. Aside from directly drinking the impure water, the animals that live in or consume the water will absorb some of the chemicals themselves. This is detrimental to the population in two ways. The fish and other wildlife may also suffer from cadmium or lithium poisoning, or they may just pass on the poisons to humans when they are eaten (CDC, 2004).

It is not necessary for this pollution to be on a large scale to have a large effect on a human population. A one-time large exposure to cadmium or lithium is not as harmful as a long period of constant smaller doses (OSHA, 2004). Especially in terms of ingestion, a ratio of couple of hundred parts of cadmium or parts of lithium per million in water is sufficient to contaminate a source of clean water. If the chemicals are ingested and then absorbed into the bones and teeth, what is known as the "body burden", the half-life of the toxins in the body can be as great as ten years, causing long-term affects like lowering sperm count and creating birth defects (OSHA, 2004).

2.6.3 Ni-Cd hazards

In a Ni-Cd battery, cadmium is the most hazardous component (WebElements, 2004). Nickel, can be handled without fear, and is commonly used as a wear-resistant coating, such as on coins (nickels). Cadmium, like most heavy metals, is extremely harmful to the human body.

It is primarily absorbed into the human body by either ingestion or inhalation. Cadmium is ingested primarily in small particles in drinking water, although dust-sized particles can be consumed directly when eating (if it is on one's hands, say), or indirectly, if it has been absorbed by what one is eating.

The chances of suffering adverse effects by direct contact are small, but when ingested, cadmium quickly enters the bloodstream while being digested and poisons the human body, causing damage to the liver and kidneys (WebElements, 2004). The kidneys are also affected with the inhalation of cadmium, which also causes problems with the respiratory system. The mucus of the lungs absorbs cadmium particles and transfers cadmium directly to the bloodstream. Cadmium is also carcinogenic.
A relatively small amount of cadmium can cause sickness. Even as little as one or two micrograms per liter over an extended period of ingestion can be harmful to a minor degree. More than that will cause irreversible effects (WebElements, 2004).

2.6.4 Lithium hazards

Lithium is the hazardous chemical used in lithium ion batteries. According to California's Environmental Protection Agency (a state-run organization similar to the United States' EPA), there is little or no risk involved with direct exposure to lithium, but inhalation and ingestion have dire consequences (OEHHA, 2004).

When the human body absorbs lithium, it directly and negatively affects the workings of the gastrointestinal system, the central nervous system, and the kidneys. The effects of minor absorption include nausea, vomiting, and diarrhea. These sicknesses pale in comparison to the long-term major effects that can be induced by large-scale exposure to lithium. Recurring seizures and comas are among these. Because lithium is

considered a dry waste, its harmful effects are felt far less frequently than if it were a liquid or semi-solid waste, because lithium is less likely to be absorbed both by humans and their surroundings. Still, it is highly susceptible to being absorbed by a water supply, and a few micrograms per liter can be harmful to humans.

Charged with protecting the people within its borders, governments have an obligation to regulate and monitor hazards such as the toxic chemicals like cadmium or lithium that are contained in cell phone batteries.

2.7 Government Policy

In order to reduce the pollution present in the United States and Costa Rican environments, both countries have established regulations on hazardous materials. The policies and standards set in each country vary widely. In the United States of America, the government has confronted the dangers of cell phone batteries and has regulated the disposal and care of them. Costa Rican companies have also understood this problem of cell phone batteries, but no government standards have been mandated.

2.7.1 Environmental protection in the United States of America

The Environmental Protection Agency was created specifically to set regulations for public welfare concerning hazardous materials. Public Law 104-142 (1996), the "Mercury-Containing and Rechargeable Battery Management Act," was created in 1996 to regulate the waste from cellular phones, and other rechargeable consumer products. The Act (1996) defines a rechargeable consumer product as any "cell phones, laptop computers, cordless power tools, personal computers, and video cameras, that: (1) contain a regulated battery as a primary energy supply, and (2) are primarily intended for personal or household use." In the Public Law, Congress states that mercury must be

phased out of batteries and that proper collection of Ni-Cd, lead-acid, and other regulated batteries must be instituted.

Congress stated that the public must be encouraged to participate in the recycling of the regulated batteries and that regulated batteries must be clearly labeled with an appropriate message: either "CONTAINS NICKEL-CADMIUM BATTERY. BATTERY MUST BE RECYCLED OR DISPOSED OF PROPERLY" or "CONTAINS SEALED LEAD BATTERY. BATTERY MUST BE RECYCLED." (Public Law 104-142, 1996). Also, labeling of the rechargeable battery must include the three chasing-arrows recycling figure.

The EPA has set standards for hazardous heavy metals. However, for cell phone batteries, the only heavy metal regulated is cadmium (Cd). Cadmium is regulated by the EPA for toxic amounts in drinking water. The maximum containment level (MCL) of cadmium in drinking water is 0.005 mg/L. The potential health effects on drinking water contaminated with more than 0.005 mg/L is kidney damage, says the EPA (2004). Lithium, which is a very reactive metal, is not regulated in cell phone batteries. In cell phone batteries, lithium is manufactured in a dry-cell battery as an ion (Li+).

Not only does the United States government regulate the amount of heavy metals that can be in the environment, including the atmosphere, soil, and water bodies, but it also regulates the handling, treatment, and disposal of batteries and heavy metals. Along with the Mercury-Containing and Rechargeable Battery Management Act, there are other strict guidelines on toxic and hazardous materials. For example, The Department of Transportation (DOT) Office of Hazardous Materials Safety is responsible for the safe transportation of materials by all means of travel, including air, land, and railways. This

office, referred to as HAZMAT, labels all materials that have been labeled as hazardous and has categorizes them by toxicity, and mandates that all vehicles shipping hazardous materials must be clearly labeled with the appropriate placards (HAZMAT, 2004). According to the "Hazardous Materials Regulations" (Title 49 CFR Parts 100-185), or HMR, there are 9 classes of hazardous materials. Cadmium is categorized under Class 6.1, which "means a material, other than a gas, which is known to be so toxic to humans as to afford a hazard to health during transportation" (HAZMAT, 2002). Therefore, cadmium cannot be shipped by highway with more than 100 kg in transit (HAZMAT, 2004).

Furthermore, HAZMAT regulates the specific handling of hazardous materials. HAZMAT has standardized procedures for loading and packaging toxic substances. In HMR 177.841, the shipping of cadmium, a Division 6.1 material, is not permissible, if any of the packaging is interconnected to any other Division 6.1 or Division 2.3 (poisonous gas) material (HAZMAT 177.841). Section 177.848 includes the "Segregation Table for Hazardous Materials," that explains which Divisions can be packaged together. Cadmium cannot be packaged with Divisions 1.1-1.5, 3, 4.1-3, 5.1-2, and 8. Therefore, it is necessary that cadmium be handled very carefully because it is particularly poisonous.

2.7.2 Environmental protection in Costa Rica

Alvarado (2002, p. 31) writes that the Costa Rican government has not laid out any legislation for the separation or recollection of rechargeable batteries containing lead (Pb) or nickel-cadmium (Ni-Cd). However, the government does recognize that improper storage and disposal of Pb-based and Ni-Cd-based batteries is dangerous to

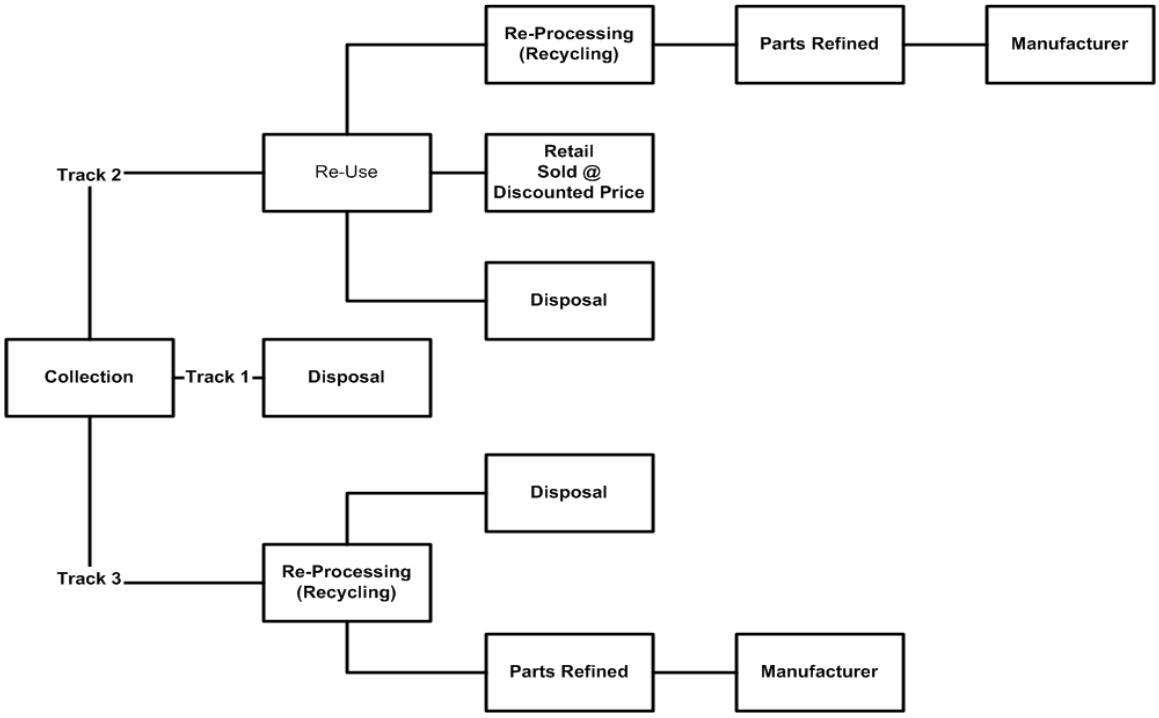
human health and they should not be disposed of in dumps and landfills (Alvarado, 2002, p.31). In the Reporte Nacional de Manejo de Materiales from Centro Nacional de Producción más Limpia (CNP+L), many materials are reported on, including dry batteries, wet batteries, computer waste, and refrigerants (Alvarado, 2002, p.7). Many of these hazardous products do not have any disposal standards in place yet, but CNP+L has made recommendations to the government to install strict laws concerning the treatment and removal of these products.

2.8 Waste Management of Cell Phone Batteries

There are various ways to handle cell phone battery waste, from incinerating the chemicals and materials to reprocessing and reusing the valuable metals. Collection is the term used for any kind of grouping of cell phones together in order to deal with the whole problem of cell phone battery waste in general. Disposal is defined as taking waste to landfills or by minimizing waste through incineration. Reuse is the process of attempting to use the cell phone batteries again, where re-processing, generally considered as recycling, is the process of taking the valuable parts of the cell phone battery and refining them so that they may be used in the manufacturing of a new cell phone battery. Bullock (1995, p.194) explains that the waste must first be minimized at the source of production, then recollected, reused, and recycled. If this is not effective, dispose the waste. However, waste management of cell phone batteries is not a simple linear flow chart, but has complex routes that could happen at any point in the management of cell phone battery waste. See Figure 1 for a better understanding of the complexity of waste management, and more specifically cell phone battery management. This figure was created as a supplement to the readings of Bullock, Pistoia et al., and

Smith et al. All of these processes are important and therefore discussed thoroughly in this section.

Figure 1: Waste Management Flow Chart



2.8.1 Waste management through collection

In order for cell phone batteries to be managed properly, they must first be collected. Collection can occur in many various forms. In the United States, companies offer services for picking up personal waste from house to house, where many businesses have dumpsters that waste is placed in and then picked up frequently by waste management trucks. However, these are basic collection programs. This section will describe collection programs for cell phone batteries in the United States, the Netherlands, Australia, and Japan.

In the United States, consumers and businesses partake in the Charge Up to Recycle! program run by the Rechargeable Battery Recycling Corporation (RBRC)

(Pistoia, et al., 2001, p. 109). In this program, consumers bring their dead batteries to a retailer, which collects the batteries and ships them off on a frequent basis. The RBRC shares the cost of combining, shipping, and recycling the Ni-Cd batteries with local communities, businesses, and other groups. Collectively, the Ni-Cd batteries are shipped to the International Metals Reclamation Co., Inc. (INMETCO) for processing and recycling. Pistoia, et al, (2001, p. 110) states that the Charge Up to Recycle! program offers over 30,000 locations for consumers to return their Ni-Cd batteries, and over 1,800 businesses and public agencies are registered for the Ni-Cd recycling plan.

In the Netherlands, Ni-Cd batteries are separated from public waste through the use of magnets (CollectNiCd, 2001), which is referenced by Pistoia, et al. (2001, p. 67). The municipal waste is brushed over by an electro-magnet that removes all the Ni-Cd batteries together. This process puts the responsibility of collection on the waste management companies, instead of having consumers bring their batteries to a collection point.

Australia has a very unique national collection program. In most countries, the program is broad for all sorts of batteries, but in Australia they have a take-back program for only cell phones (Fishbein, 2001, p. 59). The voluntary program was instituted in 1999, called The Mobile Phone Industry Recycling Program (MPIRP). MPIRP is based on a taxation per cell phone sold—US $0.15 per cell phone—and is charged to the manufacturer. The carriers pay US $0.06 per phone. The capital collected by this program is then used to contract out the recycling to companies through the Australian Mobile Telecommunications Association (AMTA), which is the organization that runs MPIRP. To make collection easier, AMTA does not charge consumers for returning

batteries and they have 1,650 drop-off locations. However, AMTA (2001) reports that since 1999 only 125,000 phones had been collected in 2 years, but that awareness is increasing and the goal is to annually collect 500,000 phones. The purpose of the program is to keep the cell phones out of landfills, but no reuse or recovery of components is dealt with. Therefore, the batteries are sent to plants for reprocessing, which is discussed in Section 2.8.3.

Japan is another country that has confronted the problem of electronic waste. Japan's philosophy is different than that of Australia's because it charges consumers to return electronic waste (Fishbein, 2001, p. 58). "This system creates a disincentive for consumers to bring used products back to the retailer, since the must pay to do so," states Fishbein (2001, p. 59). Taxing the consumer will make it less desirable to recycle a cell phone battery because it can easily be tossed into the general waste. However, this philosophy has created an aggressive campaign for producers to manufacture easily recyclable products (Fishbein, p. 58).

2.8.2 Waste management through disposal

The two most common methods of disposal are incineration and landfills. In order for disposal to be used as a waste management scheme, it must be collected, which was discussed in Section 2.8.1. By burning the hazardous material, the waste is discarded and the volume of waste is reduced significantly in incineration. In landfill disposal, the waste is not spread to the atmosphere, like incineration, but affects the ground and water supply in the nearby area. The disposing of cell phone batteries in landfills causes two big problems. As the amount of cell phones used increases, more waste is created. If used batteries were to be dumped in landfills continually there would be an increasingly

large volume of waste. Also, the amount of cadmium in the landfill would be too high for that particular heavy metal (see Section 2.6.3 for maximum cadmium levels).

2.8.3 Waste management through re-use

Reuse, according to Duston (1993, p. 129), refers to using the material without significant processing. After collecting the batteries, the industry must look at using them in the capacity in which they are supposed to work. For instance, if a cell phone battery is collected, it can be tested to see if it can be recharged and resold and put back into the consumer market. However, when the cell phone batteries are inspected for reuse, there are three different paths that the cell phone can go. First, if the battery is too damaged it may be immediately disposed of, or if it is not able to be recharged, it can be broken down and reprocessed. Finally, if it is found to be in good working condition it can be given back to retailers to sell at discounted prices.

2.8.4 Waste management through re-processing

Reprocessing can be defined as the process of using spent, or used, materials in an efficient style to conserve resources. Again, as in the disposal and reuse process, a method of appropriate collection must be used. The U.S EPA (2001) states, "[Reprocessing] turns materials that would otherwise become waste into valuable resources and generates a host of environmental, financial, and social benefits." If reusing the cell phone batteries is not possible, reprocessing is another step in waste management that should be considered, and if reprocessing is not profitable enough for the reprocessing company, the cell phone batteries will be disposed of properly in landfills or by incineration.

Cell phone batteries have many valuable parts from the Nickel and Cadmium metals, to the plastics the round battery is inserted into. In order for reprocessing to be a viable option however, the cost of reprocessing must be contemplated. Smith, et al. (1995, p. 125), believes that in order for the recycling process to be a constructive process, the cost of recycling must be greater than the value of the materials recovered in the process.

If this is the case, the used material can be broken down into its most valuable parts. David (1995) cites the example of SNAM (Societe Nouvelle d'Affinage des Metaux), which treats the Ni-Cd battery through a thermal process. SNAM uses a distillation system in a control environment to burn the metals in a furnace at a rate of 1 ton every 24 hours. This process occurs in 5 in-series steps. First, the batteries are dismantled through an automated system, and then the cases are broken to expose the inner parts. Next, the organic substances are heated and then changed chemically to enhance recovery. Finally the Cd is refined to 99.99% of its original quality.

Chapter 3: Research Methods

3.1 Introduction

The following methodology describes the steps that were followed in order to complete the goals set forth by CNP+L that are described again in detail below. The first goal of the project was to identify key stakeholders in a recycling program. Another goal was to review, investigate and criticize important efforts in recycling cell phone batteries in countries worldwide. A third goal was to approximate the effective size of a recycling program for cell phone batteries, including volume and rate of recycling. Finally, a preliminary recycling model was to be proposed to CNP+L for future implementation.

3.2 Identifying Key Stakeholders

In order to identify the key stakeholders with respect to a recycling system for cell phone batteries, a few types of potential stakeholders were considered. We identified three distinct categories of key stakeholders. One category includes companies that have a financial investment, or could possibly financially invest in cell phone batteries or cell phone battery recycling. This is the private sector, those who have an interest of profit in the process of cell phone battery recycling. We also considered large private companies that would have a benevolent interest in such a program, potentially as a collection site or a donor of start-up capital. We approached powerful (large) companies in Costa Rica such as INTEL, Baxter, Hospira, and Dos Pinos, and asked them to respond to a questionnaire regarding this subject (See Appendix D). These companies would see no direct gain from their participation, but could be instrumental in solving this common waste problem. The second category is the public sector. This is made up of government and non-profit organizations, whose interest in cell phone battery recycling is socially

and non-fiscally motivated. The third type of stakeholder is the general public which, although it does not possess much decision making power, could not be excluded from an analysis of groups of people most interested in or affected by a proposed cell phone battery recycling program.

Our strategy to identify key stakeholders required interviews. Cell phone recyclers were contacted and interviewed to determine their interest in handling cell phone and cell phone battery waste. Another type of key stakeholder is a company that collects, sorts, and packages hazardous waste such as cell phone batteries. An example of this sort of company is Servicios Ecológicos, the premier recycling management company in Costa Rica. Questions were asked of representatives of these companies to further understand financial responsibilities, and active or non-active participation in the cell phone recycling issue. See Appendix B for the questions posed to Servicios Ecológicos. These were not the only questions we asked, but served as a starting point to our guided discussion. We interviewed representatives from ICE, which among other things, is the sole national cell phone service provider. We spoke with a waste management consulting representative from Tratamientos Tecnológicos (see Appendix C). We asked each individual about the relative investments of making a product to managing the waste of the product for their company. We also determined whether or not these companies are actively involved in fixing the problem of cell phone and cell phone battery disposal. Are they advertising a collection program for cell phone batteries? Are these companies researching recycling plans for their own product? This allowed us to make a comparative analysis of each different industry between waste

management companies, manufacturers, and retail stores, as well as to determine the influence of the government and non-governmental organizations and the general public.

While interviewing key stakeholders and collecting data from these sources, we focused also on the public awareness of cell phone battery hazards and recycling practices in general, including waste disposal and health hazards. This subject was addressed in a questionnaire, which was distributed to a non-representative sample of a wide range of Costa Rica's citizens. This includes corporate executives, small business owners, cell phone retailers, and the general public. This did not result in concrete quantitative data, but demonstrates a qualitative idea as to the public awareness on the subject of cell phone battery disposal. Questions included in the interviews were such as the following (see Appendix E for the complete questionnaire). Should cell phone batteries be recycled, why? Where would the money come from for a recycling program, why? And as a follow-up to this question: Would a tax deter you from purchasing and using a cell phone; if so, what would you recommend as a place for the money to come from? What would you do right now with an unusable cell phone battery, and why? Who is responsible for the cell phone battery waste problem?

These issues were analyzed using content analysis by reviewing the responses of each individual and their involvement and awareness of cell phone battery waste. Each key phrase was tabulated and coded for analysis. Coding will consist of words, phrases, and as questions and answers. For example, if "responsibility" is used with "manufacturers" or "consumers," then they were listed together to narrow the content for improved analysis.

From the analysis, key stakeholders were identified and stratified so that all interested parties- financial institutions, environmental groups, government organizations and the general public- were identified. After each interview was held and the data were analyzed, it was necessary to compare and contrast responses. Identified key stakeholders were juxtaposed with respect to interest in and concern for cell phone battery recycling. After this analysis, they were compared with respect to their willingness and ability to participate in a recycling program.

3.3 International Cell Phone Recycling Efforts

As noted in the background research, different countries have established different cell phone battery recycling plans. Japan uses taxation, the United States uses retail collection locations, and the Netherlands uses an electro-magnet to collect and separate cell phone batteries.

To investigate the efficiency of the above methods, we primarily relied on archival research. Our background research was done with a limited access to international documents. While working in Costa Rica, our access was more restricted with regard to international data. We were able to contact a representative of the Rechargeable Battery Recycling Corporation, the responses to the questionnaire we administered gave us insight further insight into international solutions (See Appendix F). Interviews have also been conducted with executive officials of the service-provider, ICE, and with other pertinent sources of information regarding international solutions to cell phone battery waste, question summaries of which can be seen in Appendices B, C and G.

3.4 An Effective Recycling Program

An effective recycling program is one that both consumers and manufacturers understand, and are willing to use, and hinges largely on the term efficiency. Efficiency must be defined clearly in order to understand the problem and solution better. An efficient recycling system would reduce the amount of harmful chemicals entering the environment, either in the air, water, or soil, so that human health is not threatened and that the environment is not altered significantly. We could not solely rely on interviews for this data or to collect it ourselves via field observation, and so we used archival research on the successes of past projects in other countries for this information. The physical effects of a cell phone battery recycling program in Costa Rica will not be known for a long time after the program is initiated, and certainly long after our project is completed.

A program will run efficiently when the total volume of waste is recycled to recover the valuable parts of the cell phone battery, like the nickel and cadmium elements. Waste treatment managers, ICE employees and other executives were asked about their involvement in recycling the cell phone batteries. Questions were posed such as: Are cell phone batteries separated from the general trash? Are consumers encouraged by the service provider to take cell phone batteries to hazardous waste plants? What specifically happens to cell phone batteries? These questions are basic and led to a further discussion of waste management and a deeper probing into the intricacies of the cell phone battery waste problem.

Another aspect that was crucial to consider is the attitude that Costa Ricans have towards recycling. Therefore, it was necessary to gather information on the perceptions

they have towards recycling in general. This issue was addressed using a questionnaire that was distributed to random patrons of Mall San Pedro, a commercial and social interaction hub in the San José area. The mall provided us with a cross-section of the consumer in Costa Rica, a person who was very likely to own a cell phone. We distributed the same questionnaire to students at the University of Costa Rica. This gave us insight into the knowledge and opinions of an average younger and higher educated Costa Rican, another probable owner of a cell phone. The questions that follow were designed to address the recycling concern. For more complete information, see the actual questionnaire attached as Appendix E. Do Costa Ricans find recycling a hassle? Do they think that it is a necessary process that they must engage in? What should happen to used products? Do they think that they are responsible for the cell phone battery waste problem, and if not, who is? All of these questions will reveal emotions and thoughts on recycling and need to be analyzed through substantial coding and content analysis.

3.5 Proposing a Recycling Program

After exhaustively analyzing the data collected from the interviews of key stakeholders, questionnaire responses and archival research, as described in the previous sections, a preliminary model was proposed to CNP+L for a recycling program specifically centered on cell phone batteries. From the statistical data in Costa Rica gathered in archival research, as well as from the data collected from specific interviews with executive personnel, and the results of numerous questionnaires, the effective operating size of the program was analyzed and estimated. Once the size of the operation was established, the kind of system that could be implemented was recommended.

There were various strategies of collection to contemplate when proposing an efficient and effective recycling program; from manufacturer-incentive programs that will reward businesses that actively partake in recycling, to consumer-incentive programs that reward the buyer for returning dead batteries, to a mixing of both strategies. Also, the actual physical logistics of a recycling program were addressed. Using data from archival research, population density and economic status were cross-referenced on a map of Costa Rica to determine likely areas for a high volume of cell phone collection. With the use of brief interviews and questionnaires, large businesses, corporations, universities, and municipal buildings, as well as other high-traffic, high-population sites such as supermarkets, post offices, and malls were asked about their respective interests in being regional collection locations. The questions posed can be seen in Appendix D.

Because of the complexity of dealing with hazardous waste and its potential international transport, we sought the assistance of ENLACE, a Latin American environmental legal consultation agency. We asked them questions about the legal issues and complications of transporting cell phones and cell phone batteries, which can be seen in Appendix G. Representatives of this entity also directed us to specific regulations regarding electronic waste, which contribute to our archival research.

In order to determine the appropriate solution and recommendation, the interviews, questionnaires, and the other data-collection strategies were analyzed and organized into a comparative analysis. This analysis was further weighed against programs that already exist around the world by looking at their costs, size, relative participation, and efficacy. From the comparative analysis, the different strategies were ranked, and a decision on the best program was made from the following flexible criteria,

which have changed with the information collected from the questionnaires, interviews and archival research: cost, feasibility, ease of recycling on the consumer and manufacturer, volume of recycling waste, time requirement, and land usage. No single one of these criteria is the most important, and only by combining their attributes, and observing their interactions and relative strengths and weaknesses, could a final recycling program be proposed.

Chapter 4: Results

4.1 Introduction

This chapter shows the result of the execution of our methodology in Costa Rica. We have gathered data using many different methods in efforts to meet the four main objectives we set out to accomplish at the beginning of our project. The following data were obtained from our interviews, questionnaires, and archival research, and are recounted below in the order in which they were gathered. It is from these data that we will conduct analyses, draw conclusions and make recommendations.

4.2 Data from Interviews

The following are the results of the interviews we conducted while in Costa Rica. In total, we conducted six major interviews with major government officials and corporate executives, five of them being face-to-face, and one over the telephone. We also conducted four less intense interviews over the phone with environmental heads of large companies in Costa Rica. These one-on-one interactions allowed us to gather the concise information we needed from major participants (potential key stakeholders) in the cell phone waste arena.

4.2.1 Sergio Musmanni, CNP+L

As the director of the Centro Nacional de Producción más Limpia, Sergio Musmanni heads the three-person team of this non-governmental organization devoted to cleaner production practices in Costa Rica. Although we had only one formal interview with Musmanni, we also gathered information from a series of meetings and guided conversations that were comparably informative. He told us that the ideal goal for Costa Rica would be to eventually have a national recycling/recovery plan in place, but that it

was unreasonable to expect this at the time. We discussed the possibility of Costa Rica being a Central American center for cell phone and cell phone battery recycling, but according to his knowledge of the region, the countries surrounding Costa Rica are far less advanced technologically, and that sort of initiative would not be possible. In Musmanni's opinion, the best possible recourse left open at the moment is to export cell phone parts to the United States for treatment, because the facilities already exist there for processing. He further extolled the United States option because the volume of cell phones collected there (domestically and from around the world) is enough to be sustainable without depending on the Costa Rican market of electronic waste.

With Musmanni, we brainstormed about the different types of companies that could be involved in a recycling program. He confirmed the need for collection sites, transportation, sorting, disassembling, packaging, shipping, and processing. He assisted us in contacting employees of processing companies (Re-Cellular), environmental consulting agencies (ENLACE, Tratamientos Tecnológicos), waste management organizations (Servicios Ecológicos, Gente Reciclando), and representatives of the Costa Rican Ministry of the Environment and Energy (MINAE) and the Ministry of Health (Ministerio de Salud).

Another point we discussed was possible regional collection sites for used cell phones and spent batteries. Musmanni recommended that we contact large businesses in Costa Rica to ascertain their willingness to participate in such a manner. He directed us towards INTEL, Baxter, Hospira, and Dos Pinos.

When we asked Musmanni about the complications of initiating a recycling program, he cited a few key issues. One is that cell phone technology is changing so fast

that consumers feel obliged to purchase new phones and batteries and dispose of old ones faster than is essential. This resists the longtime tradition in Costa Rica of sustainable consumption, only using what you need to survive, where everything else is superfluous. In summary, he told us that the primary concern with a recycling program was the money to facilitate it. Money that currently does not exist in Costa Rica.

4.2.2 Carlos González, ICE

It was essential for us to speak with a member of ICE, as this government organization is the only cell phone service provider in Costa Rica. We conducted an interview with Carlos González specifically because he was suggested by Sergio Musmanni. We learned from González that he was actually the main drafter of our project here in Costa Rica, and therefore had a vested interest in seeing us succeed. A copy of the project description can be found in Appendix H. We chose to have two interviews with González, and the following is an account of the data he imparted to us.

To give us an idea of the size of the problem, González informed us that cell phone use was on a very dramatic rise, with 960,000 active cell phone lines early in the year of 2004, and with an expected 1.6 million lines by the end of 2005. He stressed the differences between the private and the public sector of potential recycling program participants, and also that it was necessary for both sectors to work together for an effective program. The private sector, he said, had little trouble with getting involved in a recycling program. The waste from cell phones and batteries is valuable, and the recycling of such materials is a lucrative business. The difficulty lies in the public sector, made up of government agencies and non-profit non-governmental organizations. This sector suffers from a lack of organization, because much of the government is subdivided

into separate branches, each acting independent of the rest. As with all governments, the Costa Rican government has a tight budget, and there is currently no funding for a new recycling initiative. Money and organization were needed for the implementation of a long list of items necessary for a successful recycling program, such as: collection, transportation, sorting, packing, personnel, office supplies, office and storage space, and advertising.

We had discovered during our interview with Anna Ortiz of Tratamientos Tecnológicos (see Section 4.2.6) that ICE had been investigating plan to recycle cell phones independent of other organizations. The preliminary cost of the plan was to be approximately 100 million colones per year, or roughly US $250,000. The goal was essentially the same as our project, to propose a model to recycle cell phone waste nationwide. This plan dissolved due legal conflicts within the Costa Rican government.

We shifted our interview focus to money, and discussed ways that funds could be obtained for a recycling program. The first idea proposed was to impose a tax on the purchase of a cell phone. González immediately criticized this idea, pointing out several complications. A tax must be backed by a law, and a law would take many years to draft, introduce to the congress, and then be implemented. Also, with the already high cost of cell phones, which can range between US $50 to $100 depending on style and features, the Costa Rican public would be resistant to a tax that would further raise prices. As a constructive suggestion, González offered the idea of a cooperative with a charity. He outlined a plan where a cell phone owner would donate their phone to a charitable fund. The phone would then be sold to a recycling company, with a portion of the proceeds going to the charity, and the remainder going towards a sustainable recycling program.

The cell phone owner receives the benefits of knowing he has helped a charitable cause, as well as a potential tax benefit.

Nearing the end of our time with González, we asked him about ICE's potential role in our proposed recycling program. He told us that it would be possible for ICE to participate in a variety of ways. We suggested that ICE could advertise the proposed program at the bottom each phone bill, giving each cell phone owner a monthly reminder to recycle. We discussed the viability of using ICE offices throughout the country as regional collection sites for cell phones. González gave us positive responses to both these suggestions, indicating that ICE would be willing to actively participate. He even put forward that ICE could possibly assist in transporting the collected phones from place to place, perhaps even to a final centralized collection site.

4.2.3 Gary Straus, Re-Cellular

In order to examine the electronic waste issue from the point of view of the private sector, we contacted a private company dealing in the processing of electronic waste. We held an interview over the phone with Gary Straus, the Vice President of Re-Cellular. A United States based multi-national corporation, Re-Cellular is a private company whose main revenues come from the repairing, refurbishing, and reselling of cell phones, as well as the recycling and selling of used cell phone components. When pressed for a more quantitative account of his business, Straus informed us that most of that information was proprietary and private.

In our conversation with Straus, he conveyed a definite interest in participating in the recycling of cellular phones in Costa Rica. He said that he had looked into this option in the past, and even currently had a contact in the country further investigating the

situation. The reason he gave for not currently being involved with recycling in Costa Rica is a lack of infrastructure. He told us that it was not to his financial advantage to be responsible for the initial collection, separation, sorting and packaging of cell phone waste, not to mention the necessary advertising and organization needed to start a recycling program. He indicated that it would be profitable for his company to purchase the waste at one centralized location in the country, such as the airport in San José, and take it back to the United States for processing and eventual resale. Straus also suggested that this would be the situation for other companies such as his. When pressed for more details on cost and profit, Straus claimed he could not divulge the information without being assured a financial foothold in a proposed recycling program. We informed him that it was not our place to guarantee this kind of participation. That aside, we were given surety of certain private sector interest in a cell phone waste recycling program.

4.2.4 Mario and Iliana Barquero, Servicios Ecológicos

We met with Mario Barquero, the owner of Servicios Ecológicos, and his daughter and co-worker, Iliana Barquero, in Santa Ana, a small town outside of San José. Sr. Barquero gave us a brief background about the company. Servicios Ecológicos has been collecting, sorting, and transporting waste for fifteen years. They are also able to classify, separate, package, and decontaminate hazardous materials. They purchase waste produced by businesses and after sorting, sell it to companies that will treat it or refurbish and resell it. Approximately 95 percent of the waste they deal with is recycled while the other 5 percent is sent to landfills for safe disposal. Although, they have primarily dealt with paper, cardboard and plastics, Servicios Ecológicos is able to dispose of all electronic waste produced by companies. They have not familiarized themselves with cell

phone waste yet, however, they are excited about the idea of integrating cell phone waste into their business.

Sr. Barquero also stated that in order to solve the growing cell phone waste problem a strong re-collection program will be necessary. However, this will be difficult just due to the sheer logistics of the problem. Money would be needed for transport, collection, space, and employees. Finding funding for these aspects of the program would be a complicated task to accomplish.

The Barqueros also see a few other problems in the planning of a cell phone recycling program. One large problem is that there needs to be centralized locations for the collection of cell phone waste. Servicios Ecológicos collects waste from companies, but cell phone waste is spread among the population of Costa Rica and without collection sites it would be impossible to acquire that waste.

Another hindrance is the lack of education throughout the people of Costa Rica about cell phones in general. Knowledge of the hazards and the proper disposal of cell phones and cell phone batteries is not distributed well in Costa Rica. Educating the public would help in convincing Costa Rica to recycle, but again the money issue still remains. Servicios Ecológicos already has an education program for young children on recycling, but a nationwide education effort must be launched. However, funding for an education program would be hard to come by. Motivating Costa Ricans to recycle is crucial to the sustainability of a cell phone recycling initiative.

4.2.5 Anna Ortiz, Tratamientos Tecnológicos

We interviewed Anna Ortiz, who is an environmental consultant for Tratamientos Tecnológicos. A more complete summary of our interview is attached in Appendix M.

Tratamientos Tecnológicos is a waste management and environmental consulting company located in Costa Rica. They are a subsidiary of a Netherlands-based company focused on the cleaning, packing, and shipping of toxic materials.

Ortiz expressed to us the need for a legislative act to support a recycling program. This is the only way that a recycling program can be economically feasible and sustainable. Currently (as of July 2004), a decree is in the making to establish legal backing for a recycling program. A decree is more of an executive order than a law. It is a document signed by the minister (head of state) that takes action immediately. The only drawback is that it does not encompass the same power and authority as a law. However, a decree would allow for enough legislative structure for a recycling program to be sustainable. It eliminates the need for a law because it still has the strength to enforce rules. The decree is also better suited for the cell phone waste situation because it can be passed more quickly and easily than a law, leading to a program can be underway in the near future.

The interview also gave us a better awareness of some of the problems of cell phone waste. Cell phone batteries are estimated to have a life span of 200-400 recharges, or approximately 1-2 years (Ortiz 2004). Also, ICE has been slow to set up telephone hard lines, making it easier to acquire a cell phone service in some areas than the normal land line phone service. With the increase in the legal imports of cell phones, along with the illegal smuggling of cell phones into the country, the cell phone population is rising at an alarming rate. However, from known information concerning the increase of cell phone lines from ICE, a number can be approximated. According to ICE, in 1999, the number of cell phones in Costa Rica was estimated to be 121,239. Currently that number

is estimated to be around 960,000 cell phones and next year there will be around 1.6 million cell phones. This increase is alarming due to the fact that the average person possesses their cell phone for approximately 1-2 years (Ortiz, 2004). With no current system of cell phone waste disposal it is impossible to obtain the exact number of cell phones that are spent and discarded each year. By analyzing this data we were able to conclude that Costa Rica currently has around 300,000 retired cell phones from last year alone. This is based on the fact that if there are 960,000 cell phones and 1.6 million the next year around half of the cell phones from the previous year will be discarded due to the fact that a cell phone in Costa Rica lasts around 1-2 years. Then add in the amount of cell phones from 1999-2002, 907,818, because these phones are assumed to be retired. Then add in an estimate of 300,000 for the year 2003, and it gives a grand total of 1,407,818 spent cell phones in Costa Rica.

On the other hand, not all the information that was conveyed about cell phones is negative. According to Sra Ortiz a cell phone recycling program is feasible due to the volume of cell phones in the country, however at the present moment exportation of the waste is necessary (Ortiz 2004). Due to their constant rate of increase, cell phones provide a large economic value in recycling. Also, because the Costa Rican people can relate to the cell phone as a part of their daily lives, it will be relatively easier to raise public awareness on the topic of cell phone recycling as opposed to other types of recyclable waste.

The recycling program remains at a stand still, waiting for legislative action to take effect. The whole program can be related metaphorically to a wave, with our project group at the crest, lining up the proper companies for each part of the recycling process,

and the base being the legal action pending for the wave to crash down and the program to commence. With legal action taken and the proper companies involved, a sustainable cell phone recycling program can be instituted.

4.2.6 Large Companies; INTEL, Baxter, Hospira, Dos Pinos

Another group that we interviewed was one of large companies located in Costa Rica. We made contact with the environmental heads of four corporations: Anibal Alterno of INTEL, Marvin Nunez of Baxter, Sergio Lisano of Hospira (formerly Abbott Labs), and Luis Solano of Dos Pinos. We asked each of them a short series of questions (see Appendix D) to gain a better understanding of their interest in a cell phone recycling program.

The responses to our questions were overwhelmingly positive. Each company indicated that they would participate in a cell phone collection program at some level if one were established. Also, they would allow for collection boxes to be stationed at their facilities and for the boxes to be emptied on a regular basis. A rough estimate of the number of cell phones can be established. We were able to identify 5 large companies (including ICE) which were interested in participating in a collection program, each with an employee population of roughly 5,000 employees. With an optimistic assumption that 60% of the employees own cell phones, there are 3,000 cell phones per company. Divide this by the number of cell phones in the country, 960,000, and the five companies we interviewed would constitute 1.5% of the total cell phone population.

4.2.7 Walter Zavala, MINAE

To further investigate the public sector interest in a potential recycling program, we spoke with Walter Zavala, a representative of MINAE, which is the government

agency that, among other things, oversees the environmental concerns in Costa Rica. We had been informed by Anna Ortiz that Zavala was the man responsible for pushing forward the Special Waste Decree, and hence we asked him to describe it for us. He was unable to give us either a hard or electronic copy due to the fact that the legislation was still in its formative stages. Zavala informed us that MINAE had spent two full years working on this decree, and that the industries in Costa Rica were preparing for its enactment. He predicted the Minister would sign it within the next three months at a maximum.

The decree is based on two main philosophies: whosoever contaminates the environment should be held responsible for the waste, and that this responsibility is extended to the producers, manufacturers, and importers. The decree provides for three different types of what he called "economic instruments", or ways to implement a recycling program. These are a deposit/reimbursement system, a recycling "fee" to be paid at the time of the purchase, or the voluntary participation of the public. These instruments are not mutually exclusive, and could possibly work in conjunction with each other to create more attractive economic incentives. Once the decree is signed, Zavala's overall view of the future of the special wastes industry is a more united group of producers, generating less waste with a longer product lifespan. He also foresees that the decree will include more types of waste than it does currently.

Four types of materials are covered under the decree, under the large categories of automotive, beverage waste, plastics and most important to our considerations, electronic waste. Under of the heading of electronic waste comes computers, scanners, printers, copiers, and finally cell phones and cell phone batteries. Each main category of the

decree (e.g. automotive, electronic, et cetera) will have a directing board to oversee the function of the recycling program. Governing these subsections of the program will be a decision making council above them called the Executive Unit, responsible for monitoring the entire program. MINAE's role in this will be to set goals for recycling (25 percent of materials now, 60 percent by the year 2015), to set quotas, and to assist in watching over the industry.

If a company chooses not to comply with the decree, it can be taken to an environmental tribunal for sanctions to be imposed, to public court where a judge can hand down penalties, or the administration of the program, which has the power to shut down the company. These negative incentives serve to ensure the cooperation of the industry.

4.3 Data from Questionnaires

To gauge the public opinion regarding cell phone waste and a potential recycling program, we designed a questionnaire and distributed it to the general public in the San José area, specifically at the Mall San Pedro (MSP) and the University of Costa Rica (UCR).

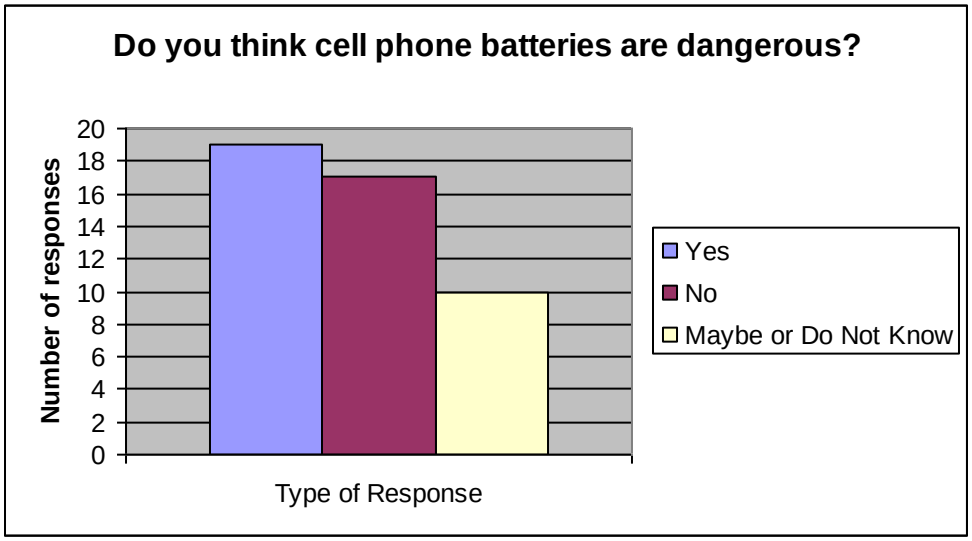
4.3.1 Mall San Pedro

We received an extremely positive reception from the people we questioned at the Mall San Pedro. It resulted in a final sample of 27 women and 19 men, with an average age of almost 29 years old. Two of the 46 people who responded did not own a cell phone. The respondents who did own at least one cell phone purchased one an average of 15 months ago. We discovered that people changed their cell phones for a variety of reasons, but most prevalently because of the development of newer and sometimes more

compact technology. The results of the four most important questions from our survey will now be described both verbally and graphically.

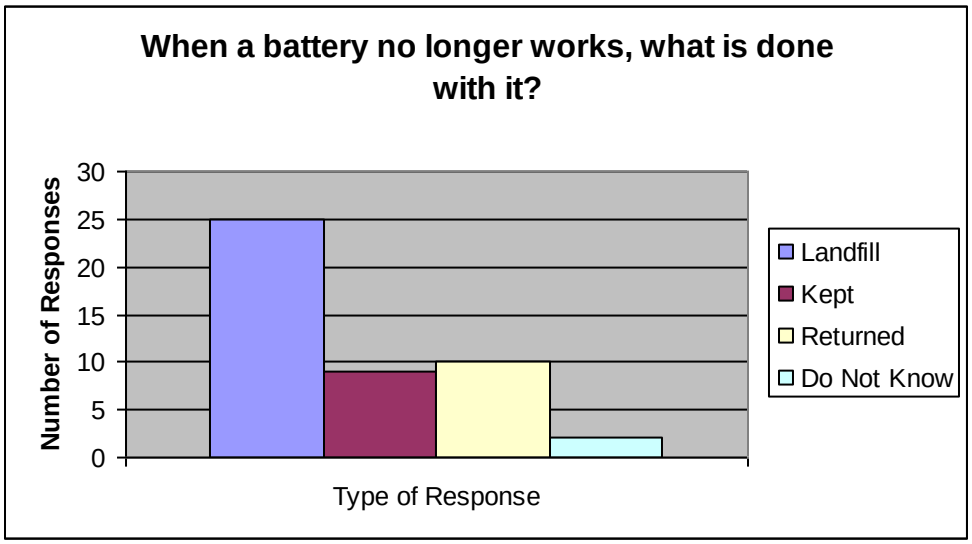
We asked each participant if he/she thought cell phone batteries were dangerous to either human health or the environment. The responses were almost evenly split, showing no lean towards one side or the other (Figure 2).

Figure 2: Awareness of Hazards of Cell Phone Batteries (MSP)



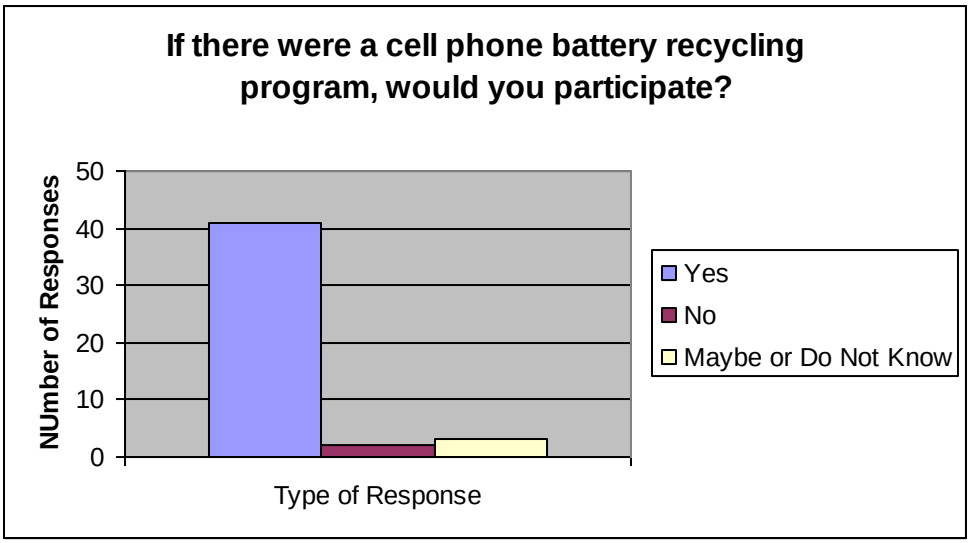
We then asked if the respondent knew how cell phone batteries were currently disposed of in Costa Rica. Each participant chose from responses of: thrown away, returned to where they were purchased, kept for safekeeping, or an open-ended choice. Responses indicate that a significant amount of the population know that cell phones and batteries are simply disposed of in landfills, and also that many are just unaware of what happens to the electronic waste (Figure 3).

Figure 3: How Batteries are Disposed (MSP)



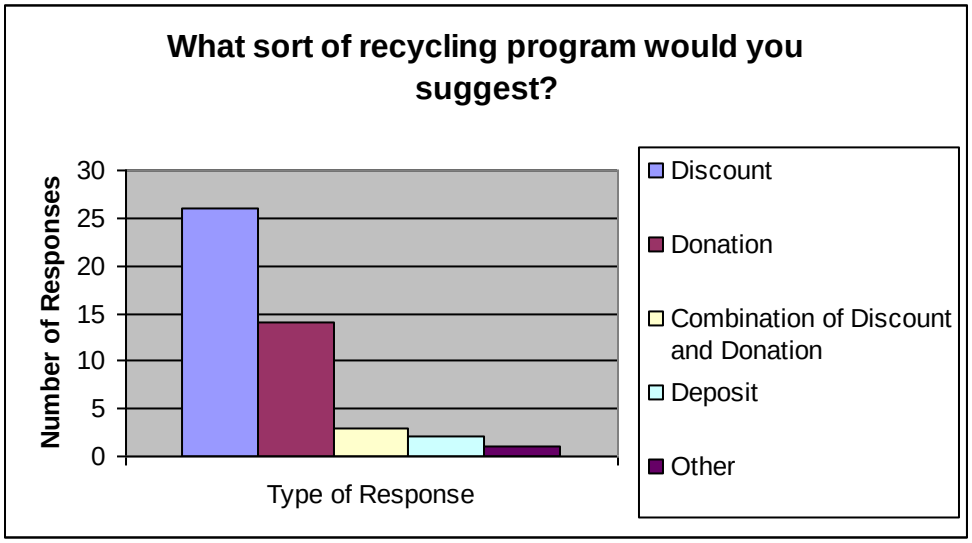
Next, we wanted to determine people's willingness to participate in a recycling program, so we asked each person if they would participate in a cell phone battery recycling program, if such a program existed. We left this question open-ended, but received only one-word answers. The overall response was decidedly in favor of participation in a recycling program (Figure 4).

Figure 4: Potential Participation (MSP)



Finally, we inquired as to what people thought would be the best plan for a recycling program. We proposed three different options: when returning an old battery they would be given a discount on a new battery purchase, donating the old battery to a charitable foundation, or paying a deposit when buying a battery to be repaid when the battery was returned. We also left a space for an open-ended response, but only received suggestions of a combination of the first two options (Figure 5).

Figure 5: Type of Recycling Plan (MSP)



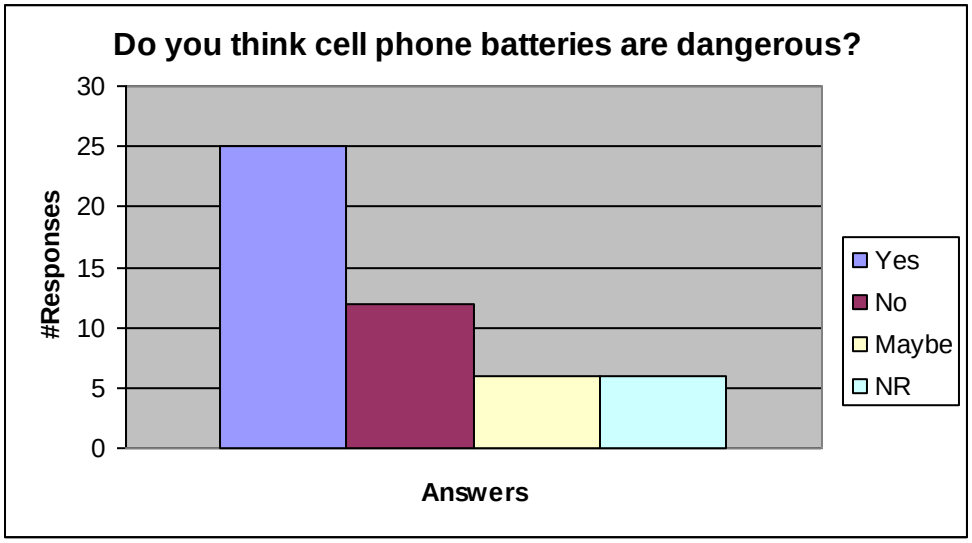
4.3.2 University of Costa Rica

Again at the University of Costa Rica there was a positive reception from those that participated in the questionnaire. A total of 19 females along with 30 males participated, with an average age of 20 years. Of the 49 participants, 10 did not own a cell phone. The respondents who did own at least one cell phone purchased one an average of 13 months ago. We discovered that people changed their cell phones for a variety of reasons in the last year, but most prevalently because of either a robbery or

because the cell phone was broken. The results of the four most important questions from our survey will now be described both verbally and graphically.

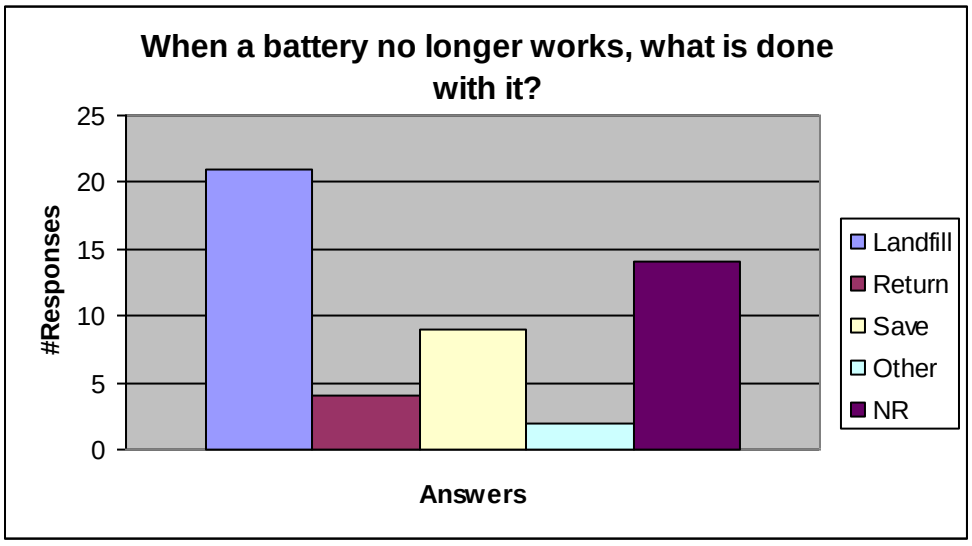
We asked each participant if he/she thought cell phone batteries were dangerous to either human health or the environment. As seen below, almost double the respondents believe that the batteries are dangerous compared with those who think they are not (Figure 6).

Figure 6: Awareness of Hazards of Cell Phone Batteries (UCR)



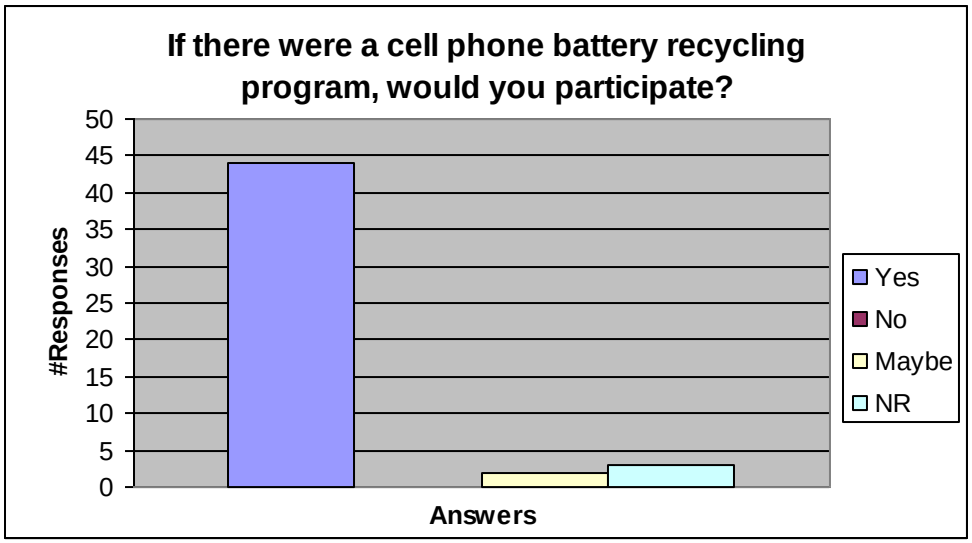
We then asked if the respondent knew how cell phone batteries were currently disposed of in Costa Rica. Each participant chose from responses of: thrown away, returned to where they were purchased, kept for safekeeping, or an open-ended choice. Responses indicate that a significant amount of the population know that cell phones and batteries are simply disposed of in landfills, and also that many are just unaware of what happens to the electronic waste (Figure 7). The large number of non-responses can possibly be attributed to the fact that the population sample is younger, and may not have owned a cell phone long enough to have to dispose of it.

Figure 7: How Batteries are Disposed (UCR)



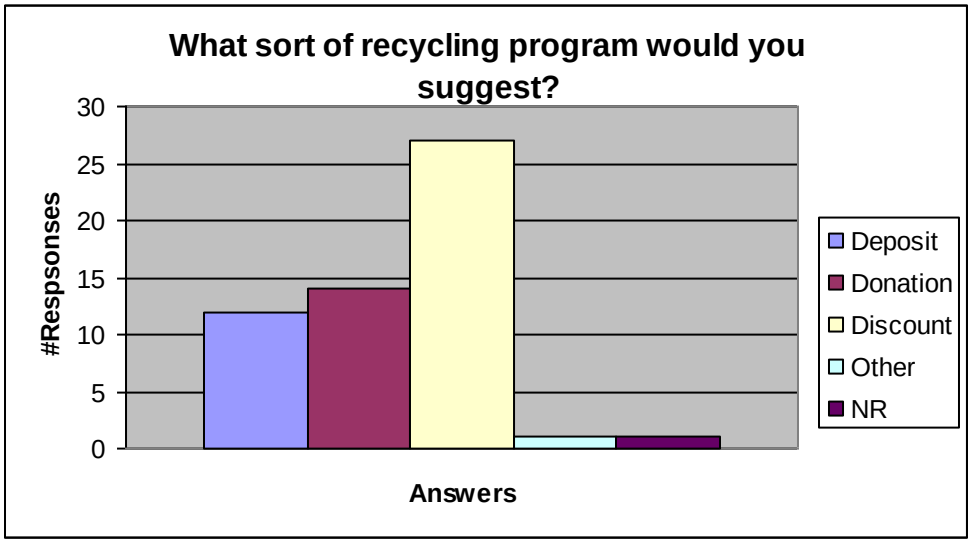
Next, we wanted to determine people's willingness to participate in a recycling program, so we asked each person if they would participate in a cell phone battery recycling program, if such a program existed. We left this question open-ended, but received only one-word answers. The overall response was again decidedly in favor of participation in a recycling program (Figure 8).

Figure 8: Potential Participation (UCR)



Finally, we inquired as to what people thought would be the best incentive for a recycling program. We offered three different options, as well as an open-ended space: when returning an old battery they would be given a discount on a new battery purchase, donating the old battery to a charitable foundation, or paying a deposit when buying a battery to be repaid when the battery was returned (Figure 9).

Figure 9: Type of Recycling Plan (UCR)



4.4 Data From Archival Research

The data that was collected via archival research originated from four distinct categories. Archival research was conducted on a few companies that were interviewed, on the regulations provided by ENLACE, on Costa Rican national waste strategy information, and on the logistics of a collection program specifically for Costa Rica. Each of these categories will be discussed in this section thoroughly.

Also data will used from the background and literature review concerning recycling programs in the United States, Australia, Japan, and the Netherlands. This information not only includes information concerning the recycling program, but also the education program instituted in the United States by the RBRC, accessible in Appendix

N. For more detail of the recycling programs of these four countries consult Section 2.8.1, regarding waste management through collection.

4.4.1 Private company information

In order to understand the businesses that could be involved in this recycling program, we researched three companies in terms of their purpose, background, experience, and expertise. These three companies are Re-Cellular, Servicios Ecológicos, and CNP+L.

Re-Cellular is a privately owned business that is based in Dexter, Michigan. This company focuses on "buying, selling, and recycling used cell phones, pagers, printer cartridges, PDAs and other handheld electronics" (Re-Cellular, 2004). They provide cell phone retailers with refurbished, graded, and used wireless products at an affordable price. Not only does Re-Cellular provide cell phone retailers with quality products as a significant supply for money, but it is also a source for disposing handheld electronics that are no longer used.

Servicios Ecológicos is a private business based in Santa Ana that works with all kinds of waste from different industrial companies. The purpose of Servicios Ecológicos is to be dedicated to the conservation, ecology, recycling, and reuse of waste (Servicios, 2003). This company was created in 1988 to manage waste from industrial companies through recycling. Servicios Ecológicos has experience with cardboard, plastic, paper, aluminum, copper, bronze, batteries, platforms, and other types of recyclable materials. Servicios Ecológicos is also equipped with a fleet of trucks, prepared for transporting industrial waste, as well as the security and equipment needed for the recollection and separation of waste.

Our sponsor is Centro Nacional de Producción Más Limpia (CNP+L). This organization is dedicated to cleaner production: an integrated preventative strategy that is applied to processes, products and services to the end of increasing the efficiency and reducing the risks to humans and the environment (CNP+L, 2003). This organization performs five different functions including promoting cleaner production, organizing demonstration projects, offering technical assistance for cleaner production, listening to the experience and needs of the national industry, and identifying opportunities to transfer cleaner production technologies. CNP+L is sponsored by the Cámara de Industrias de Costa Rica, Instituto Tecnolólogico de Costa Rica, CEGISTI, Organización de Naciones Unidas para Desarrollo Industrial, Programa de Naciones Unidas para el Medio Ambiente, and Secreteía Federal de Asuntos Económicos del Gobierno Suizo. For more information concerning the history and expertise of CNP+L, see Appendix A.

4.4.2 Hazardous waste regulations

ENLACE is an environmental legal consultant group that provided us with three documents relevant to our project concerning industrial hazardous waste. These three government documents are the following: the "Regulation on the Characteristics and the Listing of the Industrial Dangerous Waste," the "Regulation for the Handling of Industrial Dangerous Waste," and the"Regulation for the Dangerous Product Registry." Each of these documents describes the proper procedures for characterizing, handling, and registering dangerous waste.

The "Regulation on Characteristics and Listing of the Industrial Dangerous Waste" was designed to properly list all waste in a uniform fashion for every industry in Costa Rica. It also defines three different categories of waste: ordinary waste, and

dangerous waste. Waste is "all that substance or movable, deficient, unsuitable object, made unusable or without direct use…whose proprietor wants to eliminate of the same or is forced to eliminate according to the national laws. The by-products or rest of treatments are included," (Regulation Characteristics). Also, "it is considered that a waste is dangerous when it presents/displays one or more of the following characteristics: inflammable, reactive, toxic, biologically explosive, infectious, corrosive" (Regulation Characteristics). In the case of materials utilized by cell phone batteries, such as cadmium, it also lists the Maximum Concentration Level for cadmium as 1.0 mg/L. For further information on this regulation, consult Appendix I.

The "Regulation for the Handling of Industrial Dangerous Waste" was created "to establish the norms and procedures for the handling of dangerous wastes" (Regulation Handling). This regulation assigns responsibility for handling, cleaning, treatment, and disposal to the creators of the original waste. It also defines a suitable treatment program to have key stages: generation, accumulation, treatment, and final transport. Also included are the requirements for proper storage containers and facilities and definitions of specifically what containers are suitable for protection against the environment. For further information on this regulation, see Appendix J.

The final document provided by ENLACE, called the "Regulation for the Dangerous Product Registry," was created to "regulate the dangerous product registry" (Regulation Registry). This regulation on registering dangerous products details how precisely all dangerous products must be labeled, recorded, and separated. It separates materials into nine classes to keep explosives, gases, corrosive materials, liquids, and

other materials from reacting with each other. See Appendix K for more information concerning this regulation.

4.4.3 National waste strategy

Two documents that demonstrate Costa Rica's efforts in reducing electronic waste and cell phones are a document from Carlos González, of ICE, on the cell phone collection plan project, and the National Waste Strategy from Emil de la Rocha, of ACEPESA. ACEPESA is an international think tank concerned with the management of hazardous technological waste. Both of these documents address the future of recycling electronic waste.

The document drafted by Carlos Gonzalez outlines the current conditions in Costa Rica concerning cell phones, the objectives and needs of a collection plan, as well as a brief cost analysis. Currently in Costa Rica there are 960,000 installed lines and in 2005 it is estimated that there will be around 1.6 million active lines (Gonzalez document, 2004). A few of the objectives stated in the document are to recycle cell phones through recollection, establishing an education initiative, and use this program to initiate a donation program through a foundation. Also, the estimated pilot program is to cost US $60,000. For further information from this document, see Appendix H.

The second manuscript, written by Emil de la Rocha and published in April 2004, is titled the National Waste Strategy, and documents the vision for overall electronic recycling. By 2015, Costa Rica plans to recycle 60% of electronic and electrical waste (National Waste Strategy, 2004). Furthermore, it plans to institute stringent legal parameters for this type of waste and implement an education program for the general public. There are four principles for the national strategy: 1) To extend the responsibility

of the producer and the consumer; 2) To introduce a monetary incentive to produce less; 3) To have the producers be responsible for the waste throughout the life of the product, thereby deterring the production of hazardous waste; and, 4) To reduce the cost of disposal. This strategy also aims to make responsibility go beyond the producer to consumers, the government, and other organizations. See Appendix L for more information concerning the National Waste Strategy.

4.4.4 Collection program logistics

In order to gain a better understanding of a potential collection process in Costa Rica, we examined primary information regarding possible collection sites and travel routes. Specifically, we cross-referenced a road map (MapTak) and a population density map (INMOTICO) to pinpoint the highly populated and easily accessible locations. Our opinions regarding the best probable collection sites will be reserved in the following Analysis chapter. Data received from these maps are shown in Appendix O. We observed that roadways that are considered divided highways, including the Pan-American Highway, serve as better routes for transportation throughout the country. Also, from the population density map, we determined that areas with at least 500 people per square kilometer should have the easiest access to a collection point. This number includes the populations in and around the seven provincial capitals of the country (including San José), and incorporates roughly 60 percent of the total national population.

Chapter 5: Analysis

5.1 The Program

The four sections of the recycling process must be linked together to form a recycling program. With the proper organizations involved in collection, transportation, pre-treatment and processing, a sustainable cell phone and cell phone battery recycling program can be created.

5.1.1 Collection of cell phone waste

A major obstacle in the set up of a cell phone and cell phone battery recovery and recycling program is the collection of spent cell phones. The creation of collection sites would allow for a disposal points to address the immediate public need to discard spent cell phone waste. After conducting a series of interviews, questionnaires, and archival research we were able to establish several prime locations.

The first option is to set up collection sites at all ICE buildings throughout the country. ICE is already the sole provider of cell phone service and has many offices throughout Costa Rica. They are highly organized and are easily accessible to the public. Both of these characteristics make them a prime location for a collection. ICE also has the resources and influence to set up a strong advertising campaign in order to promote a collection program. By putting a small line on the cell phone invoice statement they can remind customers that they should recycle, and where to place their cell phone waste. With ICE's size and resources, they are a good option to be involved with a cell phone waste collection program.

Another area for the location of potential collection sites is at large company facilities. This would allow for the personnel of these companies to be able to easily

dispose of their cell phones. The large amount of employees working for these companies may provide the volume that is needed to help sustain a cell phone waste recycling system. However, large companies only provide easy access for employees and not the general public. By including collection sites at companies it increases incentives for employees of companies to recycle due to the ease and availability of access to collection sites.

Locating collection sites at provincial capitals would substantially increase the potential for larger volumes of cell phone waste disposal. Capital cities are more accessible due to the public transportation that runs daily between major cities. Capitals cities are also the more populated areas in the country, allowing for more individuals to have access to the collection sites. The provincial capitals alone constitute roughly 38 percent of the population of Costa Rica. But with the surrounding areas of those cities are added and the amount of commuters are also added into the equation, the provincial capitals contain closer to 60% of the population. However, those who are not located close to the capitals or do not frequently travel there may lose incentive to recycle at those locations. Disposal with regular trash would be easier than traveling to the collection site so recycling may not have precedence over improper disposal. This would be around 40% of the population, those who do not live in the provincial capitals. Public incentive is one of the major problems holding back the recycling program from sustainability.

In order to facilitate access to the collection sites by the public, areas of high traffic would serve as key locations for collection sites. A few examples of high traffic areas are supermarkets, malls, hospitals, and cell phone vendors. Collection boxes would

have to be positioned at these strategic locations to allow cell phone customers to dispose of their spent cell phones. This would make cell phone recycling convenient for the customer by incorporating disposal areas into their daily lives. There are some pitfalls that accompany this convenience. By having boxes in public locations, they become vulnerable to theft and vandalism. To deal with this problem more money would have to be spent to protect and maintain the boxes. One option may be to have business invest in secure collection devices so that the waste can be obtained. Similar to the bottle collection machines in the United States, business could invest in the collection sites and sell off the collected waste to the transport and pre-treatment companies. This would help with the funding of secure public collection sites and allow for more easily accessible collection sites.

Other locations that contain desirable characteristics for a collection sites are post offices located throughout Costa Rica. They would provide a central site for the people of that postal area. Also by instituting post offices as collection sites, mail services would be able to aid in the collection of cell phone waste from people's homes. This would be a major convenience to those who are unable to travel to dispose of their cell phone waste. One drawback to this method of collection is that Costa Rica´s mail system may not be practical for collection. The sizes of some post offices are not adequate for a central location, and are often times run out of someone's home. The mail system already is not very well organized and post offices are spread out throughout the country leaving doubts about the effectiveness of collecting cell phones in this manner.

Table 3: Summary of Collection Process

	ICE	Large Companies	Provincial Capitals	Traffic Areas	Postal System
Positive Qualities	Large Size Influential Organization Cell Phone Provider Possible Advertising Highly Organized Public Access	Employee Access Incentives for Employees	60% of Public Easy Access Centralized Locations	Easy Public Access Many Locations Increased Incentives	Centralized Locations Easy Pickup for Public
Negative Qualities		Lack of Public Access	Only City Access Need Public Incentive	Need Extra Security Need Public Incentive	Lack of Organization Unreliable

5.1.2 Transportation of cell phone waste

Carrying the cell phone waste from the collection sites and transporting them to the pre-treatment areas is another problem that needs to be solved to complete a cell phone recycling program. One option to transport this hazardous waste is to involve ICE in this process. Carlos Gonzalez specified that ICE would have little trouble transporting cell phone waste. They have an adequate amount of trucks and personnel to sustain the burden of a transport program.

Among the possibilities for transporting waste are companies similar to Servicios Ecológicos. They are companies that deal with the transport, sorting, packaging, and decontamination of waste. Companies like this would allow for transportation and pre-treatment of the waste by the same company. This in effect saves money by eliminating a middle company for pre-treatment. Servicios Ecológicos is already familiar with the pick up and transportation of waste from companies, such as INTEL.

The mail service would be a consumer-friendly way to transport cell phone waste. Collection and transport of cell phone waste by the postal system allows for an easier time for the public to dispose of their waste. It also increases the likelihood that a person will recycle their waste, due to the fact that it is more convenient. But again, the mail system is already having trouble distributing mail and burdening it with a cell phone collection and transport plan may not produce the desired results for a cell phone waste recycling program.

The use of independent transport companies is seen as a possible solution to the transport dilemma. A waste transportation company would be the best option, but this will most likely come at a price. This approach may be more expensive because another company is being added to the program. By adding more steps to the recycling process the program will become more expensive.

One final transport method that is being considered for the recycling program is consumer transport. This method of transport relies on the cell phone owner for the transport of cell phone waste to the proper sites. Although this method would be cheap, it poses a few problems. Consumers need to be aware of where they can bring their phones to. Also they need to have the initiative to bring their phones to a treatment center, rather than just discard them. These issues would require money for advertising, and there would be no guarantee on how effective the method would be.

Table 4: Summary of Transportation Process

	ICE	Servicios Ecologicos	Mail Service	Independent Companies	Consumer Transport
Positive Qualities	Large Size Adequate Trucks Large Personnel	Experienced Pre-treatment Already Transport E-waste	Eliminates Collection	Experienced Reliable	Less Cost
Negative Qualities	Lack of Experience		Lack of Experience Unreliable	Expensive Add's extra step	Consumer Responsibility Not Reliable

5.1.3 Pre-Treatment

In our recycling program, a significant portion of work must be done on the electronic waste before it is shipped for processing. This is the pre-treatment section of the program, and encompasses the sorting, disassembling, and packaging of cell phone and cell phone battery waste. There are two distinct topics of interest that arise concerning the pre-treatment. One is the legal implications of work done on potentially hazardous materials, as well as the potential human health hazards from working with said materials, the other being the actual organization that puts the time, space, and resources into the project at this stage.

The legal restrictions and regulations on hazardous waste will govern the way that cell phone waste is sorted, broken down, and then repackaged, each step requiring the intimate handling of the waste. We extensively researched these restrictions and regulations; primarily through ENLACE (see Section 4.4.2). We obtained irrefutable documentation of Costa Rican regulations regarding the procedures that must be followed when handling cell phone waste. This applies to our project directly, in that it is certainly necessary to follow all laws when establishing a recycling program. The operators of

Servicios Ecológicos agreed, and further stipulated the need to obey laws from other countries where a multi-national program is involved.

As far as the actual physical act of pre-treating the waste is concerned, there is a choice of two options, which returns us to the issue of private vs. public sector. According to Carlos González of ICE, it would have been possible for a government initiated recycling program to be responsible for the pre-treatment after the collection process. However, the Costa Rican government lacks the funding and organization for this, in fact it currently lacks the proper resources for the entire recycling project. The alternative is to appeal to the private sector. Servicios Ecológicos is a perfect example of the type of company that could be involved in the pre-treatment of cell phone waste. They lack experience in dealing specifically with cellular phones, but that is likely to be a common occurrence in waste management companies in Costa Rica. They do, however, have 15 years of experience in dealing with electronic waste, and possess the staff and the facility necessary to carry out the necessary processes of sorting, disassembling, and packaging.

There is a third option to be considered. It is theoretically possible to ship the raw cell phone waste to a processing facility outside of the country, without it having been pre-treated. However, Gary Straus, Vice President of Re-Cellular indicated that it would not be profitable or even possible for a company such as theirs to do both the pre-treatment and the area that they focus on, processing. Even if a company meeting those requirements could be found, it is quite possible that it would be less proficient in one aspect or another of the process, without having the necessary specified focus to be exemplary in either aspect.

5.1.4 Processing

We have two different alternatives to choose from in regards to processing. We considered the options of keeping the recycling program domestic (in Costa Rica), or exporting the waste to be treated in another country. According to experts (e.g., Musmanni, González), Costa Rica does not have a large enough volume of cell phone waste to have a self-sustaining program in the country. To facilitate such a program, Costa Rica would need to be a regional processing center for Central America. This was observed by the experts to be unlikely. Although Costa Rica is relatively technologically advanced when compared with its Latin American neighbors, and is the only country in the region investigating the cell phone waste problem. This could lead to Costa Rica becoming a regional recycling center at some point in the future, but rules out that option for the present.

The other option is exportation to countries that already have the infrastructure in place to recycle cell phones. This is mostly limited to "first world", technologically advanced and environmentally concerned countries, and the United States appears as the most likely choice, given its high number of private recycling companies, as well as the strict hazardous materials laws and handling regulations (Gonzalez, 2004). There is no lack of private sector interest in recycling cell phone waste, an interest that can be represented by Re-Cellular. Although there are complications with the international transport of hazardous waste, these barriers are not insurmountable. This private company fits the bill of a law-abiding organization willing to purchase cell phone waste, refurbish or process it, and then sell it or be responsible for the safe disposal of the unusable parts. Their financial investment will drive them to assure the sustainability of

the program. Although this type of company takes care of the processing issue, it still leaves the problem of collection and pre-treatment.

5.2 Legal and Financial Interdependence

The issue of financial stability is rooted in the legal issues of a recycling program for special waste, which cell phones are considered in Costa Rica. The only way that financial stability can be established is through the foundation of a law or decree that forces one group to be responsible financially, at least.

5.2.1 The elements that require funding

There are many areas of this recycling program that need funding in order to function appropriately and collect as many cell phones and batteries as possible. The areas that need the most financial support are the whole collection process, discussed in Section 5.1, advertising, an incentive program, and public education.

The collection program, from collection sites, transportation, and pre-treatment, will be a domestic program. From the various interviews conducted, it has been determined that funding for the collection program is difficult to obtain. Sergio Musmanni (CNP+L), Carlos González (ICE), and Mario Barquero (Servicios Ecológicos) stated that there is a logistical problem. Money is needed to establish collection sites, purchase collection boxes, transportation (i.e. maintenance, gas), employee wages, office supplies (i.e. computers, printers, paper, phones), treatment facilities and upkeep, and all the pre-treatment that a waste management company is responsible for. From the document drafted by Carlos González, the preliminary program budget for one year, for logistics, is included in Table 5 below.

Table 5: Logistics Budget

Logistics	Price (US$)
Central Location	18000
Vehicle	14000
Maintenance	9000/yr
Salary (2 employees)	8000/yr
Initial start up	6000
Packaging/Transport	12000/yr
Paper/Documentation	3000/yr
Security	10000
Total (1st yr)	80000

Source: Carlos González Document

This table just accounts for the money concerning the logistics of the collection program, and is just a value estimated by Carlos González.

Another factor that will need capital is the advertisement of the collection program. Advertising should be a multi-media attack through the radio, television, and internet. From interviews with Carlos González (ICE), Section 4.2.2, advertising should be primarily done by ICE, but not funded by them because it is not their sole responsibility. This project can be controlled and run in a few different ways. ICE, the communications monopoly in Costa Rica, can easily promote the recollection of cell phones and batteries through billing statements, television advertisements, and on their website. A simple line at the end of each billing statement would only cost approximately ¢0.01/statement, since the cost of toner is very inexpensive. Vendors can also sponsor the program by placing posters in their stores and by training their associates to mention and recommend this program to their customers. One or two signs indicating the recycling program at a vendor or store may only cost ¢400.00/sign, since color copying is also inexpensive. Finally, the television and radio marketing will cost more

than billing statements and vendor posters. Both television and radio marketing will take weeks of air time and more money. Radio commercials, when compared to television commercials, are less expensive, but may not reach as many people. Both radio and television commercials can vary in price—depending on quality, time, and length of advertising. However, prices on a commercial can range from US$800.00 to US$1500.00 for a 30-second slot broadcasting from a local radio or television station. These three areas of the cell phone industry can all sufficiently promote the collection program for broken or unused cell phones through continual reminders to their customers, however, if there is not any money to produce this marketing scheme, it will not be initiated; and, consequently no action will be taken by the general public to help solve the cell phone waste problem.

Furthermore, the general public will not be willing to bring their cell phones to a collection site unless they have some motivation to do so. From the questionnaires conducted at Mall San Pedro and the University of Costa Rica, 52 out of 95 respondents would like a discount on their next purchase as an incentive to recycle their phones and batteries. One way to have cell phone owners to return their unused or broken phones to a collection site is to offer a monetary reimbursement. This incentive can range from US $1.00 to US $10.00, in order to entice customer to return their phones. At the time of purchase an added charge is placed on the price of the phone, and when the cell phone owner returns the phone and battery, the deposit is returned to them. Another option is to make the returning of a cell phone as a charitable act. A cell phone owner, in this case, can return the phone to a collection site as a donation to a benevolent organization, such as an AIDS foundation, a children's cancer foundation, or a battered women's

organization, for example. A different option for attracting customers to return phones is a reimbursable deposit. All three of these options require funding, as the other parts of the collection program.

Finally, the public must also be properly educated. Three key aspects of cell phone and their batteries must be highlighted: handling, disposal, and hazards. From the interviews from Mario Barquero (Servicios Ecológicos), in Section 4.2.4, and Carlos González (ICE), Section 4.2.2, it is evident that education is a topic that must be confronted in the implementation of the collection program. The Rechargeable Battery Recycling Corporation has posted a valuable source for educating students about cell phone batteries. This document is a great source for education, and can be studied more in depth in Appendix M. Since this is the most dangerous part of the cell phone, it should have the most focus on any sort of education program. Other sources of education may be developed from MINAE or the Ministerio de Salud.

5.2.2 Legal Solutions

In Costa Rica, there are two official documents that come from the government concerning regulations: laws and decrees. Laws are passed by the legislative branch and are powerful because they can impose taxes and have a direct cause and effect penalty system (i.e. fines) (Anna Ortiz, 2004). Ortiz also stated that decrees are powerful, but only have to be signed into being by the Minister. Both of these options can solve the financial problems discussed in Section 5.2.1. The law, however, is difficult to pass in Costa Rica according to many of the interviews completed, including the ones with Anna Ortiz (Tratamientos Tecnológicos), Section 4.2.5; Mario Barquero, Section 4.2.4; Sergio Musmanni (CNP+L), Section 4.2.1; and Carlos González (ICE), Section 4.2.2. The main

reason expressed from each interviewee is that in Costa Rica so many taxes are already in place that the government is reluctant to pass taxes on an issue the public is not interested nor aware of.

Therefore, the decree for special waste is being proposed by MINAE in a few months. This decree gives financial, legal, and moral responsibility to the manufacturers and importers of special wastes and products (Walter Zavala, 2004). The decree will encourage companies to invest in waste management of their products and allow for the collection program to be funded by various industries—service providers, manufacturers, importers, and vendors (Anna Ortiz, 2004). When the decree is installed as a regulation, businesses will have to continue the management of cell phone waste, providing a sustainable program, and therefore allow for collection, treatment, advertising, and education.

Chapter 6: Conclusions and Recommendations

6.1 Conclusions

At the outset of our project, our objective was to accomplish four main goals in efforts to create a preliminary model and the general outline for establishing a collection and recycling program for cell phone waste in Costa Rica. We accomplished these goals by identifying the key stakeholders in a recycling program, researching worldwide efforts in cell phone recycling, determining the size of an effective recycling program in Costa Rica, and then using this information to propose a model recycling program to CNP+L.

6.1.1 Key Stakeholders

After properly analyzing our data obtained from various collection methods, we were able to identify key stakeholders for a cell phone waste recycling program from three different aspects of society. We have found important stakeholders from the general public, the public sector, and the private sector. Each area plays its own important role and has its own specific interests in a cell phone waste recycling program.

The general public is the basis for a cell phone waste recycling program. They are the first generators of the cell phone waste that must be collected and properly recycled. From our questionnaire, we were able to determine that the general public has a strong interest in participating in a recycling program if one were to be established, but also were relatively unaware that they were hazardous. The public participation and knowledge of cell phone hazards are vital for a recycling program to be sustained. Waste volume must be large enough for involved companies to be able to economically profit. Economic profitability is achieved when the amount of money gained from recycling cell

phone waste outweighs the cost of operation. To generate this demand requires that the public be informed about recycling and actively involved in the proper disposal of cell phone waste. The public participation is a crucial part of starting up and sustaining a cell phone waste recycling program.

Another important group of stakeholders that must be involved in the recycling program for it to be feasible is the public sector. Government agencies and public companies such as MINAE, ICE, and CNP+L are essential factors in the success of a recycling program. MINAE plays a strong involvement in monitoring waste, passing legislation, and in environmental issues. Walter Zavala has been trying to pass a waste decree allowing the cell phone waste recycling program to be instituted. MINAE would regulate the program and make sure that it runs smoothly helping to decrease the volume of cell phone waste. ICE takes on a huge role by its direct influence on the cell phone market and by its size and resources. ICE is an important participant in the program to help notify the public and possibly aiding in the collection part of the recycling program. ICE can also be involved in the direct collection of funds for the program by raising the price slightly on cell phone service charges. CNP+L assumes the action of making sure that the program is running efficiently and is well coordinated. They are able to network with consultants and companies to find people to help alleviate the waste problem. Also, CNP+L has the capacity to help the recycling program operate efficiently by seeking out the best companies for each portion of the recycling process and weighing the options. The public sector plays a significant role in the efficient development and implementation of the recycling program due to its regulatory efforts, capacity to reach the public, and ability to generate funds.

Furthermore, the private sector is vital to the economic stability of a recycling program. Private companies are out to turn a profit and by involving them in a cell phone waste recycling program they should be able to make the operation economically feasible. Ideally each step in the recycling process will have different options to choose from. From our interviews and research we were able to interact with at least one company representative from each part of the recycling process chain. However, more than one option should be weighed at each part. Companies similar to Servicios Ecológicos are attempting to become involved in the collection and sorting of the cell waste. They are important to the process for their ability to pre-treat the waste before it is sent off to be properly recycled. Companies such as Re-Cellular are waiting on the doorstep for the opportunity to be involved in a recycling program in Costa Rica. They already buy collected waste from electronic equipment out of collection companies and effectively recycle and reuse it for resale. This action falls under the processing part of the recycling program. Other private companies with interests in a cell phone recycling program are various large companies. Similar to the companies we interviewed (INTEL, Baxter, Dos Pinos, Hospira, section 4.2.6), large private companies allow for favorable areas to set up collection sites. They have many workers that can deposit their cell phones safely in collection boxes and they provide a well known location so others can discard of their cell phone waste. Companies are crucial to aiding any collection program by having boxes on their premises.

With stakeholders from all aspects of the recycling program ready to participate in the cell phone waste recycling plan it is likely that the program will succeed. This is dependant on a few factors. One is that public awareness can be raised so that a

sufficient volume of waste can be generated to economically sustain a program. Another factor is that the special waste decree must be passed before any action can be taken. This is optimistically expected to be accomplished within the next three months (Zavala 2004). When the decree is in place legal restrictions will allow for better financial stability for the cell phone waste program.

6.1.2 World-Wide Efforts

After reviewing many of the world's cell phone and cell phone battery recycling programs, a combination of programs was selected as the ideal model for cell phone collection in Costa Rica. The Netherlands, Japan, Australia, and the United States were all reviewed and described in Section 2.8.1. The Netherlands uses an electro-magnet to separate electronic waste from the general waste, which places responsibility solely on the waste management companies, since they are the ones responsible for collection, separation, maintenance, and handling. Japan charges consumers to return their cell phone batteries to create a disincentive on manufacturers, to promote the creation of less hazardous products with longer life spans, through consumer-driven advertising and urging. Australia also uses a tax like Japan; however, the tax is used to fund the recycling program for cell phones. Australia has designed a program that allows for easy drop-off for consumers, and they do not charge for the return of the phones or batteries. The company responsible for overseeing the whole collection and processing procedure is Australian Mobile Telecommunications Association, and the program is called The Mobile Phone Industry Recycling Program.

Finally, the collection program that has been the most successful, and has the potential to be successful in Costa Rica is a collection program modeled after the *Charge*

Up to Recycle! program run by the Rechargeable Battery Recycling Corporation in the United States. Like the program in Australia, this program offers many drop-off points for consumers; however, the program is not funded by taxation to consumers or manufacturers but by the industries responsible for producing rechargeable batteries. RBRC, a corporation funded by the cell phone industry, became a corporation due to a law instituted by the United States government called the "Mercury-Containing and Rechargeable Battery Act," which can be viewed in Appendix P. This law states that batteries must be properly disposed of, and the rechargeable battery corporation has taken responsibility for it and set up the recycling program.

This strategy can work in Costa Rica because the country imports many cell phones. By placing legal and financial responsibility on the importers and manufacturers of cell phones the financial funding can come through this: instituting a law like the law instituted in the United States. Also, by making drop-off points at highly trafficked locations, like Australia's or the United State's programs, will create awareness and improve participation. Overall, combining the initiatives of Australia and the United States and then tailoring them to Costa Rica's culture and approach to waste management will result in a highly successful program.

6.1.3 An Effective Recycling Program

It is difficult to determine the size of a potential recycling program, other than to say that a program will run most efficiently with the most possible waste being input into it. Costa Rica does cannot generate enough cell phone waste to support its own recycling program. As stated in our analysis, we believe that a starting base of electronic waste of approximately 5 million phones is needed to implement a program that is self-sufficient

in Costa Rica. The overhead of such a program, employee wages, storage space, transportation, et cetera, costs more than the amount of revenue recycling cell phones in Costa Rica could hope to bring in. There will be, however, from money generated by the special waste decree, sufficient funds for the logistics portion of the program, from collection up to processing. Likewise, it is an unrealistic goal at this time to promote Costa Rica as the Central American center for cell phone recycling. The rest of Central America is not technologically advanced enough to begin considering a cell phone recycling initiative, and therefore cannot become involved in a Costa Rica-based regional recycling program. They have larger concerns. Perhaps in the future it will be possible to create a larger program that encompasses more of the region and generates the necessary amount of waste needed to form a self-sufficient program without needing to outsource the processing portion of the recycling. Costa Rica can act as a leader in environmental consciousness in this instance.

The remaining option is exportation for processing. This is perhaps not ideal because it creates the complication of an international program (with more laws, more companies, more personnel, and more distance to be considered) and outsources jobs that are needed in Costa Rica. But all of this is countered by the fact that exportation is inexpensive (compared with a domestic program), it is readily accessible, and the infrastructure for processing already exists in other countries. That is, it is less expensive to export and sell the value of the waste to a private company in another country than it is to fund the creation and the maintenance of a recycling facility in Costa Rica.

When exporting, how much waste is being generated is less important, because processing facilities that already exist can buy the waste by the box or the ton or the

freight container, and simply add it to the amount of waste they have already collected. In theory, it would be possible to receive too much waste, but this is not a concern yet, as the suspected volume of waste collected from Costa Rica will not be too much of a load to sustain. Of course, the more waste shipped at one time the lower the overall cost, due to per instance customs fees and tariffs that are irrespective to volume and weight. The special waste decree provides a goal of 25 percent of cell phone waste generated in one year to be collected in the first year of implementation. This goal could be achieved not only by harvesting the waste from new cell phones that are manufactured or imported, but also by collecting the cell phones that have been building up in the country over the past five years. The goal seems reasonable given the constraints on a new and unprecedented initiative.

6.1.4 Proposing a Model

A cell phone waste recycling program needs to be economically feasible and sustainable. We see the ideal program being broken down into five separate steps that when linked together create a cell phone waste recycling program. The five steps in order are: collection, transportation, packaging, shipping, and processing. Each of these have to be weighed for options individually so that the best companies can be chosen for each separate task.

Cell phone waste collection is most crucial to the recycling program. A proper collection program must be established in order to acquire enough waste to make the recycling program feasible. The collection program must reach the public and be easily accessible. The collection program has to be advertised and publicized so that the most waste possible can be obtained. Also, it is necessary that the collection system is

sustainable in order that the whole recycling system does not suffer from lack of waste volume.

The system for transportation is the next step in the recycling process. A transportation company or transportation companies are needed to carry waste from collection sites to sites for sorting and packaging. This step requires a fleet of transportation vehicles that can meet the demand of waste and easily access to the collection sites. The transportation process is important in keeping the recycling program running efficiently and smoothly.

Pre-treatment requires that a company properly deal with the crude waste when it arrives on their grounds. Waste needs to be separated and sorted for different parts and see what is still salvageable. Then all the recyclable waste needs to be sorted and packaged up so that it may be shipped off for exportation. The remaining waste is shipped off to landfills for disposal.

The next step in the recycling process is the shipping of packaged waste to port. The pretreated waste needs to be shipped off to either airports or sea ports so that it can be exported to the processing companies. Due to the lack of transport options in Costa Rica, this step will have to be executed by large shipping trucks. The trucks will pick up the waste at the pre-treatment facilities and carry it to port. Hopefully in the future when a sustainable program is operational and the volume of waste is optimal, processing can occur in Costa Rica and eliminate the shipping step.

The final step in the cell phone waste recycling program is processing. Due to the lack of resources in Costa Rica this step will occur in a foreign country. The shipped waste will be processed so that the parts can be re-used and resold. This will help

eliminate waste and be profitable for the reselling companies by being able to sell used parts for a cheaper price. The processing step helps to properly eliminate the hazardous waste by properly disposing of it and recycling all capable waste.

6.2 Recommendations

6.2.1 The Program

For each of the five steps of the proposed recycling there are choices to be made to decide which the best possible option for each step is. The following are our recommendations for each step.

The problem of collection is two-fold; convincing the public (cell phone owners) to recycle, and then the physical gathering of the cell phone waste. To inform the public of the need to recycle and the dangers of not doing so, we recommend two things. One, an advertising campaign targeted at cell phone owners. A brief statement at the bottom of the monthly cell phone bill can serve as a notice and reminder to recycle, and can also inform owners where they can do so. Public education is also necessary, and we suggest that a larger scale education effort take place, following the example of the community outreach of Servicios Ecológicos. The actual collection of waste poses a problem as well. Once people have the desire to recycle, they must be able to drop off the cell phone waste in regional collection sites, situated evenly around the country. There are many different options available for collection sites. We have found that high-traffic areas such as malls and supermarkets, as well as cell phone vendors, serve as extremely convenient points for collection. We also discovered that large companies in Costa Rica, including ICE, being major employers with the ability to promote a program within their organizations, will be advantageous collection sites as well. To assure that there will be a collection site in

close proximity to the majority of Costa Rican citizens, we recommend that collection begin in the Provincial capitals at the minimum. At least at the outset of the recycling program, we recommend that many different types of sites be used, so as to determine the best arrangement. In a few years, the best collection sites can be evaluated and narrowed down to be more efficient.

After the cell phone waste is collected in areas more centralized than people's homes, it needs to be transported to a facility for pre-treatment. This transportation is the second integral step to our proposal. We uncovered three possible options for transporting hazardous waste, but do not have the capabilities to say which is best. Servicios Ecológicos has their own fleet of trucks, capable of moving waste all over the country. ICE also indicated that it would be possible to transport the waste, although the means of doing so has been unspecified. Finally, some of the large companies we contacted as potential collection sites indicated that they might be able to help with the transfer of the waste from their buildings to a pre-treatment facility. Provided that each of these organizations has the capability they indicated, and can operate in the transport of potentially hazardous waste within the bounds of the law, then the only determining factor will be cost. Also, these options are not mutually exclusive, and it is possible that a combination of two or three of these methods could work in conjunction with each other as a more efficient collection option.

After the modes of transporting the waste have been specified, then it must be determined where the waste will be sent to. A centralized location for pre-treatment of the cell phone waste must be determined. Pre-treatment must be done by a Costa Rican company (or possibly more than one if necessary) that is experienced with dealing with

large volumes of hazardous waste. Servicios Ecológicos is an example of one company that has the experience, capabilities, and location for pre-treatment. Ideally, the pre-treatment plant should be situated near a port and be large enough to process the waste in an environmentally friendly way. Again, Servicios Ecológicos is a good example of this, located only five kilometers from the airport outside of San José. Again, as in transportation the pre-treatment has to proceed within the bounds of the law. Following pre-treatment, the waste is ready to be transported to a port. This transportation should be done by the waste management plant.

The final step of the program is exportation and processing. Once the waste is pre-treated and brought to the port, it should become the responsibility of the foreign company to properly handle the waste. A relationship must be set up between the Costa Rican waste management company and the foreign processing company. The processing company must be qualified to handle the waste. One company, as an example, that could handle the waste coming from Costa Rica is Re-Cellular. They have already researched the problem in Costa Rica and have shown interest. Companies world-wide that are experienced in this kind of program should be researched more in depth—especially companies in the United States, the Netherlands, and Australia, which already have successful programs in place for processing cell phones and cell phone batteries, which have already been researched and documented in Section 2.8.1.

6.2.2 General Recommendations

Our recommendations are two-fold, half of which pertain to the logistics of a collection and recycling program that are detailed above. The second half deals with the needs for the overall success of such a program. First and foremost is public education.

The Costa Rican public must be educated as to the dangers of cell phone waste and the benefits of a recycling program. They also must be made aware of the proposed recycling program. This segues directly into the need for advertising. ICE has the ability to reach every cell phone user via a monthly statement, and thereby reminding each user each month to recycle and where and how to do it. We recommend that ICE's vast resources in this matter be exploited. Finally, we must again articulate that the private companies we researched in this project are not necessarily the best options for involvement in the proposed recycling program. They are merely examples of the type of company that could participate. The contribution of any private company at any stage of the process should be examined carefully and only accept as the best of all other options.

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Appendices

Appendix A: Centro Nacional de Producción Más Limpia

This appendix is not complete at this time. We are still waiting on specific information from our liaison on the topics of the history and development of the organization, the recent budgetary trends, and how and by whom policy is set. Currently our liaison is away on holiday, and we expect him to respond with information on these subjects and others in the near future.

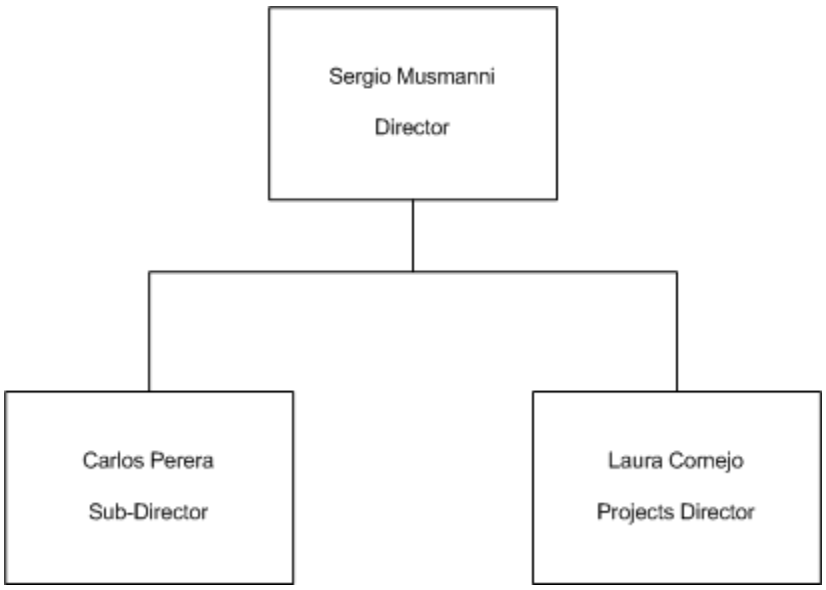
Centro Nacional de Producción Más Limpia (CNP+L) is a not-for-profit non-governmental organization in Costa Rica. They are a small company (3 full-time employees) dedicated to the promotion of cleaner production and the development of sustainable industry. The company feels that cleaner production is the responsibility of everyone, but CNP+L acts as a consulting firm to help facilitate it. CNP+L receives funding from numerous organizations, the most prominent of which are: Cámara de Industrias de Costa Rica, Instituto Tecnológico de Costa Rica, CEGESTI, Organización do Naciones Unidas para el Desarrollo Industrial, Programa de Naciones Unidas para el Medio Ambiente, Secretariá Federal de Asuntos Económicos del Gobierno Suizo.

CNP+L has several main practices whose execution amounts to the mission of the company, which is outlined briefly below. As an organization, CNP+L wishes to promote the concept of cleaner production by spreading information. This is partly accomplished by putting out publications (e.g. pamphlets, small magazines) and then ascertaining the mood of the public concerning cleaner production by collecting data (via surveys and questionnaires). Employees of CNP+L frequently make demonstrations to companies in technical industries. They implement audits on existing systems to identify

major opportunities for progress, and then suggest, by means of technical evaluations and economic feasibility studies, a plan of action. If any company or industry shows interest, CNP+L offers assistance. The organization acutely observes the needs of the national industry, and contributes to the forming of federal legislation and standards in Costa Rica. CNP+L also monitors advancements in cleaner production on the international level.

Our project, dealing with the e-waste generated by cell phone batteries, is directly related to the mission of CNP+L. We seek to better the environment by spreading information and ideas throughout the industry and the people of Costa Rica, to identify a major cleaner production opportunity, and to suggest a plan of action that is economically feasible.

We are working principally with Sergio Musmanni, the director of CNP+L. The two other members of the team are Carlos Heinrich, the sub-director, and Laura Cornejo, the projects director. Because of the size of the organization (small), the heavy workload is shared among the tight-knit almost equally. A graphical representation (organization chart) of this can be seen below in the below figure.



As CNP+L is primarily a consulting firm, the outcome of our project will not greatly affect the infrastructure of the company. However, what we do will influence the image of CNP+L in the industrial community and success for us can only mean success for CNP+L as well.

Appendix B: Interview Questions for Servicios Ecológicos

What is the purpose of Servicios Ecologicos?
Cual es el proposito de Servicios Ecologicos?
What services do you provide?
Que tipos de servicios hacen Uds?
Examples? Ejemplos?

Have you done any work with cell-phone batteries?
Hicieron con telefonos celulares en el pasado?
And now? Y ahora?

ICE is investigating a program for collecting cell-phone batteries, do you know about this?
ICE esta investigando una programa de recoleccion por telefonos celulares, lo sabe?
Tiene Ud. sugerencias?

Do you have any interest in working with ICE and CNP+L to construct a recycling and collection program of cell phones and their batteries?
Tiene interes para trabajar con ICE y CNP+L para construir una programa reclije y recoleccion de telefonos celulares?

Appendix C: Interview with Tratamientos Tecnológicos

Background Information

What does TT do? (Thermal Recycling?)

What kind of factory/building does TT have?

How big of a company is TT?

Employees

Waste volume

Do you work with private companies? If so, which ones?

Do you work with the general public? If so, how many homes?

Process

What kind of waste do you deal with?

What do you do with the waste?

How does the waste get to your plant?

Does any of your waste get exported? If so, where?

Cell Phone Problem

Overview: Currently we are investigating the feasibility of creating a collection program in Costa Rica for cell phone batteries.

Is TT conscious of the waste created from dead cell-phone batteries that is occurring now and will increase in the future?

960 000 to 1 600 000 in the next year

Nickel-cadmium batteries (most common) large hazard

Have you worked with cell phone waste (any) in the past? If so, what kind?

Is TT a company that would be interested in working in the area of cell phone recycling?

If TT is a company that has the capability to work with a cell phone battery collection program:

Collection Program

How large of an area could TT cover?

Possibility of transport from one facility to another

Possibility of transport from various collection sites

How much volume could TT receive and handle?

Possible waste could be unusable and un-recyclable cell phone parts

How much would handling cell-phone waste cost?

Estimate on price

per cell phone?

per shipment?

monthly/yearly?

Estimate on time of processing [time is money]

Appendix D: Large Company Questionnaire

How many employees are at this company?

Does this company have any recycling programs in place? Which ones?

Does your company want to help us collect cell-phones?

Approximately, what would you say the percentage is of employees that have cell phones?

Would you be willing to put a few collection boxes around your facilities?

Possibility of providing your own collection box

Possibility of someone else providing box and collection

How often would you like the boxes picked up and emptied?

Would you be willing transport these cell phones to a centralized location?

Appendix E: Public Opinion Questionnaire

Are you male or female?

Age?

Do you own a cell phone? Is this your first cell phone? How many?

Have you changed your phone in the last year? How many times?

Have you changed your battery in the past year? How many times?

Have you bought new accessories for your cell phone in the past year?

Do you think that cell phone batteries are hazardous?

What happens to cell phones when they are not used any longer?

Thrown into the trash

Taken to the store you bought it from

Kept at home in a drawer

Other_____

Would you recycle your cell phone battery if a recycling program was available?

What would you suggest for a recycling program?

Deposit on purchase that is given back on return of broken battery or cell phone

Donating the cell phone to a charitable cause

Discounted price on a new battery with return of old battery

Thank you for your time and cooperation in this short questionnaire, your responses will help us immensely.

Appendix F: RBRC Questionnaire

Collection Boxes

How much do they cost?

What is their lifespan?

What is their maximum weight?

What are their maximum dimensions? (Height X length X width)

Who makes the boxes RBRC uses?

Transportation

Is everything done through the US Postal Service or equivalent services (i.e. UPS, FedEx)?

Does any company specifically transport rechargeable batteries for RBRC?

Worldwide concern

Has RBRC contacted any other nations to try to initiate programs similar to Charge Up to Recycle?

If so, what countries?

How successful are they?

How are they run differently than Charge Up to Recycle!

Has RBRC considered including countries in Central America in Charge Up to Recycle?

Finances

How much does it cost to finance Charge Up to Recycle! every year?

What does this cost incorporate?

Employee Salary?

Transportation?

Equipment?

Advertising?

Processing of the batteries?

Who finances the program?

Appendix G: ENLACE Questionnaire

Expertise Questions:

What is Enlace´s purpose?

What is Enlace´s future concerning cell phone batteries?

What kind of work has Enlace done in the past with ewaste?

What is the overall concern for electronic waste from the governing body, legal system, lawmakers?

Electronic Waste:

Laws concerning ewaste?

Where can the laws be located?

Any new legislation being discussed/formulated?

Heavy Metals:

Maximum contaminant levels?

Packing levels?

Disposal?

Cell Phones and Cell Phone Batteries:

Any laws? If not, why?

Any laws being considered? If not, why?

Exportation laws:

What were the Basil Conventions designed to accomplish?

How could that effect electronic waste?

Are there any specific laws pertaining to Costa Rica?

Landfills:

Laws concerning ewaste and landfills?

Restrictions on materials allowed in landfills?

Collection Programs:

Are there any laws concerning Collection Programs?

What are the laws for not-for-profit organization?

What are the laws for starting a business in Costa Rica?

Enforcement:

How well are the environmental laws enforced?

Who enforces them?

Is there any company like the EPA?

Any suggestions on how to get the support of companies, government, and the public?

Appendix H: Gonzalez Document

JUSTIFICACIÓN DEL PROYECTO

Costa Rica por medio del Instituto Costarricense de Electricidad poseerá un registro de líneas de celular de 946 000 líneas instaladas y para finales del año 2004 la cifra se espera sea de 1 millon de celulares funcionando, se está gestionando para que en un plazo de dos años, aumentar el numero de líneas celulares a 1 746 000.

Actualmente, se carece de una estrategia nacional de manejo ambiental de teléfonos celulares y de las baterías, lo cual hace suponer que una gran mayoría no esta siendo dispuesta adecuadamente, lo que podría provocar contaminación y degradación de los ecosistemas.

En concordancia con lo estipulado en la legislación ambiental nacional, es necesario el establecimiento de un plan de manejo de teléfonos celulares y baterías de celulares, desarrollado con la participación conjunta de usuarios, distribuidores, ICE e instituciones estatales encargadas de velar por la protección del ambiente.

El país avanza en la adopción de tecnología de la comunicación con ciclos de vida más cortos en el reemplazo de los artículos electrónicos de consumo, tal es el caso de los teléfonos celulares.

La velocidad de aceptación de estas tecnologías no es igual en el tratamiento y disposición de desechos provenientes de estos artículos de consumo.

No existe en el país un esquema que permita la disposición adecuada de las baterías de los teléfonos móviles recargables que contienen metales pesados. (e.g. Cd, Pb, Hg, etc.)

Se estima la población futura en los 1 000.000 unidades telefónicas móviles y una tasa de reemplazo de 18 meses para los mismos y de 0,37 baterías por año, el potencial del programa se acercaría a 600 000 teléfonos y unas 314.000 baterías desechadas por año.

DESCRIPCIÓN GENERAL DEL PROYECTO

Este proyecto permitiría establecer en el país un Sistema operativo general que permita atender de una manera integral la problemática que significa la generación de estos desechos no tradicionales; esto se realizará mediante un proceso de transferencia de tecnología de la experiencia de una empresa norteamericana dedicada al reuso y reciclaje de estos aparatos en los mecanismos de recolección, acopio, transferencia y transporte de los desechos peligrosos, reutilizando al máximo los teléfonos y facilitando la disposición final de las baterías.

El esquema inicial requiere de una concientización de los empresarios que venden estos artículos por medio de capacitación para que por su medio se pueda recolectar los

aparatos, se requiere adicionalmente la cooperación de Instituciones del Estado como El ICE, Ministerio de Salud, Ministerio de Ambiente y Energía, Ministerio de Relaciones Exteriores , Instituto Costarricense de Turismo, también de la empresa privada y sus diferentes cámaras.

En el programa que se establezca en el país será de gran importancia la participación tanto del sector público con políticas de educación y promoción, como del sector privado que deberá participar como el primer punto de recolección y apoyar con campañas especiales que permitan asegurar el éxito creciente del programa.

EL OBJETO DE PROYECTO

Reciclar el 40 % de los teléfonos celulares que por diversas causas se desechan, desarrollar un sistema de recolección de los aparatos y sus accesorios y transferirlos a la empresa en U.S.A. para que esta los procese.
Desarrollar un esquema de disposición final de baterías recargables de equipos de comunicación, incluyendo mecanismos de recolección, acopio y la logística de transferencia y el establecimiento de convenios internacionales y nacionales de recepción y tratamiento.

LOS OBJETIVOS DEL PROYECTO

Reciclar los teléfonos celulares que por tecnología o daño operativo se desechan y que pueden ser reparados. Se tratará de certificar el proceso de recolección y reciclaje de las baterías bajo la norma ISO 14001.

2. Realizar el proyecto desde el ámbito privada, con una ayuda inicial que permita su despegue, la actividad debe ser lucrativa para que tenga una sostenibilidad y pueda diversificar sus acciones hacia otros campos del reciclaje

Establecer convenios - alianzas estratégicas con los expendedores y fabricantes de baterías, para devolver los residuos peligrosos a los países productores para su reciclaje o eliminación adecuada.

Elaborar una campaña educativa para que el usuario de la telefonía celular se sensibilice de la necesidad de disponer de este desecho adecuadamente.

Establecer un plan piloto de recolección de las teléfonos y baterías en las agencias telefónicas del ICE en los comercios expendedores de teléfonos y baterías en el área Gran Área Metropolitana.
Generar una acción social que motive la donación del teléfono, por medio de la donación de un aporte económico generado por el proyecto para este efecto.

Requisitos indispensables

Mecanismo de recolección eficiente y constante.
Disponibilidad para atender las necesidades de quienes permiten el acopio
Red de consumo establecida con responsabilidades y deberes bien establecidos
Esquema de acopio apropiado para las condiciones del país.
Sistema seguro de transferencia.
Convenio de recepción, tratamiento y disposición final establecido.
Convenio con Clínica del dolor para transferir por cada teléfono reciclado una cantidad de colones definida para el tratamiento de enfermos terminales.

Necesidades:

Tener un espacio y construcción para el almacenamiento y operación o un sitio de procesamiento que se pueda alquilar.
Tener logística de transporte
Definir centros de acopio y rutas de transporte
Definir el sistema de selección de los aparatos, sus aditamentos
Definir un contrato marco y convenio entre la empresa en USA y la empresa en CR
Definir un programa de capacitación a los expendedores.
Lograr la colaboración de instituciones del estado
Crear una estrategia de comunicación sobre los beneficios de reciclar los aparatos.
Diseñar un recipiente con logo de las Instituciones del Estado colaboradoras del proyecto y de la fundación de cuidados paliativos donde se depositen los aparatos, con información básica de los beneficios del reciclaje y de los teléfonos de donde contactar en caso de emergencia.
Compra de los recipientes.
Ubicación de los recipientes.
Recolección logística de transporte.
Crear bases de datos de la recolección.
Promocionar el programa a nivel nacional.
Estudiar opciones de diversificación.

Beneficios instituciones del Estado
El estado y sus instituciones con su aval pueden mejorar su imagen al interesarse en campañas y programas de reciclaje que fomentan la eliminación de residuos peligrosos y el cuidado de la naturaleza. Disminuyendo el nivel de contaminación ambiental, el deterioro y la degradación de los ecosistemas, mantener los mantos acuíferos exentos de los metales que las conforman, el reciclaje disminuirá las necesidades de nuevos volúmenes de material geológico, con efecto sobre la minería, y posiblemente permitirá mejorar la imagen internacional de nuestro país, lo que puede traer beneficios en el turismo, ya que CR se posiciona como un destino verde.
ASPECTOS JURÍDICOS.
La Constitución Política en su artículo 50 indica que el Estado procurara el mayor bienestar a todos los habitantes del país, nos otorga el derecho a tener un ambiente sano y ecológicamente equilibrado y garantiza defiende y preserva ese derecho.
La Ley General de la Administración Pública en su Titulo Sétimo de la responsabilidad de la Administración y del servidor público en su artículo 190 dice lo siguiente:" La

Administración responderá por todos los daños que cause su funcionamiento legitimo o ilegitimo, normal o anormal"... Del artículo 191 señalamos "La Administración deberá reparar todo daño causado a los derechos subjetivos ajenos"... También extraemos del artículo 194 "La Administración será responsable por sus actos lícitos y por su funcionamiento normal cuando los mismos causen daño a los derechos del administrado en forma especial, por la pequeña proporción de afectados o por la intensidad de la lesión". El legislador prevé estas situaciones en el campo de acción de la administración pública , pero en ese momento los aspectos del medio ambiente no tenían la importancia que hoy revisten. Nuestra opinión que es administrativa, no jurídica, relaciona los señalamientos supra indicados, como sustentadores de la responsabilidad que le compete al mismo.

Tampoco le hemos indicado al costarricense como manejar adecuadamente los aparatos y los desechos de los mismos, podríamos creer que no es parte de la actividad ordinaria de la Institución, la recuperación de estas baterías por el costo que puede significar, sin embargo, los aparatos celulares se han vendido en el país, como resultado del ofrecimiento de este servicio tecnológico, por tanto, esa actividad comercial (venta de aparatos celulares y sus aditamentos) esta basada en este servicio que brinda éste Instituto, por ello consideramos conveniente minimizar los efectos colaterales de este servicio, para que no sean fuente de contaminación ambiental; lo que ira en resguardo de la naturaleza y en última instancia de la salud del costarricense, en este interés debe exigirse también a las empresas privadas que sustentan su actividad comercial en el desarrollo de esta actividad, para que se inserten en los programas de reciclaje, amparados al principio de "Quién contamina paga".

Al respecto la Sala Constitucional en su S.C.V.1763 de 1994 "ha reconocido que tanto el derecho a la salud como a un ambiente libre de contaminación, sin el cual el primero no podría hacerse efectivo, son derechos fundamentales, de modo, que es obligación del Estado proveer a su protección, ya sea a través de políticas generales para procurar ese fin o bien, a través de actos concretos por parte de la Administración."...

Estimación de costos anuales :

Diseño del recipiente para depositar la batería, (pedirse un concurso simbólico a las universidades) $ 5 000,00

Creación de recipientes $ 5 000 En caso que las cajas no funcionen.

Definir centro de acopio 300 metros cuadrados a $ 5 por metro por mes, valor del espacio anual $ 18 000,00

Vehículo para recoger baterías $ 14 000, 00 de segunda en buen estado.

Combustible lubricantes, mantenimiento, seguros etc. $ 6 000,00

Salario y viáticos de dos personas parcial anual ($ 8 000)

Campaña educativa inicial $ 20 000,00

Asesoría jurídica inicio de los procesos $ 6 000,00

Campaña por los medios $ 100 000,00 en caso de promoverse al inicio de campaña

Embalaje y transporte $ 12 000,00

Papelería y documentación $ 3 000,00

Sistema de seguridad $10 000,00

Costos de un plan piloto

$ 60 000,00 incluye contrato de transporte (alquilar) , capacitación, montaje de una línea de selección experimental, diseño de materiales y papelería necesarios, establecimiento de logística necesaria teléfono, fax, Internet , mobiliario básico, alquiler temporal o construcción básica, costos operativos de la coordinación, contabilidad, inscripción de una sociedad anónima, etc.

Appendix I: Regulation Characteristics

Nº 27000

REGULATION ON The CHARACTERISTICS And The LISTING

OF THE INDUSTRIAL DANGEROUS WASTES

THE PRESIDENT OF THE REPUBLICA

And The ATMOSPHERE MINISTER And ENERGIA

With foundation in articles 50 and 140. Interjections 3) and 18) of the Political Constitution and in accordance with the had thing in the articles 60 and 69 the Statutory law of the Atmosphere, N' 7554.

Considering:

1° - That the generation of dangerous wastes has come in increase in the last years product of the growth of the industrial and agro-industrial processes.

2° - That does not exist a suitable definition and identification of this type of wastes and its generators.

3° - That the protection of atmosphere is one of the fundamental pillars of model of sustainable development that has undertaken the country, and that the Ministry of Atmosphere and Energy has come impelling processes to make its work in this field more efficient.

4° - That badly the handling of dangerous wastes the human health and the natural ecosystems hit negatively.

5° - That is obligation of velar Be in favor of the health and the quality of life of the humans, as well as of the conservation of the biodiversity.

6° - That are necessary to unify the nomenclature and classification of the wastes that by its physical qualities or chemical they cause damage to the human health or the natural ecosystems.

7° - That stops to fulfill the exposed objectives is necessary to regulate the definition, classification and codification of the dangerous wastes.

8° - That given to the previous circumstances public east regulation by the urgency procedure and it is opened to consultation so that in a term of two months the observations and commentaries become that are considered pertinent. By as much.

THEY DECREE:

REGULATION ON The CHARACTERISTICS And The LISTING

OF THE INDUSTRIAL DANGEROUS WASTES

General dispositions

I articulate 1° - The present Regulation intends to establish the characteristics of the dangerous wastes such the limit and listing that do to a dangerous waste by their toxicity to the atmosphere.

Article 2° - For the aims of application of the Statutory law of the Atmosphere. and of the present regulation the following terms that are mentioned have the meaning:

Waste = a waste is all that substance or movable, deficient, unsuitable object, made unusable or without direct use (including wastes 4.1 of pure substances), whose proprietor wants to undo of the same one or is forced according to the national laws. The by-products or rest of treatments are included. These wastes also can be ordinary or special dangerous calls

Ordinary waste = Is those solid wastes, gases, liquids, flowed and doughy that they do not require of special treatment before being arranged.

Dangerous Wastes = Is those solid, liquid, doughy or gaseous wastes that by its chemical reactivity and its toxic, explosive, corrosive, radioactive, biological, inflammable, volatilizables, combustible characteristics or others: or by its amount and time of exhibition, they can cause damages to the health of the human beings and the atmosphere, including the death of the alive beings.

Watery solution = Mezcla in which the water is the primary component and constitutes at least 50% in weight of the sample.

SIMARDE = Abbreviation of "System for the Monitoreo de Residual Aguas and Wastes", This system has a listing of the industrial wastes of the country.

Article 3° - Of the characteristics that allow to classify and to an industrial waste like dangerous.

3.1 waste is considered explosive if it presents/displays some of the following properties:

It has a constant of equal or greater explosividad to the one of the dinitrobenceno.

He is able to produce a reaction or detonating or explosive decomposition to 25°C and 1.03 kg/cm2 of pressure

3.2 waste is considered inflammable if it presents/displays some of the following properties:

Alcohol in volume is a watery solution with more than 24%.

It is a liquid with point inferior inflammation to 60.5°C and with a point of smaller ignition to 16°C.

He is not liquid but he is able to produce fire by friction. spontaneous humidity absorption or chemical changes to 25°C and 1.03 kg/cm2.

This conformed by compressed gases inflammable or oxidating agents who stimulate the combustion.

3.3 waste is considered reactive if it presents/displays some of the following properties:-

Under normal conditions (Temperature of 25°C and Pressure of atm) it is cured violently without detonation.

Under normal conditions, when putting itself in contact with water in relation reject-water of 5:1. 5:3, 3:5 react violently forming gases, steam or smoke.

Under normal conditions, when putting itself in contact with solutions of pH acid (HCI 1 N) and basic (NaOH 1 N). in relation (waste - solution) of 5:1, 5:3, 5:5 react violently forming toxic gases, steam or smoke.

It has in its constitution cyanides or sulfides that when exposing itself in conditions of pH between 2 to 12.5 can generate toxic gases, steam or smoke in 250 amounts greater to mg HCN/kg waste or 500 mg H25/kg waste.

He is able to detonate or to react explosively if strong initiator is exposed to an agent or if it is warmed up under conditions of confinement.

He is able to produce radical free.

3,4 waste is considered toxic to the atmosphere, if when being put under on approval of extraction for toxicity, the leached one of the representative sample contains anyone of the components listed in pictures 2, 3 and 4 of Annexed the 1, in greater concentrations to

the indicated ones. The test of extraction for leached toxicity of appears in the norm N° 3 "Procedure to carry out the test of extraction to determine components that make dangerous waste by their toxicity to the atmosphere".

3.5 waste is considered biological infectious if it presents/displays some of the following properties:

It has bacteria, virus or other microorganisms with capacity to produce inflammation or infection.

It contains toxins produced by microorganisms that cause injurious effects in alive beings.

3.6 waste is considered corrosive if it presents/displays some of the following properties:

In liquid state or watery solution it has pH smaller or equal to 2. or greater or equal to 12.5.

In liquid state or watery solution and to a temperature of 55°C he is able to corrode steel to the coal (SAE 1020) at a speed of 6.35 mm or more per year.

3.7 When a mixture between one is had or more "ordinary" wastes or wastes with dangerous wastes or wastes, this mixture will be taken as a dangerous waste.

Article 4° - Of the characteristics of the dangerous wastes.

It is considered that a waste is dangerous when presents/displays one or more of the following characteristics: inflammable, reactive, toxic, biological explosive, infectious, corrosive. These characteristics appear defined in the Picture # 1 of Annexed the 1, according to the agreement of Basel.

Article 5° - Types of dangerous industrial wastes.

5.1 , typical dangerous wastes are those originating ones of:

5.1a the industries whose processes generate wastes dangerous and list in the Picture # 5 of Annexed the 2,

5.1b the dangerous wastes of sources you do not specify, listed in the Picture # 6 of Annexed the 2.

5.ç All waste that not this contemplating in some of the previous points but that are considered like so by the competent authorities because they have the characteristics indicated in section 2.

5.2 Everything generating being: independently of which its dangerous process produces or nonwaste: it will have to corroborate if # 6 of Annexed the 2 produces wastes classified in the Picture.

5.3 In the list of dangerous wastes of nonspecific sources is included. Everything that waste that is of individual or mixed way and that has one or more of the following characteristics:

Those chemical agents or wastes of manufacture processes that do not fulfill the specifications of quality demanded by the standards of production of the company.

Wastes of containers

The originating wastes of flights

Article 6° - They comprise of this regulation annexed 1 and 2 with

ANNEXED 1

PICTURE # 1:

LIST OF DANGEROUS CHARACTERISTICS OF A WASTE

Characteristics

EXPLOSIVES:

By substance or waste all substance or solid or liquid waste is understood (or mixture of substances or wastes) that by itself is able, by means of chemical reaction, to emit a gas to a temperature, pressure and speed that can cause damages to the surrounding zone.

INFLAMMABLE

Incendiary fuels

By incendiary fuels it is understood those liquids, or mixtures of liquids, or liquids with solids in solution or suspension, for example, paintings, varnishes, lacquers, etc.. but without including substances or classified wastes of another way due to its dangerous characteristics. that they emit inflammable steam to 60 temperatures nongreater to 5'C, in tests with open bucket.

Inflammable Solids

One is solids, or wastes solid, different from the classified ones like explosives, that in the prevalecientes conditions during transpose are easily combustible or can cause a fire or contribute to the same one, due to the friction.}

Substances or susceptible wastes of spontaneous combustion.

One is substances or susceptible wastes of spontaneous heating in the normal conditions of it transposes or heating, in contact with the air, and that can then ignite.

Substances or wastes that in contact with the water emit inflammable gases

Substances or wastes that, by reaction with the water are susceptible of spontaneous combustion or inflammable gas discharge en dangerous areas.

REAGENT

Oxidants

Substances or wastes that without being necessarily combustible, can in general, a to yield oxygen, to cause or to favor the combustion of other materials.

Organic peroxides

The organic substances or wastes that contain bivalent structure -0-0- are unstable substances thermally that can undergo an exothermic decomposition

Toxic gas liberation cm contact with the air or the water

Substances or wastes that. By reaction with the air or the water. They can emit toxic gases in dangerous amounts.

TOXICO

Toxics (poisons) acute

Substances or wastes that can cause to the death or serious injuries or damages to the human health if they interfere or they inhale or they make contact with enemy with the skin.

Toxic substances (with after-effects or chronic)

Substances or wastes that, of being aspired or being ingested or to penetrate in the foot, they can involve after-effects or chronic, even the carcinogen one.

Toxic to the Atmosphere

Substances of wastes that, if they are freed they have or they can have immediate or slowed down adverse effects in the medio.ambiente, due to the toxic bioacumulación or efectos in the bióticos systems

Characteristics

INFECTIOUS BIOLOGICO

Infectious substances

Substances or wastes that contain viable microorganisms or their toxins, well-known or supposed agents of diseases in the animals or the man.

CORROSIVE

Corrosive

Substances or wastes that, by chemical action cause serious damages in the alive weaves that touch or that in marry, of flight, they can damage seriously or until destroying, other merchandises or the means of transpose or also can cause other dangers.

OTHERS

Substances that can, by some means, after its elimination. To give to origin to another substances for example a lexiviación product that has some of the characteristics you arrive exposed.

PICTURE # 2:

PRESENT COMPONENTS INORGANICOS

IN THE LEACHED EXTRAIDO OF A WASTE THAT DOES IT

DANGEROUS BY ITS TOXICITY

Inorganic component	Maxima concentration allowed (mg/l)

Arsenic	5.0
Barium	100,0
Cadmium	1.0
Hexavalente chromium	5.0
Nickel	5.0
Mercury	0.2
Silver	5.0
Lead	5.0
Selenium	1.0

PICTURE # 3:

PRESENT COMPONENTS ORGANICOS IN

THE LEACHED EXTRAIDO OF A WASTE THAT DOES IT

DANGEROUS BY ITS TOXICITY

Inorganic component	Maxima concentration allowed (mg/l)
Acrilonitrilo	5.0
Clordano	0,03
o-Cresol	200.0
m-Cresol	200.0
P-Cresol	200.0
Acido 2.4 diciorofenoxiacetico	10.0
2.4 Dinitrotolueno	0.13

Endrin	0.02
Heptacloro (and its epoxido)	0.008
Hexachloroethane	3.0
Lindano	0.4
Metoxicloro	10.0
Nitrobenceno	2.0
Pentaclorofenol	1000
2.3.4.6 tetraclorofenol	1.5
Toxafeno (canfenociorado technician)	0.5
2.4.5 triclorofenol	400.0
2.4.6 triclorofenol	2.0
Acid 2.4.5 fenoxipropionico trichlorine (silvex)	1.0

PICTURE # 4:

PRESENT COMPONENTS ORGANICOS VOLATILES

IN THE LEACHED EXTRAIDO OF A WASTE THAT DOES IT

DANGEROUS BY ITS TOXICITY

Organic component volatile	Concentration maximum allowed Ong/1)
Benzene	0.5
Eter bis (2 etilico chlorine)	0.05
Clorobenceno	100

Chloroform	6.0
Methyl chloride	8.6
1,2 diclorobenceno	0.2
4 diclorobenceno	4.3
1.2 dicloroetano	7.5
1.4 dicloroetano	0.5
Dicloroetileno	0.7
Disulfuro of carbon	14.4
Fenol	14.4
Hexaclorobenceno	0.13
Haxacioro-	.5
1.3 butadiene	36.0
lsobutanol	200.0
Etilmetilectona	5.0
Piridina	10.0
1, 1. 1.2 tetracloroetano	1.3
1. 1,2.2 tetraciornetano	0.5
Tetracioruro of carbon	0.7
Tolueno	14.4
1. 1, 1 tricloroetano	30.0
1. 1.2 tricioroctano	1.2
Triciornetileno	0.5

Annexed 2

PICTURE # 5

GENERATED WASTES

BY SPECIFIC SOURCES

I COSAY CIIU	WASTES	
	I COSAY SIMARDE	DESCRIPTION OF THE GENERATED WASTE
3211 Spinning, finished Weave and of textiles	S221	Drums and containers with dye wastes and colorants
	P080	Muds of the system of residual water treatment of the textile industry
	L018	Inorganic acids and mordant acid mixtures
	S222	Dispersing wastes of detergents, soaps and agents
	L045	Originating wastes of the whitened one
	P081	Wastes of adhesives and polímetros
	S223	Wastes of enlazantes agents and carbonization
	P032	Colorantes and pastes with pigments of high concentration
	L016	Rest of red
	S116	Colorantes (colorantes pigment and substance)
3231 Curtidurias and factories of finished	S224	Wastes of the finished ones
	S092	Wastes of curtiduría

	P035 S019	Muds of tannery with chromium Chemical agents for the leather, substances tanneries with chromium
3311 Sawmills, factories of brushing and other factories to work the wood	S095 S097	Sawdust and shavings of mountain range with injurious impurities Sawmill wood waste and manufacture with injurious impurities
3319 cork and wood product Manufacture N.E.P.	P082 L046 S095	Settled muds of the water treatment in processes that use: cresota, clorofenol, pentaclorofenol and arsenical Wastes of the process of cloración in the preservative production for wood Sawdust and shavings of mountain range with injurious impurities
3521 painting Manufacture varnishes and lacquers	P002 P086 S226 S227 P087	Not hardened lacquers and old paintings Cleaning agents and muds of residual water treatment Bags and packings of raw material Wastes of the command team of the contamination of the air Wastes of raw materials in the painting production.

	P088 L030	Filter helps spent (cakes of filters) Inorganic peroxides
3522 Manufacture of pharmaceutical products and medicines	S028 S229 S230 S014 S231 S118 P100	Wastes of the production that contain toxic substances to the atmosphere Activated charcoal spent that has had contact with products that contain toxicas substances to the atmosphere. Materials outside specifications that contain toxic substances to the atmosphere. Wastes of the production and pharmaceutical preparation Caducos wastes of the production and materials or outside specification that contains toxic substances to the atmosphere Overcome medicines Muds of residual water treatment of pharmaceutical production.
3523 Manufacture of prepared soaps and of cleaning, perfumes, cosmetics and others.	S228 S229	Wastes of the production that contain toxic substances to the atmosphere Activated charcoal spent that has had contact with

		products that contain toxic substances to the atmosphere.
	S230	Materials outside specifications that contain toxic substances to the atmosphere.
3320 Manufacture of furniture and accessories, except which they are metalists	P082	Settled muds of the water treatment in processes that use: cresota, clorofenol, pentaclorofenol and arsenical
	L046	Wastes of process of cloración in the preservative production for wood
	S095	Sawdust and shavings of mountain range with injurious impurities
3412 Manufacture of packages and boxes of paper and cardboard	P032	Colorantes and pastes with pigments of broad concentration
	L016	Rest of red
	S116	Colorantes (colorantes pigments and substances)
3511 basic industrial chemical substance Production except installments	L031	Organic peroxides.
3512 Manufacture of installments and plaguicidas		ALL THE WASTES OF THIS INDUSTRY
3513 plastic Manufacture of synthetic resins, matters and	P083	Muds of the system of washing of atmospheric emissions.

artificial fibers	P084	Muds of the system of residual water treatment of resin manufacture.
	P049	Not hardened resin wastes
3541 Manufacture of paintings, varnishes and lacquers	P085	Retarder wastes of flame and painting of base
	S225	Wastes of varnish dryer
	P050	Muds of lacquers and paintings
	L024	Extenders of painting and lacquer (extender nitrogen)
3322 CONSTRUCTION OF MACHINERY And EQUIPMENT FOR AGRICULTURE	P097	Wastes containing mercury of the electrolytic processes
	P096	Originating muds of the evaporation lagoon.
	P038	Galvanic muds with cadmium
	P039	Galvanic muds with cyanides
	P040	Galvanic muds with zinc.
	P041	Galvanic muds with cobalt.
	P042	Galvanic muds with copper.
	P043	Galvanic muds with precious metal content.
	P044	Galvanic muds with nickel

	P099	Galvanic muds with chromium III and/or I SAW
	P046	Galvanic muds with lead and tin
3822 CONSTRUCTION OF MACHINERY And EQUIPMENT FOR AGRICULTURE	S237	Originating wastes of the operations of drilled and grinding Solutions of the originating baths of employee of the operations of cooling
	L052	Wastes of the sweeps. Alkaline or acid
	L053	Painting, reliable, muds, cleaners and originating wastes of the operations of covering. Painted and cleaning
	P101	Muds product of the spent oil regeneration
	P102	Sand of used smelting
	S152	Tin muds
	P70	Lead muds
	P72	Other metallic muds without AI muds. Fe and Mg.
	P76	
3823 CONSTRUCTION OF MACHINERY TO WORK METALS And WOOD	P095	Muds of treatment of originating residual waters of the metal washing to remove solutions concentrated
	P096	Originating muds of the operations of the taken the grease out of one
	S238	Hasty salts of the baths of nickel regeneration
	L047	

	L054	Baths of anodización of aluminum Solutions spent and originating wastes of the latonado one
3812 MANUFACTURE OF FURNITURE And ACCESSORIES MAINLY METALICOS	P041 P095 P096 S238 L054 L055 L056 L057 L058 L059 L060 L061 L062 L048 L049 L051	Galvanic muds with cobalt Muds of treatment of residual waters originating of the metal washing to remove concentrated solutions Originating muds of the operations of taken the grease out of Hasty salts of the baths of nickel regeneration Solutions spent and originating wastes of the latonado one. Solutions spent and originating wastes of the cadmizado one. Solutions spent and originating wastes of the chromium plating. Solutions spent and originating wastes of the cobrizado one. Solutions spent and originating wastes of the

	P098	silver-plated one.
	P038	Solutions spent and originating wastes of the tin-
	P039	plating.
	P040	Solutions spent and originating wastes of the nickel plate.
		Solutions spent and originating wastes of the zincado one.
		Solutions spent and originating wastes of the tropicalizado one.
		Solutions and wastes of the tanks of cooling by oils in the decontamination operations in hot of metals.
		Solutions spent and sediments of the cyanide baths in the operations of galvanoplastía.
		Solutions spent and originating wastes of the baths fosfatizado.
		Originating muds of the evaporation lagoon
		Galvanic muds with cadmium
		Galvanic muds with cyanides
		Galvanic muds with zinc
3824 CONSTRUCTION		
OF MACHINERY And	P102	Muds product of the spent oil regeneration
EQUIPMENT OF		

INDUSTTRIAS EXCEPT MACHINERY TO WORK METALS And The WOOD		
	S152	Sand of used smelting
	P070	Tin muds
	P072	Lead muds
	P076	Other metallic muds without AI muds. Fe and Mg.
3829 CONSTRUCTION OF MACHINERY And EQUIPMENT N.E.P. EXCEPTING MACHINERY ELECTRONICA	P095	Muds of treatment of originating residual waters of metal washing to remove solutions
	P096	Originating muds of the operations of the taken the grease out of one.
	S238	Hasty salts of the baths of nickel regeneration.
	L047	Baths of anodización of aluminum
	L054	Solutions spent and originating wastes of the latonado one
	L055	Solutions spent and originating wastes of the cadmizado one
	L056	Spent solutions and originating wastes del chromed
	L057	Spent solutions and originating wastes del cobrizado
	L058	
	L059	
	L060	
	L061	
	L062	

		Solutions spent and originating wastes of the silver-plated one Solutions spent and originating wastes of the tin-plating Solutions spent and originating wastes of the nickel plate Spent solutions and originating wastes del zincado Spent solutions and originating wastes del tropicalizado
3824 CONSTRUCTION OF MACHINERY And EQUIPMENT OF INDUSTTRIAS EXCEPT MACHINERY TO WORK METALS And The WOOD	L060	Solutions spent and originating wastes of the nickel plate
	L061 L062	Solutions spent and originating wastes of the zincado one.
	L048 L049	Solutions spent and originating wastes of the tropicalizado one.
	L050 L051	Solutions spent and wastes of cooling by oils in the decontamination operations in hot of metals.

	S100 P097 P098 P038 P039 P040 P041 P042 P043 P044 P099 P046 S237 L052 L053 P101	Solutions spent and sediments of the cyanide baths in the operations of galvanoplastía. Solutions spent of cyanide of the tanks of cleaning with salts in the decontamination operations in hot of metals Solutions spent and originating wastes of the baths of fosfatizado Wastes of exhausted catalysts Wastes containing mercury of the electrolytic processes Originating muds of the evaporation lagoon Galvanic muds with cadmium Galvanic muds with cyanides Galvanic muds with zinc Galvanic muds with cobalt Galvanic muds with copper Galvanic muds with precious metal content Galvanic muds with chromium III and/or IV Galvanic muds with nickel Galvanic muds with lead and tin Originating wastes of the operations of drilled and grinding Solutions of the originating baths of tempering of

		the operations of cooling
		Wastes of the sweeps, alkaline or acid
		Paintings, reliable, muds, cleaners, and
		originating wastes of the operations of covering,
		painted and cleaning
3823 CONSTRUCTION OF MAQUINAR TO WORK METALS And WOOD	P099	Galvanic muds with nickel
		Galvanic muds with lead and tin
		Originating wastes of the operations of drilled and
	9046	grinding
	S237	Solutions of the originating baths of tempering of
	L052	the operations of cooling
	L053	Wastes of the sweeps, alkaline or acid
	P101	Paintings, reliable, muds, cleaners, and
	P102	originating wastes of the operations of covering,
	S152	painted and cleaning
	P70	Muds product of the spent oil regeneration
	P72	Fused sand used
	P76	Tin muds
		Lead muds
		Other metallic muds without AI muds, Fe and

		Mg.
3824 CONSTRUCTION OF MACHINERY And EQUIPMENT OF INDUSTTRIAS EXCEPT MACHINERY TO WORK METALS And The WOOD	P095	Muds of treatment of originating residual waters of the metal washing to remove concentrated solutions.
		Originating muds of the operations of the taken the grease out of one.
		Hasty salts of the baths of nickel regeneration.
	P096	Baths of anodización of aluminum
	S238	Solutions spent and originating wastes of the
	L047	latonado one
	L054	Solutions spent and originating wastes of the
	L055	cadmizado one
	L056	Spent solutions and originating wastes del
	L057	chromed
	L058	Spent solutions and originating wastes del
	L059	cobrizado
		Solutions spent and originating wastes of the silver-plated one
		Solutions spent and originating wastes of the tin-

		plating
3823 CONSTRUCTION OF MAQUINAR TO WORK METALS And WOOD	L055	Solutions spent and originating wastes of the cadmizado one.
	L056 L057	Solutions spent and originating wastes of the chromium plating.
	L058 L059	Solutions spent and originating wastes of the cobrizado one.
	L060 L061	Solutions spent and originating wastes of the silver-plated one.
	L062 L048	Solutions spent and originating wastes of the tin-plating.
	L049 L050	Solutions spent and originating wastes of the nickel plate.
	L051 S100	Solutions spent and originating wastes of the zincado one.
	P097 P098	Solutions spent and originating wastes of the tropicalizado one.
	P038 P039 P040	Solutions and wastes of the tanks of cooling by oils in the decontamination operations in hot of metals.
	P041	Solutions spent and sediments of the cyanide

	P042	baths in the operations of galvanoplastía.
	P043	Solutions spent of cyanide of the tanks of cleaning
	P044	with salts in the decontamination operations in hot of metals.
		Solutions spent and originating wastes of the baths fosfatizado.
		Wastes of exhausted catalysts
		Wastes containing mercury of the electrolytic processes.
		Originating muds of the evaporation lagoon
		Galvanic muds with cadmium
		Galvanic muds with cyanides
		Galvanic muds with zinc
		Galvanic muds with copper
		Galvanic muds with precious metal content.
		Galvanic muds with chromium III and/or I SAW
3720 NONCFERROUS METAL INDUSTRIES BASICAS	P070	Tin muds
	P072	Lead muds
	P076	Other metallic muds without AI muds, Fe and Mg.
3811 FABROCACION OF	P095	Muds of treatment of originating residual waters

CUCHILLERIA	P096	of the metal washing to remove solutions
MANUAL TOOLS And	S237	concentrated
ARTICLES OF	L052	Originating muds of the operations of the taken
FERRETERIA	L053	the grease out of one
	P101	Originating wastes of the operations of drilled and grinding
		Solutions of the originating baths of tempering of the operations of cooling.
		Wastes of the sweeps, alkaline or acid
		Painting, reliable, muds, cleaners and originating wastes of the operations of covering. Painted and cleaning
3812 MANUFACTURE		
OF FURNITURE And		Muds of treatment of originating residual waters
ACCESSORIES	P095	of the metal washing to remove solutions
PRINCIPALMENTES		concentrated
METALICOS		
	P096	Originating muds of the operations of the taken
	S238	the grease out of one
	L054	Hasty salts of the baths of nickel regeneration
	L055	Solutions spent and originating wastes of the
	L056	latonado one
	L057	Solutions spent and originating wastes of the

	L058	cadmizado one
	L059	Solutions spent and originating wastes of the chromium plating
		Solutions spent and originating wastes of the cobrizado one.
		Solutions spent and originating wastes of the silver-plated one.
		Solutions spent and originating wastes of the tin-plating
3560 PRODUCT		Spent catalyst
MANUFACTURE	S235	Muds of the system of residual water treatment of
PLASTICOS N.E.P	S236	plastic production
	P083	Muds of residual waters of the systems of
	P094	washing of atmospheric emissions
		Residual pigments.
3710 INDUSTRIES		Muds of treatment of originating residual waters
BASICAS OF IRON And	P095	of metal washing to remove concentrated
STEEL		solutions
	P096	Originating muds of the operations of the taken
	L047	the grease out of one.
	L048	Baths of anodización of aluminum
	L049	Solutions spent and wastes of the tanks of cooling
	L050	by oils in the decontamination operations in hot of

	L051	metals.
	S100	Solutions spent and sediments of the cyanide
	P097	baths in the operations of galvanoplastía.
	P098	Solutions spent of cyanide of the tanks of cleaning
	P038	with salts in the decontamination operations in hot
	P039	of metals.
	P040	Solutions spent and originating wastes of the
	P041	baths fosfatizado.
	P042	Wastes of exhausted catalysts
	P043	Wastes containing mercury of the electrolytic
	P044	processes.
	P099	Originating muds of the evaporation lagoon
	P046	Galvanic muds with cadmium
	S237	Galvanic muds with cyanides
		Galvanic muds with zinc
		Galvanic muds with copper
		Galvanic muds with precious metal content.
		Galvanic muds with chromium III and/or I SAW
		Galvanic muds with nickel
		Galvanic muds with lead and tin
		Originating wastes of the operations of drilled and
		grinding
3829CONSTRUCCION	P070	Tin muds

OF MACHINERY And EQUIPMENT NEP EXCEPTING MACHINERY ELECTRONICA		
	P072	Lead muds
	P076	Other metallic muds without AI muds, Fe and Mg
3831 INDUSTRIAL CONSTRUCTION OF MACHINERY And APPARATUSES ELECTRICOS	S196	Mixtures tin lead epoxido cement and
	S208	Covered copper of mixture tin lead
	S211	Mixture tin - lead and plastic
	S103	Lodos of the residual water treatment of operaciones electrical industrialists
	S104	Painting wastes
	S239	Wastes of producción of electrical circuits
	S240	Residuos of the production of semiconductors
3832 CONSTRUCTION OF EQUIPMENT And RADIOS, TELEVISION And	S196	Mixtures tin lead epoxido cement and
	S208	Covered copper of mixture tin lead
	S211	Mixture tin - lead and plastic
	P105	Muds of tratamiento of residual waters of the

COMMUNICATIONS	P104	operations of construction of equipment and
	S241	radios, television and communications
	S239	Painting wastes
	S240	Wastes of the magnetic tape production
	P106	Wastes of the production of electrical circuits
		Wastes of the production of electronic tubes
		Muds of residual water treatment in the production of acid lead batteries
3839 CONSTRUCTION		Muds of the residual water treatment in the
OF APPARATUSES And		production of nickel-cadmium batteries
PROVISIONS	P107	Production of wastes of the nickel-cadmium
ELECTRICOS N.E.P	S242	batteries
	S243	Production of wastes of the batteries zinc-carbon
	S244	Production of wastes of alkaline batteries
	S245	Batteries of waste and wastes of the furnaces of the production of mercury batteries
3513 PLASTIC		Muds of the system of washing of atmospheric
MANUFACTURE OF		emissions.
SYNTHETIC RESINS,	P083	
MATTERS And		
ARTIFICIAL FIBERS		
	P084	Muds of the system of residual water treatment of resin manufacture.

3541 MANUFACTURE OF PAINTINGS, VARNISHES And LACQUERS	P049 P085	Not hardened resin wastes Retarder wastes of flame and painting of base
	S225	Wastes of varnish dryer
	P050	Muds of lacquers and paintings
	L024	Extenders of painting and lacquer (extender nitrogen)

Code SIMARDE	Description of the waste
S214	Residuos solids with anthracene content
S162	Lead wastes
P037	Muds of the cellulous manufacture of paper
P056	Rubber muds, with dissolvent content
L022	Dietilico Eter and other alifáticos ethers
L023	Metilentanoato (methyl acetate) and derived alifáticos
S144	Lead sulphate
S160	Arsenic lime

S165	Tin calcined
S168	Hidróxido of aluminum
S169	Salts with cyanide
S170	Lead salts
S048	Salts potásticas
S082	Barium salts
L008	1,2 etanodiol and its derivatives (etilenglicoles)
L010	Dimealformida
L012	Tetracloroetano
L013	Tricloroetano
L014	Tetracloroetano
L020	Diosano
E001	N - ACETIL - 2 TIOUREA
E002	ACRIKEUBA
E003	Aldrin
E004	ALCOHOL ETILICO
E005	Aluminum phosphate
E006	5 - (aminometil) - - isoxazolol
E007	4 - AMINOPIRIDINA
E008	2,4,6 trinitrofenol ammonium salts
E009	ACIDO ARSENICO

E010	Pentoxido of arsenic
E011	TRIOXICO OF ARSENICO
E012	Barium cyanide
E013	TIOFENOL
E014	BERYLLIUM
E015	Eter diclorometil
E016	bromoacetona
E017	BRUCINA
E018	2 (1 - metilpropil) - 4.6 dintrotenol
E019	calcium cyanide
E020	CARBIBI SULFIDE
E021	CLOROACETALDEHIDO
E022	4 - CLOROANILINA
E023	1 - (Or - clorofenil one) bourea
E024	3 - CLOROPROPIONITRILO
E025	BENCILO CHLORIDE
E075	MONOXIDO OF NITROGENO
E076	NITROGLYCERIN
E077	n - nitrodimetilimina
E078	n - nitometilivinilamina
E079	octaMETILPIFOFOSFORAMIDA
E080	I OXIDIZE OF OSMIUM (VIII)

E081	acid 7 oxibeciclo (2,2,1) heptano -2,3 dicarboxilico
E082	PRATION
E083	FENILMERCURIO ACETATE
E084	N-FENILTIOUREA
E085	forato
E086	PHOSGENE
E087	fosfito
E088	acid fosforotioico
E089	POTASSIUM CYANIDE
E090	POTASSIUM DICIANOARGENTATO (l)
E100	PROPIONITRILO
E101	2-PROPIN- 1
E102	SELENUREA
E103	SILVER CYANIDE
E104	SODIUM AZIDA
E105	SODIUM CYANIDE
E106	strychnidin- 10- one and salts
E107	tetraetilditioopirofosfato
E108	tetraetil lead
E109	tetraetil pirofosfato
E110	Tetranitrometano

E110	I OXIDIZE OF TALIO(III)
E111	Thallium selenite (i)
E112	Sulphate thallium (i)
E113	TIOSEMICARBAZIDA
E114	Triclorometanetiol
E115	Vanadico Acido
E116	I OXIDIZE VANADIUM (V)
E117	Cianido of zinc, Zn (CN) 2
E118	Zinc phosphate when this in greater concentrations of 10
E119	Toxafeno

I articulate 6º - Rige from its company/signature.

Of eight and twenty-nine, San jOse April thousands nine hundred ninety

JOSE MARIA FIGUERES OLSEN - the Minister of Ambienten Energy, René Castro Salazar - 1 time (Request Not 13970). -

1 - (o-clorofenil)

3 - CLOROPROPIONITRILO

BENCILO CHLORIDE

Copper cyanide

Cianogen

Chloride of cianogen

CICLOHEXIL -4,6- DINITROFENOL

Diclorofenilarsina

Dieldrin

Dietilarsina

Acid fosforoditioico, dietil O-O s (etilnoetil) to eter

Dietil O;O foforotianato O-pirazinil

phosphoric, dietil acid 4 nitrofenil to ester

(R) - ADRENALIN

DIISOPROPILO FLUOROFOSTATO

Dimetoato

2 butanona, 3-3 dimetil -1-metiltio - Or metilaminio, carbonil oxin

alpha, alpha, dimentilfeniltilamina

2 METIL -4,6 DITROFENOL

2.4 DINITROFENOL

ditiobrureto

they endosulfan

endrin

aziridina

fluoridina

acetamida, 2-fluoro-

SALT SODICA, ACIDO FLUOROACETIO

4,7 - methane - 1 H - indeno

isodrin

hexaetil tetrasfosfato

acid hidrocianico

methane, isocianato

sudden mercury

metomil

aziridina 2 metil

METILHIDRACINA

2 metil-lactonitrila

aldicarb

metil paratiol

alpha-nafultiouretano

carbonito of nickel

cianida of nickel

NICOTINE

MONOXIDO OF NITROGENO

4 NITROANILINA

DIOXIDO OF NITROGENO

PICTURE # 6

WASTES GENERATED BY SOURCES YOU DO NOT SPECIFY

Code SIMARDE	Description of the waste
L018	Acids inorganic and mordant acid mixtures
L019	Mixtures reliable organic
L021	Dissolvents halogenados and halogenados dissolvent mixtures

L032	Oil emulsions for maquinado and stretched
L037	Oil used lubricant
L038	Oil to perforate, to cut and to polish
L040	Oils without content of policlorados bifenilos
L041	Oil wastes (lubricant heavy hydraulic engineer)
L042	Wastes of reliable
L044	Acid solutions
P014	Muds of sedimentation with injurious impurities
P017	Muds of industrial residual water treatment with impurities
P048	Muds and materials with halogenados dissolvents
P055	Muds of washing of tanks and estañones
P067	Muds with halogenados nonorganic dissolvent content
P075	Muds with aluminum oxides
P077	Mezcla of polished of metals (oil-stone)
P078	Muds of rectified burnishing and
S001	Mercury, mercury lamps, fluorescent

S020	Masses filter and of absorption used with injurious impurities
S022	Special cardboard wastes with impurezas
S029	Wastes plastics, with special impurities
S034	Wastes of papers with special impurities
S038	Wastes metalists with special others impurezas (nonoils)
S040	Wastes P plastics.E. with special impurities
S043	Wastes P plastics.P. with special impurities
S083	Material of work with solid impurities of gras and oil (Wipe, wicks and rags)
S093	Aluminum sulphate, aluminum phosphate wastes
S103	Wools and felts of polished like injurious impurities
S111	Material textile of packing with injurious impurities
S114	Glass wastes and ceramics with injurious impurities
S115	Material of work with impurities nocivas or rest, mainly organic
S147	Asbestos cement wastes, cement dusts with

	asbestos.
S167	Limaduras of lead
S179	Recipientes with rest of painting it bases reliable
S182	Sealants
S192	Red cartridges (fotocopiadoras printers)
S218	Oil filters
L039	Oils with policlorados bifenilos
L015	Baths of revealed
L028	Acids, with mineral content
L032	Concentrated and semiconcentrated with cyanide content
L033	Concentrated and semiconcentrated with chromium content (VI)
L034	Concentrated and semiconcentrated with metallic salts
L036	Coolants organic
L005	Rubber with dissolvent content
P059	Muds of glass grinding with injurious impurities
S021	Animals noneatable deads
S051	Partes of noneatable dead animals

S151	Mineral fiber wastes with injurious impurities
S156	Other solid wastes of mineral origin with injurious impurities
S206	Equipment and material with content of policlorados bifenilos

Appendix J: Regulation Handling

N° 27001

REGULATION FOR THE HANDLING OF THE INDUSTRIAL DANGEROUS WASTES

PRESIDENT OF THE REPUBLICA

And The MINISTER Of ATMOSPHERE And ENERGIA.

With foundation in articles 511 and 140. 19 interjection 1 and. The Political Constitution and in accordance with the had thing in artículos 60 and 69 the Statutory law of the Atmosphere N° 7554.

Considering

1° - That the generation of dangerous wastes has come in increase in the last years, product of the growth of the industrial and agro-industrial processes.

2° - That it does not exist a suitable definition and identification of this type of wastes and its generators.

3° - That the protection of the atmosphere is one of the fundamental pillars of the model of Sustainable Development that has undertaken the country, and that the Ministry of the Medio.ambiente and Energi'a has come impelling processes to make its work in this field more efficient.

4° - That badly the handling of dangerous wastes hits negatively in the human health and the natural ecosystems.

5° - That is obligation of the velar Be in favor of the health and the quality of life of the humans, as well as of conservation of the biodiversity.

6° - That is necessary to unify the nomenclature and classification of the wastes by its physical qualities or chemical they cause damage to the human health or the natural ecosystems.

7° - That stops to fulfill the exposed objectives is necessary to regulate the definition, classification and codification of the dangerous wastes.

8° - That given the previous circumstances publishes east regulation by the urgency procedure and it is opened to consultation so that in the term of two months the observations and commentaries become that are considered pertinent.

Therefore:

They decree:

REGULATION FOR THE LOS HANDLING INDUSTRIAL WASTES DANGEROUS

General Dispositions

I articulate 1° It presents/displays Regulation intends to establish the norms and procedures for a handling adapted of the dangerous wastes, from all waste that considers dangerous according to establishes the REGULATION ON the CHARACTERISTICS and the LISTING OF the INDUSTRIAL DANGEROUS WASTES.

I articulate 2° The generator of dangerous wastes will be the person in charge to guarantee that its treatment and final disposition are made the present according to the demanded conditions in regulation.

I articulate 3° For effects of the present regulation the following definitions settle down:

LETHAL DOSE AVERAGE (LD 50): Dose of a chemical agent necessary to produce the death of the 50 of the exposed animals of experimentation. It is I calculate statistical

of I number of milligrams of a chemical agent by necessary kilogram of corporal weight, to kill the 50 of a exposed animal population of experimentation.

CONCENTRATION LETHAL AVERAGE (CL 50): Concentration of the chemical agent in the atmosphere, which to the being inhaled produces the death of the 50 of the exposed animals of experimentation. It are expressed like parts by million, by space of 1 hour of inhalation.

Article 4° Of the stages of handling of industrial dangerous wastes.

4.a 1 suitable system of handling of wastes must contain the following elements or key stages:

Generation

Accumulation and storage Transport

Treatment

Final Disposition

4.the 2 stages previously indicated not only must be considered in individual form, but that also must consider the existing interrelation between the same ones, in agreement of the advance in the handling of the waste until its adapted final disposition more.

4.3 Before beginning any system of handling of the dangerous wastes, actions of reduction of such are due to make so that the smaller possible amount is handled, facilitating its control and monitoring. This favors so much to the industrialist to have to handle to a smaller volume of wastes, like a the atmosphere since the amount of wastes will be smaller that will have to be arranged in.

I articulate 5° Of the generators of dangerous wastes.

5.a 1 generating being of dangerous wastes is that that: generate one or more dangerous wastes as result of its activity treats dangerous wastes.

5.2 Each generating being of dangerous wastes must classify its dangerous wastes suitably. For this classification it will have to execute the following actions for each waste:

To separately collect the wastes from the moment that such take place. This with the purpose of being able to identify easily but as waste is dangerous and as it is not it besides to avoid contaminating the nondangerous wastes.

To identify and to classify the dangerous wastes. For this use will be due to do of norm 1. Also, the analyses of the wastes will take control of base in representative samplings of the totality of each waste.

5.3 the generator of dangerous wastes will have to make the efforts necessary to reduce the generation of dangerous wastes to the maximum. For it it must maintain to the day the following information:

Points of the process where dangerous wastes are generated

Points of generation of dangerous wastes where it is possible to reduce

Proportion of wastes that can be avoided in each point of generation.

5.4 Also, the generating being must complete for each generated dangerous waste, the information asked for in the leaf of dalos of the waste that appears in ANNEXED the 1. and to send it to the Environmental Contraloría.

I articulate 6° Of the accumulation

6.the 1 accumulation of the dangerous wastes, is the filling process of the containers in which the wastes are collected while they are generated. This action must take a end more close possible of the generation site. Also, this action is previous to the storage.

6.2 the accumulation of different dangerous wastes in joint form is not allowed, that is to say, each wastes dangerous will have to be accumulated for their storage in individual form. This does not imply that a same type of waste cannot be mixed in a single container for its accumulation.

d.the 3 punios of accumulation must stay and operate of form to which the possibilities of Fire, explosion are diminished or liberation of the dangerous wastes which they can alter the human health or of the atmosphere. For this the following conditions of security are due to follow:

6.3.1 Containers:

They must be closed hermetically, but with the possibility of opening them and of closing them.

They must be done gives material that I did not present/display problems of mutual incompatibility with the waste to store in him.

They must be in good state and free of flights.

The accumulated volumes will have to be such that assure a suitable environmental storage.

6.3.2 Rotulación: In each container one is due to indicate clearly: the type of dangerous waste that contains, its characteristics of danger, the date in which the accumulation in the same one began and I number of codification of the same one. This code must be the indicated one in ANNEXED the 2 of the Regulation on the characteristics and listing of

industrial dangerous wastes (Code SIMARDE). In case that the waste this including in the list and it does not correspond to those considered dangerous the code will be assigned by these competent authorities.

6.3.3 Location of the points accumulation: The accumulation points must be areas near the generation point where the containers adapted with the generated dangerous wastes are due to fill. These areas must be supervised by a worker of the generating process of wastes that in addition makes the filling process of the packages and the inspection to detect flights, I spill at least, or anomalous situations that could put in danger the labor situation and of the atmosphere.

6.3.4 Equipment of Security.

The accumulation points will have to count at least on the following equipment of security:

System de internal communication or of alarm able to provide immediate action on the part of personnel enabled before an emergency.

An apparatus (telephone, or similar) that is easy to accede in the scene of operations to call to the department of police, firemen, or the person in charge of a local or national emergency.

Water in a suitable volume and pressure necessary to replace it by hoses, similar equipment of foam formation, systems of spray of water or systems.

Extinguidores portable of fire

Command team of flights

Decontamination equipment

Absorbent of liquids

6.3.5 Identification of each site of accumulation: In addition to the mentioned equipment each station or site of accumulation must be identified as so with the suitable rotulación and to maintain to the reach a protocol that indicates the emergency and routine actions.

6.3.6 Equipment of security and protection for the employee: It is obligation of each generator to maintain the equipment of security adapted for its workers in this one and all the stages of the handling of dangerous wastes. This equipment must be acquired with base in an evaluation of the danger of or the generated wastes. Also the personnel must make sure that who this one in contact with the wastes systematically uses the protection prescribed in each case. All this must be contemplated in the Ticket "Information of the shown Generator" in ANNEXED the 1.

6.4 Always they must stay closed the containers used for the accumulation of the dangerous wastes during the accumulation stage, with exception of when it is necessary to open it to add or to remove wastes.

6.5 the Ticket of Accumulation is due to fill or Storage of dangerous wastes (ANNEXED 3) and to complete conforms it is made the accumulation stage, so that it can be solicitd by the corresponding authorities at any time and to know the amount volume of accumulated waste and the state of the storage of the same one.

Article 7° On the mutual incompatibility between dangerous wastes

7.1 to determine the mutual incompatibility between 2 or more of the dangerous wastes, it will be come from the following way:

7.1.1. it identifies the reactive group to which the dangerous waste belongs. (Picture N° 1, ANNEXED 2)

7.1.2. With base in the following table of mutual incompatibility the groups will intercept themselves to which the wastes belong.

Like result of the conducted intersections, a series of abbreviations can be obtained, which will indicate the type of reaction that could be expected between those types of wastes, thus is considered that the wastes are incompatible.

In case that several dangerous wastes in a single warehouse must be stored, a minimum space of 3 meters among them is due to leave free for whom they are incompatible.

GROUP

REACTIVO 1

1 2

2 HS 3

3 E.gf.S E.gf.S 4

4 H. gf. F. H. gf. F.

E. gf E, gt 5

5 . H.F.And,

gf. gf 6

6 H.F.E H.F.E H. F, E 7

7 Gf 8

8 H.F.E H.F.E 9

9 H. F, G

GROUP

REACTIVO 1 2 3 4 5 6 7 8 9

H: It generates heat by chemical reaction

F: Produce fire by violent exothermic reactions and by

ignition of mixtures

G: It generates gases in great amounts and it can produce pressure and

rupture of the closed containers

gt: It generates gases toxic

gf: It generates gases inflammable

E: It produces explosion due to extremely vigorous or sufficiently exothermic reactions to detonate unstable compounds or products of reaction

S: Solubilización of metals and composed of toxic salts

Article 8° On the storage

8.the 1 storage is the later phase to the accumulation; and it is where the wastes properly empacados and packed for their later treatment or final disposition stay.

8.2 the storage of any dangerous waste will have to take into account the following conditions:

The incompatilidad of the wastes to store

The conditions of the packages and packing

Plans of contingency

Impermeability of floors

Ventilation suitable depending on the type of stored waste

Conditions of the warehouses of storage as far as security

8.3 the storage of dangerous wastes, in the facilities of the generating being, will be by a maximum period of a 1 year calendar; as of the moment at which it was begun to accumulate the dangerous waste.

8.4 Another criterion to restrict the period of storage of the dangerous wastes within the facilities of the generating activity consists of never surpassing the 3 785 liters (1000 gallons) stored of a same type of dangerous waste.

8.5 In case that before a year, the generator has 3 78. mentioned liters, will be able to send the dangerous waste to a center of authorized storing outside the industry for their storage in safe form by a space until of a year from the moment in which beginning the accumulation of the same one.

8.6 Anyone of the two indicated criteria previously, that one is fulfilled of first will be the dominant criterion to establish the period of storage of such in the facilities of the generating activity.

8.7 Once reached the period of allowed storage, one will be due to come to transport such to a center of authorized for this aim, to an installation for treatment and disposition or exported storing for its suitable final disposition.

Article 9° Of the quantitative limitations and conditions of storage of the packing and packages

9.1 the maximum amounts allowed by inner package used to contain the different used dangerous wastes are the following ones:

Picture Not 1: Maximum amounts allowed by package

Dangerous characteristic of Desecho	Group of package o packing	Physical state of the waste	Cant. Maxima of waste by inner package
Wastes that They react	II	Liquid	1 1 (metal)
			500 my (plastic)

Spontaneously	III	Liquid	or glass) 51
Wastes that/ they can experiment Spontaneous combustion	II	Solid	100 or 500 g
		Liquid	25 my
	III	Liquid or solid	1 kg
Wastes of organic peroxides	II	Liquid or solid	500 g
	nor	Liquid or solid	1 kg

9.2 Next the general conditions for the storage of dangerous wastes are detailed.

a) All embalajes/envases must be clean and free of materials other people's to which is going away to introduce.

b) The materials of the packing or package must be appropriate for the nature of their content.

c) The packing must effectively be protected, whereas the package must effectively be closed.

d) The packing must be resistant to shocks, blows, friction, humidity. é) the size and volume of the rammers must be different according to the diverse properties from the dangerous wastes.

f) The rammer space must be clean, dry and ventilated well.

9.2.1 Explosives:

a) The packages destined to contain wastes with explosive characteristics must be the quite resistant thing like not letting save their content in the normal conditions of transport and storage.

b) The parts of the packages that are in direct bonding with the dangerous wastes will not have to be affected by the chemical action or of another nature of these wastes.
When be necessary, these parts will have to be provided with a suitable inner coating or to have been object of an appropriate treatment. Said parts of the packages will not have to include components that can react dangerously with the contained waste so that potentially dangerous products form or they are debilitated considerably.
c) Cushioning and absorbent material EI inert and will be adapted for the nature of the content of the container.
d) The containers, the pair to them of containers and the closings of plastic matters that can enter direct bonding with a dangerous waste will have to be resistant to his, action and will not have built-in materials that can react dangerously, form dangerous compounds or moderate, to debilitate or to make unusable the containers or their closings.
e) The packing or packages of plastic matters must be the sufficiently resistant thing to the aging and the degradation caused by the substances contained in them or the ultraviolet radiation. The permeación of the contained substance will not have to constitute a danger in the normal conditions of transport.
Rammers:
In order to pack dangerous wastes with explosive characteristics they will have to be made according to the "following characteristics of packed:
a) Category of rammer A (ordinary): All the wastes with characteristics of explosives, will have to be packed in a zone where the temperature is smaller to 20 °C and moved away of heat sources, like sparks, flames, steam pipes heating coils.

b) Category of rammer B (waste pyrotechnicses): For the wastes pyrotechnicses the same dispositions will be used that the category of rammer To with the reservation of not sobrestimar (it is to say directly did not pack on the bulks no different load).

c) Category of rammer C (types of special wastes): The wastes for which this modality is prescribed consist of wastes that explosives and chemical agents of smoke-producing type contain, tear or toxic. The main problem is in the risk of fire or spontaneous combustion with loosening of dense smoke or tear or toxic steam, in case that some flight of the content of the bulks takes place.

it follows the estibación of category A. In the case of wastes with toxic characteristics, they will have to be to pack itself in a space hermetically closed.

category rammers will not be able to be placed to smaller distances to the 6 ms of distance of any factor that opens fire (it calls ashes, sparks), an ash ejector or any other factor that allows to open fire. Also they will have to be separated from passable places, as well as from the mouths against fires, pipes of steam, routes of access, and to not less than 8 ms of distance of office and safeties.

9.2.2 Of the incendiary fuels.

The incendiary fuels will divide in 3 categories according to their group of packing or packaging, according to the danger degree that involves each one of them:

• High danger (Group packing or packages 1), smaller or equal initial Boiling point 35 to °C

• average Danger (Group packages or packing II), greater or equal initial Boiling point 35 to °C; point boiling in closed glass of 23 °C

• Low danger (Group packages or packing 111), initial Boiling point 35 greater to °C; point inflammation in greater or equal glass closed to 23 and 61 equal minor or to °C. i For their package or packing the following dispositions will be followed

a) It doubts the facility whereupon these wastes can become inflamed, the packing or the package must be protected against the external sources of inflammation.

b) The packages that are in direct bonding with wastes incendiary fuels will have to be hermetically closed.

c) 1-ace even to them of mud package which they are in counted direct with the dangerous wastes does not have to be affected by the chemical action or of another nature of the wastes. When it is necessary, these parts will go provided with an inner coating or will be object of a suitable treatment. mentioned parts of the packages they will not have to include components able to react dangerously with the content so that products get to form, potentially dangerous or that these parts are debilitated, considerably.

d) When the possibility that exists the emanation of gases (or by elevation of the temperature or other causes) produces an appreciable pressure inside I move, will be able to be equipped to this with a breathing device on condition that the gas thus emitted does not cause a danger, considered the toxicity, inflammability, corrosivity, and emitted amount of the gas. breathing device will be constructed so that it cannot escape I eliminate some being the On guard vertical bulk. The outer package or packing will be arranged so that it does not interfere with the good operation of the breathing device.

9.2.3 Of inflammable solids:

a) Given the facility whereupon these wastes can become inflamed, the packing or packages must protect contained you against the external sources of inflammation.

b) For the transport of this type of waste, one will be due to be able to dampen such with water or some other liquid within totally impermeable containers. The closing will be in all the effective cases to avoid lost of I eliminate and it will be possible to be demanded in certain cases that are a hermetic closing,

c) Before packing bulks that contain this type of substance I know will carry out an inspection in order to verify that there is in them nothing that indicates that this taking place a flight or that has taken place previously a flight that can have reduced the amount of liquid indicated in the previous point, making it inferior to the specified one.

9.2.4 Of the corrosive substances:

a) The corrosive wastes will have to stay driest possible,

b) All the wastes of the present class for which a packing or plastic packages is allowed without outer element of protection, will have to stay, of being possible, to temperatures near 20°C since the resistance of the majorities of the plastic materials diminishes to high temperatures.

9.2.5 Of the poisonous substances:

With the object of packing or packaging they are had I divide the toxic substances in 3 categories according to the danger degree that they involve:

• Group packing or packages I: Prepared substances and that involves very serious risk of envenenamiento. (LD50 for 5 smaller or equal ingestion mg/kg; LD50 by contact with 40 the smaller or equal skin to mg/kg; CL50 by smaller or equal inhalation á 0.5 mg/l)

• Group packing or packages II: Prepared substances and that involves a serious risk of envenenamiento. (LD50 by 50 smaller or equal ingestion greater to 5 mg/kg mg/kgl)

LD50 by contact with 200 smaller or equal the greater skin to 4(1 to mg/kg; CL50 by inhalation greater to 0.5 mg/1 smaller or equal to 2 mg/1)

• Group packing or packages III: Substances and prepared that entrañan un risk de relatively slight envenenamiento. (LD50 by ingestion greater to 50 mg/kg and equal minor or to mg/kg; LD50 by contact with the skin greater to 200 mg/kg and equal minor or to 1000

mg/kg; CL50 by inhalation greater to 2 mg/1 and 10 equal minor or mg/1)

For their package or packing the following dispositions will be followed:

a) All the packages will be like minimum effectively i had supper. Nevertheless, in the case of dangerous wastes that according to the criteria of toxicity by installation they are assigned to the packing groups or packages I or II, they will have to be contained in its packages hermetically closed.

b) The parts of all package that are in contact with the enemy dilecto with the dangerous waste do not have to be affected by the chemical action or of another nature of this waste. The mentioned parts of the packages will not have to include components able to react dangerously with the content, so that they get to form potentially dangerous products or that said even to them they are debilitated consideradamente.

c) When the possibility that exists the gas emanation (either by elevation of temperature or other causes) produces an appreciable pressure inside a bulk will be able to be dolar to this of a breathing device, as or has been mentioned previously.

d) Since the steam pressure of the liquids of low punió of boiling usually is high, the packages destined to contain are; liquids will have to be sufficiently resistant to support, with an ample safety factor, the inner pressures that probably will be developed in them.

e) When they fill the packages with liquids left an empty space sufficient to have the security of which flights nor permanent sets in the packages as a result of an expansion of the liquid caused by the temperatures do not take place that probably will take place during their storage.

9.3 Of the decontamination

In case of spill of toxic substances in any stage of handling and particularly if it is liquid plaguicidas, measures adapted for the decontamination under the supervision will be taken from a competent person. If there is some reason to suspect that a flight of some waste of the present class has taken place, the entrance in the warehouse nor in the compartment will not be allowed until the one in charge has taken in consideration all the aspects related to the security from the workers and the medio.ambiente and that is guaranteed this security.

9.4 In other situations of emergency the entrance in the warehouse to personnel properly enabled and in those cases was authorized solely taking independent respiratory apparatus and indumentaria protector.

9.5 Conditions of storage warehouse.

One is due to keep the same conditions of security indicated in the accumulation stage, reinforcing the fact that the floors of the storage warehouses must be totally impermeable and to count on protection walls. Also a suitable system of ventilation is due to have (as long as the stored waste allows it). In most of the cases the warehouses they will have to remain closed and the access will be restricted for personnel solely enabled. The warehouse used for the storage of dangerous wastes will have to be another different one from the warehouses of raw material.

9.6 Precautions against fires.

The precautions demanded against fires in the zones of accumulation or the warehouses of storage are:

a) To maintain all combustible matter remote of ignition sources.

b) To protect the inflammable substances by means of packing suitable packages.

c) To reject and to rectify the bulks in which they are observed deteriorated or with flights.

d) To pack the bulks so that they are protected against the possibility that accidentally they undergo deterioration or heating.

e) To secrete the bulks of the substances that can cause or propagate a fire.

Or To make respect the prohibition to smoke in the danger areas and to place easily reconocibles signboards or symbols that they indicate "PROHIBITED TO SMOKE".

g) To have present the danger that involves the short circuits, lost to earth and the sparks. In attention to this one is due to maintain in good state electrical cables of the circuits of lighting system and energy, as well as the accessories. To disconnect the cables or the equipment that do not offer security. When a bulkhead adapted for segregation aims is prescribed, to obturate the perforations of the covers and the bulkheads that take step to cables and to the able pipes so that the entrance of gases and steam is prevented.

h) The inclusion of the precautions against fires in the corresponding card of the dangerous wastes is recommended, always and cuandó is applicable.

i) Since smoke that emits certain substances when a fire affects them put in serious risk of poisoning the personnel if not this prote'ge' against them, it will be necessary to take to

always indumentaria protector and independent respiratory apparatuses when trying to fight those fires.

Article 10. Of the transport

10.1 For the transport of dangerous wastes within the country, or for its storage, treatment or final disposition, the norm to follow will be the same one imposed for the dangerous substances in the decree N° 24715-MOPT-MEIC-S.

10.2 the classification of the dangerous wastes for transport effects, is indicated in the Regulation of Characteristics and the Classification of the Dangerous Wastes.

10.3 All vehicle destined to the transport of dangerous wastes, will have to be registered like so in Contraloría Ambiental (M1NAE), also any conductor of this type of vehicles will have to count on a license for carrier of wastes

dangerous. It stops to acquire the indicated license each conductor will have to fulfill the necessary requirements for the same one; which will be established by the Environmental Contraloría.

10.the 4 vehicles will have to be prepared at least with the shown minimum requirements in ANNEXED the 4.

10.5 As it is indicated in the decree N° 24715-MOPT-MEIC-S, all automotive vehicle that is dedicated to the transport of dangerous wastes will have to carry, in addition to documents required by the Law of transit for terrestrial public routes, those others that settle down in:

a) Denominated document "Manifest of Transport of Dangerous Wastes" (ANNEXED 5)

b) Documents or cards of emergency which will have to be signed by a professional runs (chemical or engineer chemistry), incorporated to the respective professional school (ANNEXED 5).

c) a certificate of the generator of the dangerous waste, the one that it will have to include the information contained in the ANNEXED I.

10.the 6 carriers will have to clean any dangerous waste that remains later to the unloading that happens during the transport stage. All these dangerous wastes, and products of cleaning of transpose must be treated like such, thus in case of being made a unloading in a treatment installation it will be due to count on a zone to make the cleaning of the same one and that the currents of that cleaning take to the currents of the treatment plant.

10.7 In the load stage, it unloads and cleaning is due to always follow the safety measures of the personnel necessary to assure the health the workers involved in each one of those stages. The necessary equipment of security will depend on the danger characteristic of each handled waste.

Article 11. Of the treatment of the dangerous wastes

11.the 1 treatment of a product or waste is a method, technique or process, designated to change the physical, chemical or biological characteristics so that a nondangerous or less dangerous waste for its storage takes place, transports or final disposition safe.

11.2 the treatment includes the neutralization of the wastes, recovery of energy or sources of waste materials. Next the main ones are indicated you practice for the treatment of the dangerous wastes.

ALLOWED METHODS OF TREATMENTS

OF DANGEROUS WASTES

División general Subdivision

RECYCLING: Use like fuel (direct nonincineration) or another average one to generate energy whenever it does not generate other substances dangerous.

Recuperación/Regeneración of reliable.

Reciclaje/recuperación of organic substances that are not used like reliable.

Reciclaje/recuperación of metals or composed metalists.

Reciclaje/recuperación of other inorganic matters.

Regeneration of acids or bases.

Recovery of components to diminish the contamination.

Recovery of components of the catalysts.

Used oil refinement.

Use of the obtained residual materials in anyone of the enumerated operations.

Interchange of wastes to put under them some of the enumerated operations

FÍSICO-QUÍMICO :Treatment physical-chemistry nonspecified elsewhere of this listing that gives as result compound final or mixtures that which discard with anyone of the operations indicated in this picture.

BIOLOGICAL: Biological treatment not specified elsewhere of this listing that gives as result compound final or mixtures that have discarded of anyone of the operations indicated in this picture.

INCINERATION: Incineration

IT WAS DELPAÍS: Export

OTHER MECHANISMS: Chemical Fixation Encapsulamiento Stabilization Solidification

11.the 3 All facilities of treatment of dangerous wastes, will have to make a study of environmental, previous impact to their installation.

11.4 In addition to the study of environmental impact, in case of the installation of an incinerator, the design of a system of combustion gas treatment will be due to present/display so that the noncontamination with this equipment can be assured.

11.5 to choose the installation that treats its dangerous wastes, the generator must make sure previously that the site counts on necessary the legal requirements for its operation, also must make sure that the same one suitably has

wastes or end items to the stage of treatment or in opposite case, are the same generator that will have to find some mechanism environmentally suitable to have them.

Article 12. Of the final disposition of the dangerous wastes

12.the 1 suitable final disposition of the dangerous wastes talks about a: the unloading, injection, deposition, launching and/or positioning of any dangerous waste (previously treated). Said

disposition must become so that the waste or any component of the same one that enters the atmosphere does not carry any kind of problem for the atmosphere.

12.the 2 only methods of final disposition are the indicated ones in the previous picture. These methods are:

- Stuffed Toilet of Security, - Encapsulamiento. - Incineration. - Export to developed countries.

12.3 the export of the dangerous wastes will have to be made solely with aims of treatment or for final disposition.

I articulate 13. Of the facilities of Treatment and disposition of dangerous wastes:

13.1 All installation of treatment and disposition of dangerous wastes, will have to demonstrate with a study of environmental impact that its operation environmentally will be adapted. Also the one in charge of the treatment of dangerous wastes will have to fulfill all the legal and environmental requirements stipulated by the law; in addition to the present regulation.

13.2 the tratador of the dangerous wastes will have to present/display a study that demonstrates that the treated waste is deactivated properly or at least that it has been managed to diminish his potential of danger so that can be had a safe way and so that it does not affect the medio.ambiente.

13.3 Queda totally prohibited the import of any dangerous waste to the country, or to treat internally, to store o so single to use the country as passage for other Central American countries. (According to Agreement of Basel and Central American legislation of transport of dangerous wastes).

13.the 4 facilities for treatment and filial disposition will have a plan of analysis of wastes, which gains the victory to include.

a)Determinación of the most critical parameters to analyze in different desechos dangerous that they are had. b)Métodos of examination to use to determine those c)Métodos parameters of sampling to use to obtain a representative sample of each treated waste to suitably and that it is possible to have him in form environmentally.

13.5 In addition to the analysis plan of the dangerous wastes, delight to control a plan of control, inspection and monitoreo site; Including laboratories, warehouses and all the other facilities.

13.6 the security required in the treatment facilities and final disposition must include continuous monitoring the 24.00 hours. thus misino a continuous monitoreo and an entrance of control to the air side of the installation, which will have to be bordered with an artificial or natural barrier around.

13.7 the minimum duración to make inspection are:

Zone of load and unloading	Daily
Area of storage of contenedores	Weekly
System of tanks	Daily
Incineradoras	Daily
Other Units of heat treatment	Daily
Units of physical Treatment,	Weekly
biological chemistry or	Daily
Closed systems of vasijas, and	Daily
control apparatuses	Daily
Censors of compressors	

Article 14. Of the warehouses of storage outside, power plants

14.1 the places that are destined for storage of dangerous wastes outside the land in which the dangerous waste is generated will have to work exclusive warehouses for this aim.

14.2 These exclusive warehouses will have to be in moved away zones of urban nuclei and protected zones, with restricted and isolated entrances.

14.the 3 warehouses of dangerous wastes must accept mud the indicated thing in section 6 besides to have an incoming log of the dangerous waste, where it will have to be written down:

a) Origin of the dangerous waste (generating being)

b) Type of waste (name, code)

c) Date from entrance to the storage installation

d) Fecha in which the accumulation of the waste in the site began that generated it

e) Date in which the period of 1 year established by this norm expires (from the date of accumulation of the same one)

f) Personal in charge of the waste on the part of the generator

14.4 Storage (the one in charge) it will have to notify to the generator with 1 month of anticipation that its waste is going to turn the period prescribed, sending a copy to the Environmental Contraloría

14 5 In case of having dangerous wastes that they have turned the period allowed, will be due to report those cases to the Environmental Contraloría enclosing a copy of the incoming log of such.

14.6 En las etapas de tratamiento y disposición final igual que en el resto de las etapas de manejo se deberá contar con planes de contingencia en casos de emergencia así como en el caso de desastres (Terremotos, incendios, derrumbes o inundación).

Article 15. The ANNEXES constitute part of this Regulation

ANNEXED 1

Form:

INFORMATION OF THE GENERATOR: LEAF OF IDENTIFICATION OF DANGEROUS INDUSTRIAL WASTES.

ANNEXED 2

PICTURE N° 1: REACTIVE GROUPS TO DETERMINE MUTUAL INCOMPATIBILITY OF THE DANGEROUS WASTES

GROUP 1 - Muds of diacetileno

Alkaline caustic liquids

Alkaline cleaners

Corrosive alkaline liquids

Corrosive alkaline fluids of balería

Residual caustic waters

Limestone muds and other corrosive alkalis

Limestone residual waters

Limestone and water

Caustic waste

Muds of washers of efluentes gaseous of high furnaces

Muds of primary operations in the copper production

Wastes of sifting of the drainage in processes of curtiduria in: pulpado of hair retained, finished humid and repair of skins for deslanado dyeing

Waste alkaline of the cleaning of boats

Solutions spent of the baths of salt in the cleaned one of containers in the decontamination operations of metal heat

Territories of whitening of oils or fats

GROUP 2 - Acid muds

Acid and water

Acid of batteries

Chemical cleaners

Acid electrolytes

Acid or reliable grout

Corrosive Licor and other acids

Acid waste

Mixtures of acid wastes

Sulfuric acid wastes

Strong waters of the glass

Precious waters of treatment with pumice stone or metals

Waters of the processes of heavy metal concentration

Mud waters

Waters of water treatment of operation of

galvanoplasty

. • Waters of water treatment of the production of

blue iron pigments

Waters of water treatment of the production of

pigments molibdato orange

Waters of the solutions of the operations of galvanoplasty

Waste in the manufacture of semiconductors

Wastes containing mercury of electrolytic processes

Acid wastes in the processing of films

Solutions spent of the operations of galvanoplasty and

of the rinsing of the operations of the same one

Solutions of silicon engraving

Solutions of aluminum extrusion

Acid solutions of the chemical cleaning

GROUP 3 - Aluminum

Beryllium

Calcium

Lithium

Potassium and Magnesium

Sodium

Dust zinc

Other reactive metals and hidruros

Waters of biodegradación of muds containing laid-down load or polluting heavy metals

Catalyst spent of mercury chloride

Muds of equipment give control of gas discharges, smoke and dusts

Muds of oxidation of biological treatment that contains any subject toxic substance to

sanitary or ecological control

Muds of oxidation of residual water treatment

Muds of water treatment of the green pigment production of chromium, chromium oxides

(anhídridos and hydrating)

Wastes of homo in the green pigment production of I oxidize of chromium

Wastes of the polarization of the processes of calcination and the processes of the milling of piezoelectric ceramics

Removed painting wastes of furniture

Wastes of hot seal and aluminum

Wastes of asbestoses in all its forms, residual asbestos

Wastes of all material that contains heavy metals

Originating solids of dams of fundidoras of lead

Earth with nickel catalyst

Residual asbestos

GROUP 4 - Alcohol

Water

Spent dissolvents not halogenados: cresoles, cresilisico, nitrobenceno acid, metanol, tolueno metilcetona, metilisobutilcetona, disulfuro of carbon, ethyl isobutanol, piridina, xylene, acetone, acetate, etilbenceno, etílico ether, n-butilico alcohol, ciciohexanona.

GROUP 5 - Any concentrated waste of groups 1 or 2

Calcium

Lithium

Metallic Hidruro

Potassium

SOC1 (Chlorides of the oxiácidos ones of sulfur), PC1 (chlorides of phosphorus), CHSiCÍ (alquiísilano chlorides)

Other reactive wastes to the water

GROUP 6 - Alcohol

Aldehydes

Halogenados hydrocarbons

Nitrated hydrocarbons

Hydrocarbons nonsaturated

Other organic compounds and reliable reagents

Fixed bases of dimetil - sulphate

Activated charcoal containing dangerous substances

absorbidas

Dissolvents of cleaning in mechanical parts.

Dissolvents of mechanical lamination in electronic circuits

Dissolvents spent halogenados in other operations that are not the taken the grease out of one:

Methylene Tetracloroetileno, chloride, tricloroetileno, 1.1,

1-tricloroetano, trifluoroetano, or diclorobenceno,

triclorofluorometano

Used dissolvents spent halogenados in the taken the grease out of one: methylene tetracloroetileno, tricloroetileno, chloride, 1.1.1, tricloroetano, trifluoroetano, tetracloruro of

chlorinated carbon carbon, fluorides

Empty packages that had contained nobody upo of plaguicida

Used packages and empty inns for the handling of environmental dangerous chemical wastes

Muds of oil bath in the tempering and heat treatment, of metals

Muds of water treatment of wastes of the tempering in the decontamination operations of metal heat

Wastes of the manufacture of computers

Wastes of the cleaning of circuits by immersion

Wastes of the chemical milling in equipment miniature

Dissolvent wastes in the production of capacitores of ceramics

Wastes in the magnetic tape manufacture

Wastes of the newspaper impression and cleaning of the equipment

Wastes of fotoacabado.

Wastes of retrograbado and impression by plate

Wastes of protection of electronic components

Wastes of dissolvents used for the extraction of coffee and caffein

Wastes of policlorados bifenilos or any other material that contain them

Wastes of the bottoms of the tanks of gasoline distribution conteniendo etraetilo of lead

Wastes in the microfilm manufacture

Wastes of laboratories of circuits printed in wood

Mixtures of wastes of plaguicidas

Plaguicidas caducos

By-products of the plastic manufacture

Oily muds of the processes of crude petroleum refinement

Bifenilos policlorados residual

Materials that contain bifenilos policlorados in 50 concentrations greater to ppm

Materials that contain wastes of dibenzodioxinas or dibenzofüranos

Muds of the exploration perforations

GROUP 7 - Wastes of the selective flotation in the operations, of metal recovery from minerals

Sediments of the wastes of lagoons of water treatment of cianidación in the operations of metal recovery from minerals

Sediments of the wastes of the lagoons of cyaniding water treatment in the operations of metal recovery from minerals

Solutions.spent of cyanide baths in the operations of metal recovery from minerals

Solutions spent of cyanide in the decontamination operations of surfaces de heavy metals

GROUP 8 - Chlorates

Chlorine

Cloritos

Chromic acid

Hipocloritos

Nitrates

Percioratos

Permanganatos

Peroxides

Other strong oxidating agents

Muds of water treatment in the manufacture and

processing of explosives

Muds of water treatment in the electrolytic process in

the chlorine production

GROUP 9 - Acetic acid and other organic acids

Wastes of group 3

Wastes of group 6

Other inflammable and combustible wastes

ANNEXED 3

Form:

ACUMULACIÓN/ALMACENAMIENTO TICKET

ANNEXED 4

REQUIREMENTS MINIMUMS THAT MUST HAVE THE VEHICLES

IT STOPS TO BE ABLE TO TRANSPORT DANGEROUS WASTES:

Diesel engine: Its use is obligatory for those vehicles with a gross weight greater to 3 51X1 kg

Device of escape: The back extremity of the escape device must be but the far possible thing of the transported matter or the orifices of exit of the product.

Exhaust gases: the exhaust gases do not have to be projected on the deposit of the fuel of the vehicle

Instruments with flame: when matters are transported that present/display explosion or fire risks, it will be prohibited the use of instruments with flame nor edge specifically or in the proximities of the vehicle as it is the case of heating apparatuses, apparatuses of lighting system by incandescence. Devices witnesses with resistant filament outdoors, accessories to smoke, etc.

Body: the devices of fixation of the body or the cistern must present/display one furnia suitable and one sufficient solidity.

Center of gravity: the height of the center of gravity of the vehicle with the load does not have to surpass in an I II) respect "the width of the route of the vehicle (distance between the outer meeting points with the ground of the pneumatic rims, left and right to the misino axis.)

Disc of limitation of speed: the vehicles will have to carry in the back pair to him, of the left side a disc indicating the authorized terminal velocity the one that will have to be of white color, with fifteen centimeters of diameter and indicative numbers in black color, with a measurement of 10 centimeters of height by 6 cm wide.

H; Devices of enlistment: the vehicles tows or semitrailers will have to take a special device that pernita to uncouple them of fast way and an auxiliary system enlistment to be used in conditions of emergency.

Safety valve: in the fuzes of entrance, exit or others of the dangerous product. In case of being transported volatile gases or liquids, the container will have to be sealed in its totality, as much commits like externally, with its respective valves of escape.

The vehicle must be equipped with a system of comunicación by radio frequency.

In case that the vehicle counts on lancines for the transport of the dangerous wastes, they will have to be constructed or had with a material that does not undergo corrosion due to the waste that is transported. Source:

REGULATION FOR The TERRESTRIAL TRANSPORT OF DANGEROUS PRODUCIOS (N 2475-MOPT-MEIC-S)

B. EMERGENCY CARD

A. Information on the dangerous waste:

Name of the waste

Physical properties of the dangerous waste (density

Point of fusion, boiling point, punió of inflammation, punió critical, volatileness, coefficient of difusividad. etc.)

Chemical property impórtame (reactivity with air water or pyres common substances)

Indications on toxicity and danger of the waste

Indications on immediate Treatment in case of ingestion, inhalation or contact with the skin

Compatibility with other chemical producios and incompatibilidades.

Maxima amount transported and regulated minimum amount

Actions to take in case of fire.

B. Information general:

Telephone numbers in case of emergency, available the 24 hours of the day

Protocol by Incidents

Instructions of answer to incidents, according to International specifications. tipo extinguishing. Plan of evacuation, materials to gather the spilled product, well-taken care of generals, etc.

Source: REGULATION FOR THE TERRESTRIAL TRANSPORT. I GAVE; PRODUCTS PE1.1GROSOS (N * 24715-MOPT-MEIC-S)

ANNEXED 5

Form:

A. MANIFESTO OF DANGEROUS WASTES

B. EMERGENCY CARD

A-Informacio'n on the dangerous waste:

Name of the waste

Physical properties of the dangerous waste (density, point of fusion, boiling point, flash point, tactically important point, volatileness, coefficient of difusividad, etc.)

Important chemical property (reactivity with common air, water or other substances)

Indications on toxicity and danger of the waste

Indications on immediate treatment in case of ingestion, inhalation or contact with the skin

Compatibility of other chemical agents and incompatibilidades

Maxima amount transported and regulated minimum amount

Actions to take in case of fire

General B-Informacio'n:

Telephone numbers in case of emergency, available the 24 hours of the day

Protocol by incidents

Instructions of answer to incidents, according to international espicificaciones, type of extinguisher, plan of evacuation, materials to gather the spilled product, well-taken care of generals, etc.

Source: REGULATION FOR The TERRESTRIAL DANGEROUS PRODUCT TRANSPORT (N° 24715-MOPT-MEIC-S)

Article 16. Of the sanctions.

the imcumplimiento of the arranged thing in this Decree will be sanctioned according to the established thing in article 99 of the Statutory law of the Atmosphere, N° 7554, of the 13 of November of 1995.

Article 17. It prevails from the company/signature of the same one.

Dice in the Presidency of the Republic.-- San jOse, to the twenty-nine days of the month of thousands April of nine hundred nóvenla and eight.

JOSE MARIA FIGUERES OLSEN.--E1 Minister of the Atmosphere and Energy, Rene Castro Salazar.--l time -- (Solicitud (l N "13971).— C-84000.-- (27521).

Appendix K: Regulation Registry

No. 28113

REGULATION FOR THE DANGEROUS PRODUCT REGISTRY

Article 1. Object

The present Regulation intends regular the dangerous product registry, according to criteria briefed in annexed the 1 (Guide for the Dangerous Product Classification), or other products declared like such by the Ministry, by means of decree or administrative resolution.

Article 2.Exceptions

The present Regulation will not be applied

a) The human and veterinary medicines.

b) the plaguicidas of industrial use and domestic servant.

c) the formulations of agroquímicos.

d) the narcotics and the psicotrópicas substances.

e) The used chemical agents like nourishing additives.

f) the products or apparatuses that emit radiations.

g) chemical, biological or compatible Substances for farming use.

h) the laboratory reagents.

Article 3.Definitions

With the object of the application of the present Regulation, it will be understood:

Lethal dose Average (DL50): Dose of a chemical agent, necessary to produce the death of 50% of the exposed animals of experimentation. It is a statistical calculation of the

number of milligrams of a chemical agent by kilogram of corporal weight, necessary to kill 50% of an animal population of exposed experimentation.

Lethal Concentration Average (CL50): The concentration of a substance that causes 50% of mortality in the test animals, usually under exhibition of a certain period. It are expressed in parts by million (ppm, ing/L or g/m3).

Label: Material printed or inscription graphical, written in characters legible, that identifies and describes the product contained in the package that accompanies, according to the effective norm.

Form: Form of Dangerous product Registry (annexed 2).

Poisoning: Effect adverse due to the enter or to the exhibition a substance. The set of injurious effects produced by a chemical agent.

Dangerous product handling: Dangerous the product manufacture, import, storage, distribution, provision, sale, use or transport of toxic, inflammable, irritating character, supporter of combustion, corrosive, briefed in Gui'a for

Classification Dangerous Products (annexed l), or others declared thus by the Ministry.

Trade name: Name with which the manufacturing house identifies a determined product for its commercialization, approved by the Registry of the property.

Raw material: All the active or inactive substances that are used in a production process, as much if they remain inalteradas, as if they experience modification or they are eliminated during the manufacture process.

Mixture of defined composition: Mixture of substances with specified scopes of composition, that can be made by soluto and a dissolvent (example: hydrochlorate acid

concentrated or formalin) or by a mixture of similar components (example: queroseno, cipermetrina).

Ministry: Ministry of Health

Sample for analysis: Part or extracted portion of a set, by methods that make it representative of the same one.

Sample without commercial value: That product without commercial value, according to article 120 of the law number 7557, General Law of Customs.

Generic or common name: Common name of a substance approved by some official organism of international standardization.

Chemical name: Scientific designation for a substance, according to the system of nomenclature developed by the Union the International of Pure and Applied Chemistry (lUPAC, by its abbreviations in English), or by the rules of nomenclature of CAS (Chemical Abstracts Service), or a name that indicates the substance clearly, to allow the evaluation of its risk.

Number CAS: Record number of the substance before the Chemical Abstract Service, pertaining to the American Association of Chemistries (ACS by its abbreviations in English).

Precursors: Substances or chemical agents, including in the listing official of control defined by the Ministry of Health, that take part in the process of drug production of illicit use, or normally synthetic, and that they are gotten up to the molecule of the end item, so that are indispensable for their elaboration.

Dangerous product: Everything product, substance either object of toxic, combustible character, inflammable, radioactive, infectious, irritating, corrosive supporter of

combustion, according to criteria briefed in annexed the 1, or declared other like so by the Ministry.

Essential chemistries: Substances or chemical agents, including in the listing official of control defined by the Ministry of Health, that take part in one or more stages of the process of drug production of illicit use, or are these natural, semisynthetic or synthetic ones, that generally is not gotten up to the molecule of the end item and can be replaced by others of similar nature.

Article 4. The handling of those dangerous products properly registered before the Ministry will be only allowed, as long as the establishment counts on the permission of effective operation.

Article 5. Registry

In order to register a dangerous product it will be come from the following form:

1) dangerous product Registry for sale to by greater and minor mattered or produced in the country:

a) Products with number of CAS.

In order to register pure products with I number of CAS, will be due to present/display the Form (annexed 2). This group includes pure products, mixtures of defined composition or any other product that count on own number of CAS.

b) Products without number of CAS

For the registry of any product without number of CAS, one will be due to present/display the Form (annexed 2) and the Leaf of Security (annexed 3).

2) Uso of already existing registry:

In the case of dangerous products with identical characteristics, it is to say: trade name, generic or common name, formulation, manufacturing house, to those of a registered product either, the interested one will be able to make use of the assigned record number or. For it it will have to notify such circumstance in the Form (annexed 2), demonstrating with the offered information in question of the same product.

3) Raw material:

The dangerous products concerned directly by the national industry to be used exclusively in their process of production will not require registry; solely, the interested one will have to notify in the Form (annexed 2), for only time, the product to concern, and to present/display the Leaf of Security (annexed 3) for those dangerous products without number of CAS.

Presented/displayed the previous information, the Ministry will emit the respective resolution in a maximum of ten (10) working days, counted term as of the date of reception of documents.

Article 6. Use of the registry and the authorization of import of raw material

The use of the dangerous product registry and the authorization of import of raw material will be per indefinite time. Except for the had thing in articles 7 and 8 the present regulation.

Article 7. Cancellation, revocatory refusal and of the registry or authorization

The Ministry will cancel, it will deny or revoke the registry or authorization of a product or raw material when:

a) Anyone of the requirements demanded by the effective norm is failed to fulfill.

b) knows new technical information that it indicates risks for the health of the people, derivatives of the use handling of a dangerous product, previous technical evaluation of the Ministry.

c) the handling of the product has been prohibited by the Ministry.

By "new technical information" the registry will have to be understood subsequent to not only emitted, but, in addition that that, although existing before registering the product, not outside well-known by the Ministry or the interested one but after that fact.

Revocatory of the registry or the authorization it will be governed by the established thing in article 154 of the General Law of the Public Administration.

Article 8. Desalmacenajes in customs

The obtaining of the registry of a dangerous product will authorize to the registrante to carry out desalmacenajes without requiring the previous authorization of the Ministry of Health, safe in the case of the precursors, essential chemistries or other dangerous products that tell on a special norm that it demands this requirement.

The Main directorate of Customs will have to provide to the Ministry periodically, that pertinent information related to the dangerous product import.

All physical or legal person who concerns samples without commercial value of dangerous products, will be able to desalmacenar them without requiring the previous registry, presenting/displaying solely the Form properly full and where its condition of sample is pronounced. This disposition is not applied in case of controlled products, such as the essential precursors and chemistries, in which case if it will require the previous registry and the authorization of desalmacenaje of the Ministry.

Article 9. Labeled

All the dangerous products will have to be manipulated in packages with their respective labels in Spanish language, adhered or printed in their package, or attached stationery store, according to the indications established in annexed 4 and 5.

Article 10. Certificates of registry and sale in the country

The Ministry will emit title deeds and sale in the country, to all physical or legal person who manipulates dangerous products, when the product is registered before the Ministry.

Article 11. Prohibitions

1) one prohibits the commercialization, transference or donation of those dangerous products that have been concerned by a national industry without to have made the corresponding registry according to article 5, interjection 1 or 2, according to corresponds.

2) prohibe the participation in activities that imply contact with dangerous products a:

a) Minors of 18 years, without the due permission of the competent being.

b) nonapt People to make activities of handling of this type of products.

c) pregnant Women or in period of lactancia, when one settles down in the label that the product is dangerous for its health or the one of the boy.

Article 12. Dispositions end

a) The Ministry will have faculties to exempt to the registrante of the presentation of the technical information that this available one in its bases of data.

b) For the case of precursors and essential chemistries, in addition to the stipulated thing in this regulation will govern the norm specifies effective in this matter

Article 13. Derogatoria

Deróguense the decrees executive numbers 26805-S of the 11 of March of 1998 and 24867 of 31 of January of 1996 and all those decrees and norms that are against to him.

Article 14. Use

It prevails to start off from its publication.

Annexed 1.

GUIDE FOR THE DANGEROUS PRODUCT CLASSIFICATION

The present guide, reunites in a single document, obtained criteria classification of the "Code of Federal regulations 40", of the United States of America and the "Relative Recommendations Transport of Dangerous Merchandise of the UN" For the reference to the laboratory methods, and in case of doubt differences of criterion as far as the classification of a dangerous product, she will resort to anyone of original documents available in the Direction of Registries and Controls of Ministry d Health.

CLASS 1

Explosives

They are included in this class: explosive substances in itself the explosive objects, and the substances and objects that make p to produce a casualty effect or pyrotechnics. explosive is any substance or article, (or it mixes substances) including any device, that of spontaneous way, by chemical reaction, can give off gases to a temperature, a pressure and a speed such, that it causes damages in the environs. And definition they enter the substances pyrotechnicses (luminous, gaseous or smoke-producing those that produce thermal effects, sonorous, or combination of such effects, as a result of nondetonating exothermic chemical reactions), although do not give off gases.

1.1 Substances and articles that present/display a risk of explosion of totality of the mass. It is understood by explosion of all the mass, that practically extends of instantaneous way to virtually the totality of the mass.

1.2 Substances and articles that present/display a projection risk but not a risk of explosion in all the mass.

1.3 Substances and explosives that present/display a fire risk and risk of which small effects of rarefaction wave of projection or both effects take place, but not an explosion risk all the mass.

1.4 Substances or articles that present/display a risk of explosion under fattened case of inflammation or of. effects are limited the package to a large extent, and normally remote fragments of appreciable size do not project. The outer fires will have to almost cause the practically instantaneous explosion of the totality of the mass.

1.5 Comprende the substances that present/display an explosion risk all the mass, but which they are so insensible, that the probability happens an initiation or detonation is very low.

1.6 extremely insensible detonating article Consiste with that has escasísima fattened probability of accidental or propagation.

CLASS 2

Gases

DEFINITIONS

1)Se understands by gas all substance that:

a) To 50 2.96 ºtengan a steam pressure superior to 300 kPa (atm), or that

b) Is totally gaseous to 20ºC, to a pressure of 101, 3 kPa, (1 atm)

2) compressed Gas: any gas (except for which they go in dissolution that, packaged to pressure for the handling, and 20ºC, is completely gaseous.

3)Gas liquefied: the one that packaged for handling, and 20 ºC, partially liquid.

4)Gas liquefied cooled: the one that packaged for the handling, partially liquid because of its low temperature.

5)Gas in dissolution: gas tablet that, packaged for the handling is dissolved in a dissolvent.

2.1.- Inflammable Gases: Any material that are gas to 20 (68 ºF) or less and 101.3 kPa (1 atm) of pressure or any material that has a 20 boiling point of º¢(68 ºF) or less to 101.3 kPa and that:

(1) It is inflammable when a mixture with air to 13% or in volume is had less, or

(2) Tiene a rank of inflammability with the air of at least 12% without concerning the inferior limit.

2.2 compressed, noninflammable and nontoxic Gases: Gases that are transported to an absolute pressure of 280kPa (2.8 atm) or greater, to a temperature of 20°¢(68°F), and that

(1) They are suffocating, it is to say are gases that normally dilute or replace present oxygen in the atmosphere.

(2) They are supporters of combustion, that is to say, they are gases that can cause the combustion of another material with greater intensity than the air or to contribute to this combustion, in general because they provide oxygen, or that,

(3) they cannot be included in any other division.

2.3.- toxic Gases by inhalation: A material that are gas to 20ºC(68ºF) or less and 101.3 kPa (14.7psi, 1 atm) or that has a boiling point of 20ºC(68ºF) or less to 101.3 kPa (14.7psi, 1 atm) and that:

(1)Se knows that he is toxic or corrosive for the humans who would put in danger the health during their handling.

(they 2)En absence of data adapted on human toxicity, assumes that he is toxic for the humans since in laboratory tests with animals a value for 5000 is had CL50 nongreater to ml/ml3

Notes:

The gases that respond to these criteria in regard to their corrosivity, have to classify themselves like toxics, with secondary risk of corrosivity.

For gases or mixtures of gases that present/display irrigations related to more than a division, the superiority order is the following one:

It prevails 2.3, soon 2.1 and finally 2.2.

CLASS 3

Liquids inflammable or combustible

INFLAMMABLE LIQUIDOS:

liquid that has a nongreater flash point of 60,5ºC(141ºF) or any material in liquid phase with a flash point equal or greater to 37,8ºC(100ºF), than intentionally is warmed up and it is tried to transport or it is transported in or on its flash point.

LIQUIDOS FUELS:

Any liquid that has a flash point on 60,5ºC(141ºF) and below 93ºC(200ºF).

CLASS 4

Solids

4.1. Solid inflammable: They can be substances with some of the following characteristics:

They are explosive substances (group 1), that stop to suppress the explosive properties, are dampened with sufficient water, alcohol, plastificante or any other inhibitor of the explosive property.

Those materials that are thermally unstable and that can still experience a strongly exothermic decomposition without the participation of oxygen (air).

The easily combustible solids like:

i) Those that can cause a fire by friction.

ii) Those that show a burned reason of greater 2.2 mm (0.087 plg) per second.

¡¡¡to less)Cualquier metal dust that can be inflamed and mainly reacts the length of a sample in 10 minutes or.

4.2.- Solid of spontaneous combustion: They can be substances of anyone of the following classes:

Pirofórico solid, is a material that, still in small amounts and without a source of external pilot-flame ignition, can become inflamed in cinco(5) minutes after making contact with enemy with the air.

Material car-calentable, is the material that, when being in contact with the enemy with the air and without provision of energy, experiences a car heating. A material of this type that presents/displays a spontaneous ignition or if the temperature of the sample exceeds 200ºC(392ºF) during the period of test of 24 hours.

4.3.- Solid dangerous to the contact with the water: A material that, when making contact with enemy with the water, is taken to be spontaneously inflammable or to produce inflammable or toxic gases.

CLASS 5

Oxidants or organic supporters of combustion and peroxides

5.1.- Oxidating or supporters of combustion: A material that can, generally, by means of the production of I oxygenate to cause or to increase the combustion of other materials. These substances can be contained in an object.

5.2. Peroxide organic: Any organic compound that contains I oxygenate (o) with the bivalent structure - O-O- and that can be considered as a derivative of peroxide of I hydrogenate, when one or but atoms of I hydrogenate have been replaced by organic radicals. Lost the organic ones are thermally unstable substances that can undergo a autoacelerada exothermic decomposition. In addition, they can have one or several of the following properties:

i) To be susceptible of an explosive decomposition;

ii) Arder quickly;

iii) To be sensible to the shocks or the friction;

iv) Reaccionar dangerously when making contact with enemy with other substances;

v) at sight Causar damages.

CLASS 6

Substances toxic and infectious substances

6.1.- toxic Substances or poisons: Material that is not a gas, that is known that he is so toxic for the humans, that can put in danger its health to the handled being. Also, those, that not having data adapted as far as its toxicity in humans:

(1) one assumes that he is toxic for humans because it falls in anyone of the following categories when tests are made to him in the animal laboratory (whenever it is possible, must be used test data in animals, reported in chemical Literature):

Oral toxicity. material with a DL50 for nongreater acute oral toxicity of 500 mg/kg or a solid with a DL50 for 200 nongreater acute oral toxicity of mg/kg.

Skin toxicity. A material with a DL50 for nongreater acute skin toxicity of 1000 mg/kg.

Toxicity by inhalation. Dust or fog with a CL50 for acute toxicity by 10 nongreater inhalation of mg/L; or

(2) a material with a steam concentration saturated in air to 20ºC(68ºF) of more of fifth of the CL50 for acute toxicity by steam inhalation and with a CL50 for acute toxicity by nongreater 5000 steam inhalation of mL/ml3; or

(3) an irritating material, that as causes great irritation, in spaces specially confined.

(4) a material of which scientific studies are had that indicate a carcinogen, teratogénico or mutagénico suspicion of to be in humans or animals.

6.2.- infectious Substances: They are subject to this classification, solely the substances that have been proven that causes disease in the human being or the animal or that propagates a disease when exhibition to them exists.

The categories or materials that compose Division 6.2 are defined as it follows:

(1) infectious Substance: alive microorganism or its toxins (including the bacteria, virus, ricketsias, parasites and fungi) that they cause or they can cause to diseases in humans or

animals and any agent whom it causes or it can cause to severe incapacity or a fatal disease. The terms infectious substance and etiológico agent are synonymous.

(2) Specimen of diagnosis: any material human or animal including, (but not limited a), you excrete, corporal secretions, blood or its components, skin and its fluids with diagnosis intentions.

3) regulated medical Waste: waste or reusable material, that is not a culture or stock of an infectious substance, that contains an infectious substance and is generated in:

the diagnosis, treatment and immunization of humans or animals;

the investigation concerning the diagnosis, treatment and immunization of humans or animals;

the production or test of biological products.

(4) Other dangerous biological products: any other product not including in groups 1, 2 and 3, that can produce damage to the people or animals, or the atmosphere, except those of therapeutic, nourishing use or of farming use exclusively.

CLASS 7

Substances radioactive

They are not included in the decree, its registry must be transacted in the Direction of Protection of the Human Atmosphere (lonizantes Substances)

CLASS 8

Corrosive

Liquid or solid that causes total destruction of the thickness of any alive weave in the place of the contact during a period of specific time. Also, those that if an escape takes

place, can cause damages of consideration to other merchandise or to transport means, or even destroy them, and can also cause other risks.

CLASS 9

Misceláneos

The substances of this group, are those, whose characteristics do not agree with those of some of the previous ones, but which they present/display a manipulated risk to the being. It is included here:

Materials that have some anesthetic property, injurious another similar that could cause to some extreme annoyance or incomodidad to the man or some damage in the atmosphere or to the animals.

Annexed 2.

Note: to see table in page 4 of Alcance No. 74 to the Newspaper No. 194 of 6 of October of 1999.

Annexed 3.

Minimum information that it must contain the LEAF OF SECURITY - MSDS

The following one is the Leaf of Seguridad (MSDS) that has the format adopted by International Standarization Organization (ISO). It is not necessary that the leaf that appears, follows the same format, but that contains the information that is asked for like minim in each section.

In the case of concerned dangerous products whose Leaf of Security is in a language different from the Spanish, the Form of Annexed N° 3 of this Decree, signed by the technical person in charge in Costa Rica is due to present/display and the Leaf of Security who provides to the manufacturer or distributor of the product, is original that brought the

product or the photocopy of the Leaf of Security that low of Internet of some of Bases de Datos of the manufacturing houses or of other recognized organizations.

(Thus reformed by executive decree 30718)

For each one of the sections of the document the indicated parameters are due to include at least. (*)

For products of national manufacture, the used method is due to indicate to determine each parameter.

SECTION 1

Identification of the product and information of the manufacturer

Commercial name of the product (it marks) Identification of the manufacturer.

Name of the manufacturer

Direction of the manufacturer

Telephone numbers and fax

Telephones of emergencies provided by the manufacturer.

SECTION II

Composition and information on the dangerous ingredients

A listing of the components of the product (even though they are declared like intellectual property), that is classified like dangerous, or that produces sinergismo (according to the criteria of classification of the UN, in the "Recommendations Relative to the Transport of Dangerous Merchandise" and the criteria of the OSHA.) and their concentration expressed as percentage (m/m or m/v or v/v) according to is the case. If the concentration for some component is defined as a rank, the difference between the greater and smaller value of the same one, cannot be superior to 20.

Each dangerous component and that produces sinergismo identified with its common or generic name and number of CAS (N' of registry in the Chemical Abstracts Service).

SECTION III

Identification of the irrigations and effects by exhibition

In this section, to provide information with the potential effects in the human health and the symptoms caused by the exhibition to the product.

Effects of the exhibition by:

Inhalation

Ingestion

Contact with the eyes

Contact with the skin

Information existing it stops:

Carcinogenicidad

Mutagenicidad

Teratogenicidad

Neurotoxicidad

Reproductive system

White Organos

Other effects

SECTION IV

First aid

It details the instructions to follow in case that the accidental exhibition requires of immediate treatment. It must include the measures to follow in case of:

Ocular contact

Skin contact

Inhalation Ingestion

Information for the doctor

Antidote recommended (if it applies)

Information for the fire

SECTION V

Measures against the fire

In this section it is provided with a basic guide in case of fire, in addition, describe other useful properties to avoid it and to fight it, including the appropriate extinguishing agent.

For those combustible or inflammable or explosive materials or that can increase the proportions of a fire:

- spontaneous combustion or Flash point
- Limits of inflammability (if it exists)
- Agente(s) extinguishing
- personal Protective equipment to fight the fire
- Products dangerous by combustion

SECTION I SAW

Measures in case of spill or flight

The actions are described to take to diminish the adverse effects in case of spill or flight of material.

- Procedures for attention of spills
- Procedures for attention of flights

SECTION VII

Manipulation and storage

It gives to information of practices adapted for the safe handling and storage.

Temperature and conditions of storage

Suitable form to handle the containers

Commentaries generals when he applies, like the effects of the exhibition to the light of the sun, the flame, humid atmospheres, etc.

SECTION VIII

Controls to the exhibition and personal protective equipment

It provides information with practices and protective equipment, equipment to diminish the exhibition of the worker.

Conditions of ventilation

Respiratory protective equipment

Ocular protective equipment

Skin protective equipment

When they exist, the following command signalses to the exhibition will be included determined by the OSHA or the AGCIH of the U.S.A.:

TLV (Threshold Limit Value) or value limit threshold.

PEL (Permissible Exposure Limit), equivalent to TWA (Time Weiglited Average). The concentration of the polluting agent, to which it can be exposed a worker 8 hours daily, 5 days to the week, without undergoing adverse effects.

STEL (Short Term Exposure Limit). The concentration, that cannot be exceeded at any moment during the work day, and that allows to the worker a exhibition him without adverse effects by 15 min., as long as some anomaly does not notice before.

SECTION IX

Physical and chemical properties

It provides additional information that it can be of aid in the characterization of the material and the design of good practices of work.

Scent and appearance

Specific gravity

Solubility in water and other dissolvents

Boiling point or fusion (according to it is the case and when it applies)

pH.

SECTION X

Stability and reactivity

It describes the conditions that must be avoided and the mutual incompatibility with other materials that can cause a reaction that changes the own stability of the material.

Stability

Mutual incompatibility

Risks of curing

Dangerous products of decomposition

SECTION XI

Information on toxicología

In case that it exists:

Lethal dose oral average in rats or another animal of laboratory

(DL50)

Lethal dose average by inhalation (HL50)

Chronic dose average (CL50)

SECTION XII

Information on the effects on the ecology

In case of existing it includes information on the effects that the material can have in plants or animals or the surroundings to that it has been destined.

SECTION XIII

Considerations on the final disposition of the product

It provides useful information to determine the appropriate measures of disposition.

Procedures for disposition of wastes.

SECTION XIV

Information on the transport

It provides the basic information for the transport within the frame with the classification of dangerous merchandise of the UN.

SECTION XV

Information regulatory (optional)

Additional information in the regulations is included that affect the product. (as these regulations depend on the country, it is only useful when the regulations agree)

Examples: precursors, asbestoses, exhausting of the ozone layer, carcinogen, etc.

SECTION XVI

Another information (optional)

It is used to provide any additional information, for example dates of elaboration and revision of the MSDS, classification NFPA or VMMIS, etc.

Note: to see table in reach 74 Newspaper 194 of 6 of October of 1999

(*) Abbreviations ND (nonavailable or not determined) and NA (it does not apply) in those cases in that will be accepted the information absence is comprobable.

Annexed 4.

Requirements of labeled for products danger

Products for commercialization

- ñ ÿ ¿0 0 @ s @ ó m ä ñ ÿ ¿- commercial and common Name of the product

- Record number of the MINSALUD.

- Name of the manufacturer for products of national manufacture and name of the importer, for concerned products

- Listing of the dangerous ingredients by common name (equal to as it were declared in the Leaf of security)

- Content or net weight in the packing or packages expressed in the international system of weights and measures

- Use to that the product goes destined.

- Warnings and precautions for the use, relative to the danger of the product for humans and the medio.ambiente.

- the specific warnings for the labeled one according to the nature of the product Must be gotten up, as it is the case of products inhalants, asbestoses, etc.

- Symptoms of poisoning.

- First aid and procedures to follow in case of ingestion, inhalation or by skin or ocular contact.

- Antídoto(s) and indications for the medical treatment (if it applies).

- With emphasized letter the phrase In case of poisoning takes to the patient to the doctor and contributes to this label "(telephones of emergencies: National center of Poisonings Firemen Emergencies: 911

- Simbología according to the classification of danger of the Organization of United Nations or the European Union (Annexed S). The simbología must present/display the colors and respective indications. NOTE: The products that or have form in their package or label of origin leave from the asked for information single mind will have to enclose the faltante information.

Raw materials of internal use

- commercial and common Name of the product

- Listing of the dangerous ingredients by common name.

- Warnings and precautions for the use, relative to the danger of the product for humans and the medio.ambiente.

- Symptoms of poisoning.

- First aid and procedures to follow in case of ingestion, inhalation or by, skin or ocular contact.

- Antídoto(s) and indications for the medical treatment (if it applies).

- Simbología accepted internationally that indicates danger (the UN, European Union, NFPA), they can be in black and white.

- the specific warnings for the labeled one according to the nature of the product Must be gotten up, as it is the case of products inhalants, asbestoses, etc.

NOTE: The products that or have form in their package or label of origin leave from the information only asked for will have to enclose the faltante information.

NOTE: to see table of Dangerous Product Classification according to Norm the International of the UN in pagina 7 of Alcance No. 74 of the Newspaper No. 194 Annexed 5.

Note: To see Picture of "product Classification according to the norm of the Nations United in page 7 of Alcance No. 74 of the Newspaper No. 194 of 6 of October of 1999.

Dice in the Presidency of the Republic -. San jOse, to the ten days of the month of nine and ninety September thousands nine hundred.

MIGUEL ANGEL RODRIGUEZ ECHEVERRIA.- the Minister of Health, Dr. Brown Rogelio Evans.- 1 time.- (Or C. NO. 21020).- C-128500-(61281).

Appendix L: National Waste Strategy

Estrategia Nacional para el Manejo Integrado y Sostenible de desechos de Artefactos Eléctricos y Electrónicos.

I.- Introducción.

Esta estrategia se elabora en el marco del proyecto "Diseño de una Estrategia Sostenible para la Minimización y Manejo de los Desechos de Componentes Electrónicos en Costa Rica y Holanda, Aprovechando las Experiencias Novedosas de Empresas Holandesas". Financiado por el Convenio Bilateral para el Desarrollo Sostenible Costa Rica Holanda.

- Esta estrategia es el resultado de cuatro acciones:
- Un Diagnóstico de la Situación del Manejo Integrado y Sostenible de los Desecho de Componentes Electrónicos en Costa Rica.
- Una Evaluación del Sistema de Manejo de Residuos Eléctricos y Electrónicos de los Países Bajos.
- Una pasantía en Holanda para conocer la experiencia holandesa en el tema. En esta pasantía participaron la Cámara de Industrias de Costa Rica, el Instituto Tecnológico de Costa Rica, ACEPESA, VICAL/empresa recicladora de vidrio, el Ministerio de Ambiente y Energía, el Ministerio de Salud, el Ministerio de Ciencia y Tecnología y la American Chamber of Commerce (representada por la empresa Lanier). Además, con financiamiento propio, participó la representante en Costa Rica de la empresa holandesa AVR.
- Un proceso de discusión y análisis realizado por el Comité Nacional (integrado por las instituciones que participaron en la pasantía, además de INTEL, Componentes el Orbe y SAUTER/INFOMAX) y consultas a grupos de empresarios y empresarias dedicados a la gestión de desechos y talleres de reparación de equipo electrónico.

Paralelamente, en Holanda se elaboró una propuesta para el fortalecimiento del sistema actual.

Esta estrategia se divide en cuatro componente: legal, técnico/opertivo, institucional y sociocultural.

El componente legal se fundamenta en la legislación actual, procurando incorporar los desechos electrónicos en el "Decreto Ejecutivo para la Creación de un Sistema para el Manejo de Residuos Especiales, Mediante el Uso de Instrumentos Económicos". Este decreto está elaborado originalmente para 5 materiales; no obstante, existe voluntad política por parte del Ministerio del Ambiente, para incorporar los desechos electrónicos.

Para que este decreto se cumpla, será necesario instalar un sistema técnico/operativo que recolecte, transporte y dé tratamiento a los equipos desechados. Para ello, se requerirá mejorar los mecanismos actuales de acopio y transporte de materiales reciclábles, preparar a las empresas recicladoras nacionales para procesar los materiales con factibilidad local y buscar las mejores alternativas de mercado nacional e internacional para estos productos y materiales. Con respecto al reuso, será necesario desarrollar sistemas de información y comercialización que permita a los talleres de

reparación disponer oportunamente de los repuestos usados. También se requerirá de al menos una planta de desensamblaje que realice el preproceso de separación de componentes y materiales reciclables de acuerdo a los requerimientos del mercado.
A nivel Institucional, será necesario que el Ministerio de Ambiente y Energía y el Ministerio de Salud incorporen en sus procesos internos mecanismos e instrumentos que les permitan monitorear y actualizar esta estrategia y supervisar adecuadamente el cumplimiento del decreto y otras disposiciones legales que se consideren necesarias.

Para el financiamiento y administración del sistema técnico operativo, será necesario que las empresas importadoras, distribuidoras y productoras de este tipo de equipos se organicen y constituyan una Unidad Ejecutora para el sistema.

En el ámbito sociocultural, será necesario promover acciones de información, sensibilización y educación a los y las usuarias para un manejo responsable de estos desechos.

II.- Visión

Para el 2014, Costa Rica estará procesando al menos el 60% de los desechos de los artefactos eléctricos y electrónicos que ingresan al país, mediante un sistema integrado y sostenible de gestión de estos desechos.

III.- Objetivos estratégicos

Fortalecer el segmento empresarial dedicado a la gestión de desechos de artefactos eléctricos y electrónicos y el que atiende la reparación y reuso de estos artefactos.

Promover y fortalecer la organización de las empresas dedicadas a la importación, producción y distribución de artefactos y componentes eléctricos y electrónicos, para que estén en capacidad de organizar y garantizar el óptimo funcionamiento del sistema de gestión integrada y sostenible de los desechos de artefactos eléctricos y electrónicos; de acuerdo a las disposiciones legales establecidas por el gobierno central.

Impulsar la formulación y aprobación de un marco legal que regule el manejo ambiental de los desechos de artefactos eléctricos y electrónicos.

Promover la información, sensibilización y educación de la ciudadanía, para un manejo responsable de los desechos de artefactos eléctricos y electrónicos.

IV.- Principios

Esta estrategia se rige por los principios del desarrollo sostenible e incorpora cuatro principios adicionales del manejo de los desechos:

La responsabilidad extendida del productor y el consumidor, según este principio “los distintos actores, a través de la cadena del producto, comparten la responsabilidad por el impacto ambiental en su ciclo de vida, esto incluye el impacto inherente en la selección de materiales para los productos, el impacto en sí en los procesos de manufactura, y el impacto por el uso y disposición de los productos”. (CNP+L, 2003)

El que contamina paga, dicho principio se basa en la noción de que los agentes no tienen suficientes incentivos para disminuir la producción (de ahí la descarga de desechos) al nivel deseado por la sociedad. Es decir, que el que contamina paga una multa económica por mayores niveles de contaminación y paga una multa menor o recibe una recompensa financiera por niveles inferiores de contaminación. El objetivo que se persigue con este principio es de incorporar al mínimo costo social, los gastos de la protección ambiental.

Principio precautorio, otro principio que se puede incorporar es el "precautorio" para garantizar que el agente generador de contaminación responda por el control en todo el ciclo de vida del producto. Este principio se basa en la aversión al riesgo, concluyendo que la resolución para los problemas requiere un programa agresivo para disminuir significativa y efectivamente los daños al ambiente. El principio sostiene que la autoridad puede ejercer una acción preventiva cuando hay razones para creer que las sustancias, los desechos o la energía introducida en el ambiente pueden ser nocivas para la salud o para el ambiente.

El principio de menor costo de disposición, el cual define una orientación dada en el Convenio de Basilea para que las soluciones que se adopten con relación a los residuos minimicen los riesgos y costos de traslado o desplazamiento, logrando que en lo posible los desechos se traten o depositen en los lugares más próximos a sus centros de origen; o el principio de reducción en la fuente, el cual sostiene la conveniencia de evitar la generación de desechos mediante el uso de tecnologías adecuadas, tratamiento o minimización en su lugar de origen (Lobo, 2003).

V.- Papeles y Responsabilidades Generales

El Gobierno Central, con la rectoría del Ministerio de Ambiente y Energía, dicta las disposiciones legales que regulan el manejo ambiental de los desechos de artefactos eléctricos y electrónicos, supervisa su cumplimiento y otorga los incentivos y sanciones según corresponda. Coordina y en la medida de las posibilidades ejecuta las acciones de información, educación y sensibilización de la ciudadanía.

Para cumplir esta labor, el MINAE cuenta con el apoyo del Ministerio de Salud, para la supervisión del cumplimiento de las disposiciones, el otorgamiento de sanciones e incentivos; así como en las acciones de información, educación y sensibilización de la ciudadanía.

Empresas importadoras, distribuidoras y productoras de componentes y artefactos eléctricos y electrónicos, diseñan y administran el sistema de gestión integrada y sostenible de desechos de artefactos electrónicos, a través de la Unidad Ejecutora, creada y financiada con una tasa aplicada a los equipos y cuyo monto depende de los requerimientos de la sostenibilidad financiera del sistema.

Unidad Ejecutora, administra eficientemente el sistema y cumple con las metas establecidas por las disposiciones legales.

Empresas privadas y públicas de recolección, transporte, acopio, desensamblaje y reciclaje de desechos, incorporan, mediante las técnicas adecuadas, la gestión de los desechos eléctricos y electrónicos en sus procesos de trabajo.
Empresas de reparación de equipos eléctricos y electrónicos, mediante la reparación de los equipos y el reuso adecuado de los componentes, alargan su vida útil y disminuyen la generación de desechos.

Ministerio de Ciencia y Tecnología, colegios técnicos e Instituto Nacional de Aprendizaje, incorporan en la formación técnica de los y las estudiantes de ocupaciones relacionadas, los principios y objetivos de esta estrategia.

Consumidores y consumidoras (incluyendo empresas e instituciones y consumidores y consumidoras individuales), pagan por el tratamiento de su equipo desechado, entregan el equipo en los lugares indicado por la Unidad Ejecutora y mantienen una vigilancia ciudadana sobre el funcionamiento del sistema.

ONGs especializadas y gremios empresariales; contribuyen a:
Fortalecer el segmento empresarial dedicado a la gestión de desechos de artefactos eléctricos y electrónicos y el que atiende la reparación y reuso de estos artefactos.
Fortalecer la organización de las empresas dedicadas a la importación, producción y distribución de artefactos y componentes eléctricos y electrónicos, para que estén en capacidad de organizar y garantizar el óptimo funcionamiento del sistema de gestión integrada y sostenible de los desechos de artefactos eléctricos y electrónicos; de acuerdo a las disposiciones legales establecidas por el gobierno central.
Promover y, en la medida de sus posibilidades, ejecutan acciones de información, educación y sensibilización de la ciudadanía sobre el manejo responsable de los desechos de artefactos eléctricos y electrónicos.

Centros educativos y organizaciones de la sociedad civil en general, promueven y, en la medida de sus posibilidades, ejecutan acciones de información, educación y sensibilización de la ciudadanía sobre el manejo responsable de los desechos de artefactos eléctricos y electrónicos.

Universidades y centros de investigación, desarrollar nuevas tecnologías para el tratamiento ambiental de los desechos eléctricos y electrónicos.

Municipalidades, incorporan en los sistemas de gestión de desechos, los procesos de trabajo adecuados para la recuperación de estos desechos, en coordinación con la Unidad Ejecutora.

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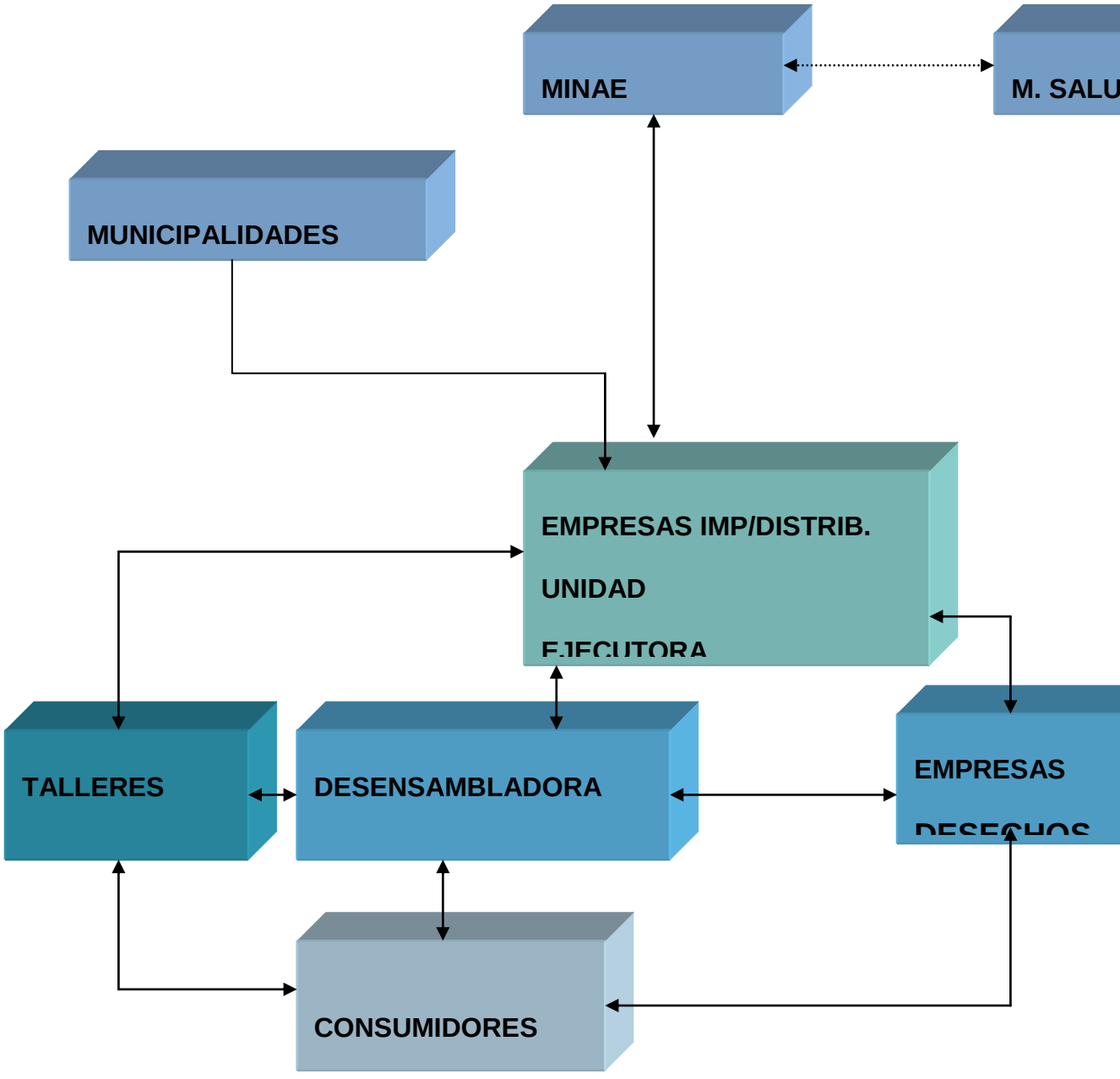
IQP/MQP SCANNING PROJECT

ESTRUCTURA DE RELACIONES ENTRE LOS ACTORES DE LA ESTRATEGIA



VI.- Alcances de la Estrategia

La Estrategia para el manejo de los desechos de artefactos eléctricos y electrónicos es de carácter nacional y comprende un periodo de 10 años.

Se iniciará con el manejo de la línea gris (computadoras, accesorios de impresión, fotocopiadoras, escáner, cámaras digitales y telecomunicaciones), incorporándose las líneas blanca (refrigeradoras, lavadoras, congeladores, cocinas, secadoras) y marrón (equipos de sonido, radios, vídeo- grabadoras, vídeo digital), una vez que el sistema de manejo de los desechos de la línea gris esté funcionando.

VII.- Instrumentos de la estrategia.

Proyecto "Decreto Ejecutivo para la Creación de un Sistema para el Manejo de Residuos Especiales, mediante el Uso de Instrumentos Económicos". (MINAE) El componente legal se fundamenta en la legislación actual, procurando incorporar los desechos electrónicos en el "Decreto Ejecutivo para la Creación de un Sistema para el Manejo de Residuos Especiales, mediante el Uso de Instrumentos Económicos". Como dijimos antes, este decreto está diseñado originalmente para 5 materiales; no obstante, existe voluntad política por parte del Ministerio del Ambiente, para incorporar los desechos electrónicos.

De esta forma, se establecerán cuotas de recuperación para el tratamiento de desechos de equipo electrónico que los productores, importadores y distribuidores deberán cumplir. Para ello tendrán que organizarse y definir los mecanismos de recuperación y pago del sistema. Será responsabilidad del Ministerio del Ambiente, supervisar el cumplimiento de la cuota establecida.

Creación de la Unidad Ejecutora. Esta es una figura privada, creada a partir del decreto, que articula a los importadores, distribuidores y productores de artefactos y componentes eléctricos y electrónicos. Su función principal es coordinar y monitorear el funcionamiento del sistema, fijar los montos a pagar por el costo del tratamiento de los equipos, administrar los fondos, acreditar los puntos de acopio y transporte, controlar el proceso de desensamblaje, asegurar el cumplimiento de las metas establecidas por el gobierno central, reportar a las partes interesadas.

Dependiendo de la figura legal que se decida, la Unidad Ejecutora estaría regida por el código de comercio, ley de asociaciones o la ley de cooperativas. Debe operar con criterio de sostenibilidad. Los fondos podrían ser generados por un sobreprecio a los equipos, tarifas, donaciones, transacciones u otros[1].

Las empresas no asociadas a la Unidad Ejecutora, tendrán la responsabilidad directa por el cumplimiento de las metas ambientales y la legislación vigente en materia de sus desechos electrónicos.

Sistemas de cobro de los servicios de tratamiento: Para la sostenibilidad del sistema, se ha identificado tres alternativas de pago:

[1] En este momento se está realizando un estudio de prefactibilidad para definir las condiciones de viabilidad técnica y financiera para esta Unidad.

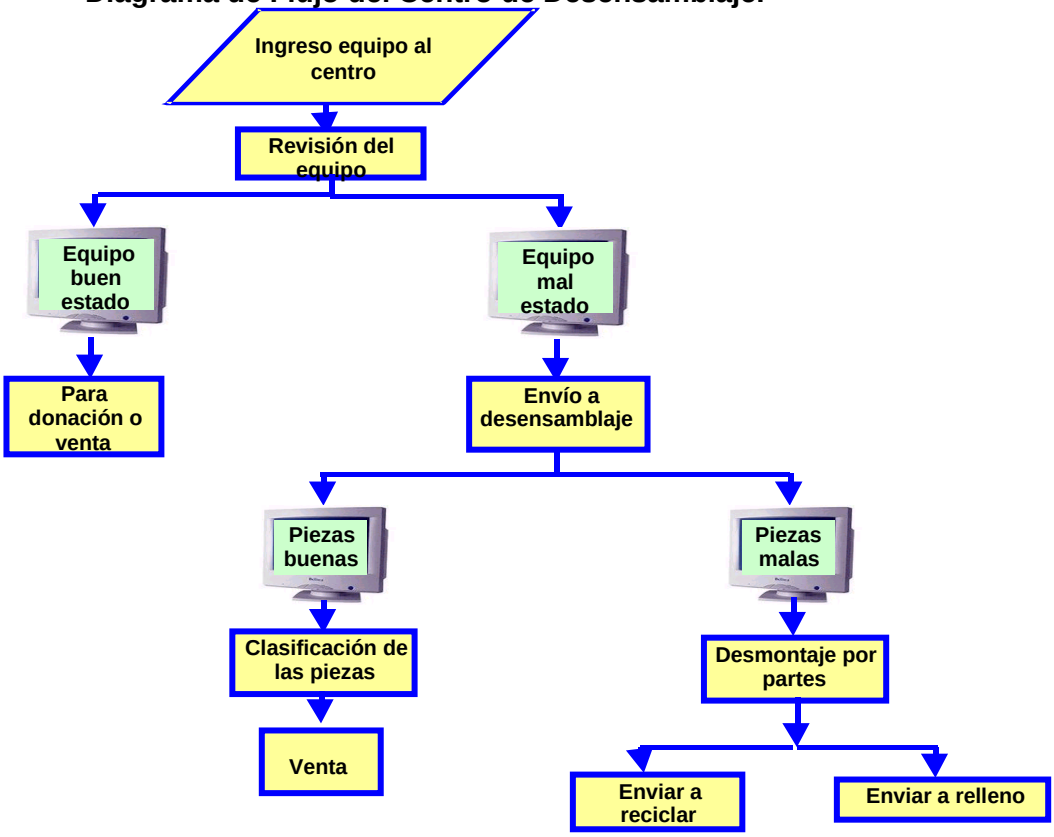
- Opción 1: El/la usuario/a paga al momento de entregar el equipo desechado para su tratamiento.
- Opción 2: El/la usuario/a paga al momento de comprar un nuevo equipo.
- Opción 3: Una combinación de ambas. Los desechos históricos pagan al entregarse el desecho y los equipos que se adquieran cuando el sistema esté funcionando, pagan el costo de tratamiento del desecho al adquirirse.

Tanto las opciones, como los mecanismos que se requieran para recoger estos recursos serán definidos por la Unidad Ejecutora.

Creación de Centro de Pre-proceso o Desensamblaje: Una característica del proceso actual de manejo de los equipos electrónicos es la tendencia a la reparación y actualización del equipo para alargar su vida útil. De igual manera, existe una infraestructura básica para el reciclaje de algunos materiales presentes en los desechos ordinarios. Con el fin de fortalecer estas tendencias se plantea la creación de un centro de pre-proceso o desensamblaje de los desechos de artefactos electrónicos, que permita:

- recuperar los componentes en buen estado para crear un centro de repuestos para la reparación de equipos y,
- recuperar materiales para el reciclaje, algunos de los cuales podrían ser exportados o procesados en el país, si las pruebas técnicas dan resultados positivos. En la medida en que sea factible se tratará de procesar localmente los materiales, con el propósito de que haya un aprovechamiento nacional de estos recursos.

Diagrama de Flujo del Centro de Desensamblaje.



Bolsa de repuestos de equipo electrónico. La divulgación de la información acerca de los repuestos disponibles, una vez recuperados en el centro de desensamblaje, se efectuará mediante la creación de una bolsa de repuestos. Este instrumento será responsabilidad del Centro de Desensamblaje.

Sistema de registro y monitoreo de los equipos electrónicos. La información acerca del ingreso de equipos electrónicos, su registro y el seguimiento de su destino una vez que se convierte en desecho es un instrumento de la Unidad Ejecutora, que le permitirá verificar el cumplimiento de las metas de tratamiento de los desechos generados. El sistema de registro y monitoreo de los equipos electrónicos, garantizará la información que respalde las consideraciones financieras del sistema de manejo de desechos de artefactos eléctricos y electrónicos. Los datos para el sistema serán suministrados a la Unidad Ejecutora por Aduana y los empresarios productores, importadores y distribuidores de equipo eléctrico y electrónico que se encuentren afiliados al sistema

Sistema de monitoreo y supervisión para cumplimiento del Decreto. El seguimiento a la aplicación del Decreto por parte del Ministerio de Ambiente requiere de un sistema de monitoreo y supervisión, que retroalimente el mejoramiento del sistema. Esto requiere del diseño e implementación del sistema, así como el entrenamiento del personal encargado.

Plan de recolección y procesamiento de los desechos eléctricos y electrónicos históricos. Una de las primeras acciones de la estrategia consiste en la recolección, para su procesamiento, de los desechos históricos, proceso que debe ejecutarse mediante un plan que establezca las prioridades, mecanismos y procedimientos, de manera que se pueda atender la oferta de manera escalonada según tipo de usuario y zona geográfica.

Programa de información, sensibilización y educación para el manejo responsable de los desechos eléctricos y electrónicos. Para el manejo responsable de los desechos de los equipos se requiere que cada usuario pague un monto para su tratamiento y entregue los desechos en el sitio indicado. Para cumplir con estas acciones, será necesario crear nuevos hábitos en los y las consumidoras. Es necesario proveerles de la información específica de que hacer con su equipo. También se deben realizar campañas de sensibilización y educación acerca del impacto en la salud y el ambiente de la disposición inadecuada de este tipo de desechos. Esta es un labor permanente en la que participan diferentes actores sociales, tanto gubernamentales como privados.

VIII.- Ciclo de Manejo de los Desechos de Artefactos Eléctricos y Electrónicos

Con la estrategia para el manejo integrado y sostenible de los desechos de artefactos eléctricos y electrónicos, se espera cerrar el ciclo de estos desechos, de la siguiente manera.

Se inicia con la importación y distribución de los equipos hacia los y las consumidores/as locales. En este momento podría aplicarse la opción 1 del sistema de cobro para el tratamiento del desecho, como una modalidad de sobre precio, ya sea de

carácter visible o invisible.[2] En otro nivel se presenta la producción de componentes electrónicos para la exportación.
Cuando los y las consumidores/as tienen equipo en mal estado o está desactualizado, tienen dos opciones: llevarlo a reparar a los talleres o desecharlo.

En caso de que el equipo sea desechado, serían entregados en los centros de acopio acreditados por la Unidad Ejecutora o directamente al Centro de Desensamblaje. Cuando se trate de grandes cantidades de equipo, el centro de acopio o el centro de desensamblaje puede asumir el transporte de los desechos.

Una vez que el centro de acopio a acumulado una cantidad determinada de desechos, lo transportarán al centro de desensamblaje.

Cuando el equipo ingresa al Centro de desensamblaje, será sometido a revisión para determinar si tiene componentes en buen estado. Una vez desensamblado el artefacto, los componentes en buen estado se ingresarán en la bolsa de repuestos para su comercialización en el mercado nacional. Los materiales reciclables serán enviados a las empresas recicladoras locales, en caso de poder procesarse localmente, o serán exportados para su debido tratamiento.

Finalmente, el residuo restante se enviará a un relleno sanitario para una disposición ambientalmente segura.

A partir del sistema de cobro de los servicios de tratamiento establecidos por la Unidad Ejecutora, se deben generar recursos suficientes para financiar, los programas de información a consumidores, los costos de los centros de acopio, el transporte de estos desechos, el proceso de desensamblaje y el funcionamiento de la misma Unidad.

[2] Otra opción posible para el cobro por tratamiento sería la aplicación de un impuesto al ingresar al país los equipos. En el caso de equipos históricos se propone que se cobre por el tratamiento en el momento de recibirlo en el centro de acopio o a través de ventanillas externas, se pague directamente a la Unidad Ejecutora.

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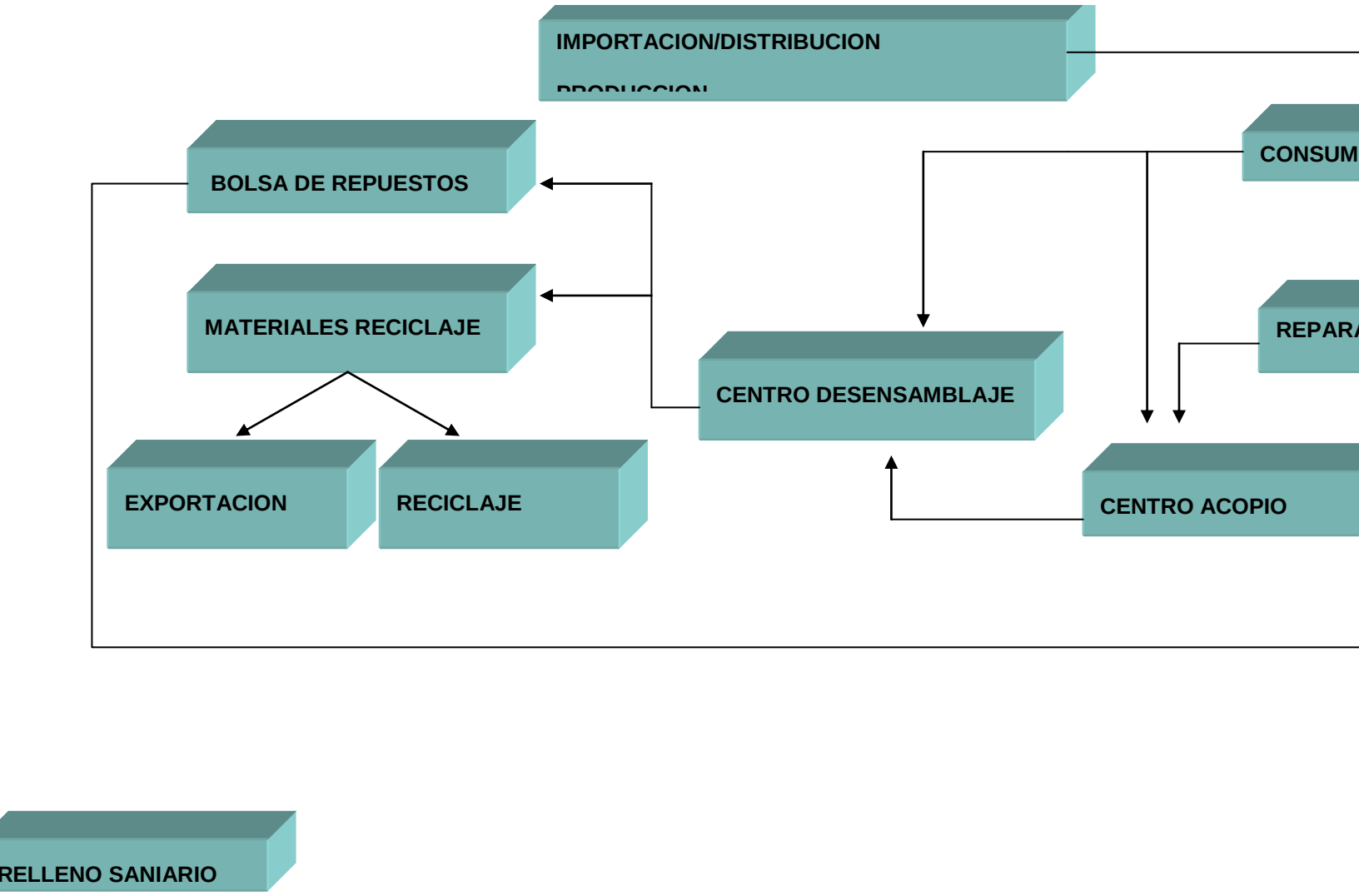
in original submission

IQP/MQP SCANNING PROJECT

Diagrama del Ciclo de Manejo de los Desechos de Artefactos Eléctricos y Electrónicos



Appendix M: Anna Ortiz, Tratamientos Tecnológicos

Recommended Contacts
Walter Zavala of the Ministry of Environment 233-4533 ext 165
Arturo Navarro of the Ministry of Health 255-3711
Victoria Rudin of Acepesa 280-6327

Works Discussed

TT Background Info
- Waste management company and environmental consultant
- Work for Dutch company AVR
- Clean up, pack, and ship toxic materials

Legislation
- Working to set up a decree on e-waste disposal
- Working with Acepesa ONG, International Technologicos, MINAE, Ministry of Science and Technology, Chamber of Commerce, Ministry of Health, and the private sector
- Not many private projects, because beginning of legislature
- CONSUPEL national convention for toxic substance consulting, environmental management, environmental impact studies
- Decree will call for an executive unit, to organize different people under the same umbrella to legally take responsibility
- Decree needs to be written before any action can be taking on a recycling program
- Decree makes companies legally responsible

Current Problems
- Too much unknown e-waste and batteries on the streets
- Urban areas ICE can not put hard lines in so cell phones are the popular choice for communication
- No idea on how much e-waste is actually in the country information is too jumbled i.e. the customs example
- Tough to stop smuggling of cell phones into the country ICE invoice system is the most effective way to stopping it
- Have to make a decree with an incentive to hand in old batteries i.e. hand in old phone get paid for a new one
- Cell phones and batteries not considered red waste under Basil decree can be exported to the US other e-waste can not because US is not signed under Basil
- Not enough volume to involve 4 or more companies
- Need to involve least amount of companies possible
- Ultimate goal is to set up pre-treatment in the country
- Can not control what collection people actually do with the waste that is collected
- Need for a value on batteries
- Low volume for an international market standard
- Something not legally binding will die quickly first a boom then it will taper off

- Need a decree because it is more effective than a law but less powerful
- Cell phone life span only 1-2 years
- No way of understanding how many dead cell phone batteries there are in the country
- No producers of cell phones in the country other e-waste has producers i.e. Intel making them responsible for waste

Cell Phone Pro´s

- They are economically viable
- They are easier to raise public awareness with then other e-waste

TT Project

- With a consortium work on the strategy, how do we make people aware, who´s interested, what do we do, the theoretical aspect of the project
- Phase 2: decree, feasibility study, implementing strategy

Question: Why are we lining up the companies?

- We have started from the end instead of the beginning
- We can ask anyone we want they will all show interest but no one is being pressured for action
- Unaware people have no legal right to do anything and probably will not do anything
- Need legal framework first and to raise public awareness or else the volume will not be large enough volume of waste

Need to connect legislature-economic viability-waste management

Appendix N: Education Plan from RBRC

Dear Educator,

Today's life-styles demand increased mobility and the list of new portable electronic products continue to grow. A recent survey indicated that fifty-four percent of consumers say they power their daily lives with four or more cordless products. Products such as cellular and cordless phones, camcorders, laptop computers, cordless power tools, walkie talkies, CD players, remote control toys, PDAs, and digital cameras get their **power from rechargeable batteries**.

The Rechargeable Battery Recycling Corporation (RBRC), a nonprofit organization created in 1994, is dedicated to rechargeable battery recycling in the U.S and Canada. More than 20 million pounds of rechargeable batteries have been successfully diverted from entering our nation's solid waste stream.

As a public service for battery recycling awareness, RBRC presents the ***Charge Up to Recycle!***® Battery Lesson Plan. Recommended for students ages 10 and up, the lesson plan can be implemented in its entirety or as a supplement to science course curriculums. Created by educators associated with Keep Indianapolis Beautiful and rechargeable battery industry experts, the lesson plan has also been endorsed by the National Geographic Society™ for comprehensive coverage of the science and recycling of batteries.

Students will utilize their skills in science, mathematics, history, economics, chemistry and language arts while participating in interactive experiments and activities ,and examining illustrations and graphs. The activities demonstrate how batteries work, explore different types of batteries, explain the need to recycle, and provide helpful battery usage and handling tips.

For additional copies of the RBRC Battery Lesson Plan, visit the RBRC web site at www.rbrc.org for a free download. RBRC welcomes your feedback to better educate our country's youth about the importance, ease and accessibility of rechargeable battery recycling for a cleaner, safer environment. Please contact us at teachingresources@rbrc.com with your questions, comments and feedback.

Thank you for your interest in battery science and rechargeable battery recycling.

If it's rechargeable, it's recyclable!

Ralph A. Millard
Executive Vice President, RBRC

Recommended grade levels

The ***Charge Up to Recycle!***® **Battery Lesson Plan** is suitable for grades 5 and up.

Subjects

The lesson plan, used in its entirety or divided by sections, will utilize the students' skills in Science, Mathematics, History/Social Studies, Economics, Chemistry, Language Arts, and Art.

Objectives

Students will:

1 follow the development of primary and secondary batteries

2 become familiar with the different types of batteries
3 explore the many uses for batteries
4 study the parts of a battery and how one works
5 learn which batteries can be recycled
6 realize the economic and environmental advantages of using rechargeable batteries
7 become familiar with the rechargeable battery recycling program

Materials

Required for activities

- pencils
- ruler
- scissors
- plastic tape
- scale
- aluminum foil
- paper clip
- metal nail
- coin
- rubber band
- wire strippers
- bowl
- paper tube (such as empty toilet paper or paper towel roll)
- two battery-run products (such as flashlights)
- secondary battery charger
- assortment of primary and secondary batteries: Alkaline-Manganese, Carbon-Zinc, Nickel-Cadmium in various sizes of A through D, button cells of Lithium or Silver Zinc, 1.5 V dry cell battery

Vocabulary

alkaline
anode
battery
capacity
cathode
cell
charge
circuit
conductor
current
dry cell
electricity
electrode
electrolyte
electron
insulator
ions
primary cell
rechargeable
sealed cells
secondary cell

separator
terminal
vented cells
volt
wet cell

Getting Charged Up About Batteries

Table of Contents

- glass jar
- water
- electrical (cooper) wire
- small flashlight bulb
- light bulb holder
- plastic spoon
- wooden spoon
- lemons
- paper towels
- Charts A-E (pages 12-16)

- Ask students if they know when batteries were first used.

1 Although the basics of electricity were established in 600 B.C. by the Greek philosopher Thales of Miletus and then refined by scientist William Gilbert of England in 1600, the first battery actually dates back to the 18th century.

2 Nearly 3,000 years ago, Thales and other Greeks discovered that by rubbing amber with goatskin, the amber could attract some objects. This attraction became known as electricity. Then in 1600, Gilbert performed some additional experiments to learn more about electricity. He is thought to have coined the word "electric" which may have come from the Greek word, "elektron," which means amber. The term "electric" was then applied to materials that behaved like amber.

- Let students rub a glass jar and then try to raise the hair on their heads, much as Thales did in 600 B.C. Students will recognize this as "static electricity."

3 The credit for the first battery goes to Count Alessandro Volta, Italian physicist and pioneer in electricity.

- Ask the class if they recognize his name.

The electrical unit called the volt is named in his honor. A volt is the unit for measuring the potential difference between two points in an electrical circuit.

Historical Background

One of Volta's first experiments in 1800 was a battery made from a pile of cardboard disks soaked in acid (possibly sea water) and layered between copper and zinc disks. The experiment resulted in the generation of an electric current that came to be known as the Voltaic cell, the first wet-cell battery.

4 In 1802, Johann Ritter, a German physicist, conducted research on electricity and discovered the possibility of a rechargeable battery. Research continued when in 1859, Raymond Gaston Planté, a French physicist, invented the first practical secondary battery, the lead acid battery. Though of limited use, research continued on the secondary batteries. In 1881, other scientists developed batteries with improved materials and manufacturing processes. In 1899, Swedish scientist, Waldmar Jungner, invented the Nickel-Cadmium storage battery.

5 For the next 50 years, rechargeable battery development was very slow. Then in the 1950s, European scientists developed a new form of Nickel-Cadmium battery that allowed them to seal the cell. However, the first rechargeable batteries were expensive, took up to 24 hours to recharge, and did not hold their charge as long as their carbon-zinc or alkaline disposable counterparts.

The sealed Nickel-Cadmium cell today performs well, is clean, has high energy, and finds a use in electronics. Now, companies such as Panasonic, SAFT America, SANYO Energy, Sony, and Varta Batteries, offer rechargeable batteries which cost less, recharge faster, and hold the charge longer.

Activity #1 - Make a home-made battery based on the Voltaic cell. (page 9)

600 B.C. The Greek philosopher and scientist, Thales of Miletus - one of the Seven Wise Men of Greece - depicted the ability of picking up a sheet of paper or small straw with an

amber rod made of fossilized resin
that had been rubbed with a cloth -
a form of static electricity.
1600 The basics of electricity are
established by English physician and
physicist, William Gilbert, the "Father
of Electricity," and printed in a
thesis entitled De Magnete.
1745 Ewald von Kleist developed
the Leyden Jar.
1746 Pieter van Musschenbroek,
Dutch mathematician and physicist,
perfected the principle of the Leyden
Jar, called the first capacitor, for
the storage of electric charge.
1746 Benjamin Franklin experimented
with the study of electricity,
which led to the development of a
practical condenser or capacitor for
storage of static electricity.
1752 Franklin used the kite experiment
to identify lightening as electricity
after having experimented with
electricity for several years. He later
developed the Conventional Current
Theory which assumes that electricity
fluidly flows from plus to minus.
Actually, electricity stored in a battery
flows from negative to positive.
1784 French physicist, Charles
Augustin de Coulomb demonstrated
Coulomb's Law in which he showed
the relationship of the forces between
electric charges and that the electrical
charge is on the surface of the conductor.
1791 Italian physician and physicist,
Luigi Galvani, incorrectly believed
that electricity was present in
animals, a theory later corrected by
Volta.
1799 – 1800 Count Alessandro
Volta, an Italian engineer and physicist
and a pioneer in electricity, invents
the Voltaic cell, the first "wet
primary battery" that could produce
electricity through chemical action.
The volt is named in his honor.
1802 Johann Ritter, a German
physicist, discovered the possibility
of a rechargeable battery.
1826 Georg Ohm discovered what

is now known as Ohm's Law - the fundamental relationship of electricity.

1831 Michael Faraday from England, an English physicist and chemist, formed what is known as Faraday's Law, the foundation of the scientific study of electricity.

1836 Fellow English physicist and chemist, John Frederic Daniell, invented Daniell's cell.

1840 William George Armstrong, an English inventor, built the hydroelectric machine, a steam water-powered generator which produced frictional electricity.

1859 Raymond Gaston Planté, a French physicist, invented the Lead Acid battery, the first practical secondary battery.

1866 Werner von Siemens of Germany, a member of a scientific family of electrical engineers and industrialists, made innovative improvements to the generator.

1868 Georges Leclanché, a French chemist, developed a primary cell called the Leclanché cell that had an electromotive force of approximately 1.5 volts.

1888 Gassner from the United States made improvements to the dry-cell battery.

1899 Waldmar Jungner from Sweden, invented the Nickel-Cadmium storage battery.

Timeline of Electricty and Batteries

1901 Thomas Edison, American scientist, invented the Nickel-Alkali storage battery.

1932 The duo of Shlecht-Ackermann from Germany, invented the sintered electrode.

1947 Neumann of France achieved the first successful complete sealing of the Nickel-Cadmium battery.

1960-62 Commercial use of sealed Nickel-Cadmium cells in portable devices begun.

1977-78 Lithium primary cells are

commercialized.
1978 Sealed-Lead Acid cells become commercially viable.
1983-84 Solar cells introduced commercially.
1989-90 Nickel Metal Hydride introduced as a substitute for Nickel-Cadmium batteries.
1991-92 Rechargeable Zinc-Air batteries introduced for computers.
1992-93 Rechargeable Alkaline cells available to the consumer. Rechargeable Lithium batteries become commercially viable.
1990-92 Carbon-Zinc batteries no longer contain mercury.
1994 Reusable Alkaline batteries no longer contain mercury.
1996 *The Mercury-Containing and Rechargeable Battery Management Act* was signed on May 13th by President William Clinton. It established a system for collecting and recycling of Nickel-Cadmium batteries nationally; created a national labeling for these batteries; and phased out the use of mercury in nearly all batteries.
1996 RBRC's Ni-Cd battery recycling program launched in the U.S.
1997 RBRC's Ni-Cd battery recycling program launched in Canada.
2001 RBRC begins collection and recycling of all rechargeable battery chemistries.

3

c) Electrolyte - a paste-like substance or solution that contains charged particles that can move or conduct an electric current.
d) Separator - material that provides separation and insulation.

4 Electricity created by a battery consists of a stream of tiny invisible particles called electrons flowing from one metal end of the battery to the other metal end, just like a liquid. The path it follows is called a circuit. When electricity flows in a circuit, it is called current. Electricity only flows when it can go from one terminal to another. The positive and negative electrodes must have a pathway or circuit to follow. When the circuit is complete, electricity flows from an area of high electrical potential to one of low

potential. The difference in electrical potential makes the electricity move. Electricity can flow through some things, but not through others. Materials that allow electricity to flow through it are called conductors. Metals usually make good conductors. If electricity cannot flow through the material, it is called an insulator.

- Ask the class if they can name some materials that make good conductors and insulators. Good conductors include aluminum, carbon, copper, salt water, water, and zinc. Insulators include dry salt, glass, plastic, wood.

5 The electrical symbol for a battery is

- Ask the students if they have seen this symbol before.

The longer lines indicate positive and the shorter lines indicate negative. All batteries have a number followed by the letter "V". The "V" stands for volts. *(Remember, the volt is an electrical unit that measures the potential difference between two points in an electrical circuit.)*

- Ask the class to give their definition of a battery. *(NOTE: The public calls it a "battery," but the industry refers to it as a "cell." The lesson will use the term "battery" throughout.)*

1 A battery is an electrochemical device that contains two or more power cells connected electrically so that the chemical energy is converted into electricity. Simply stated, a battery powers products that require electricity to work. They are useful because they allow us to transport electricity and use products in locations where there are no electrical outlets such as beaches, sports events, picnics, etc.

2 In a battery, each cell that stores the electrical energy in a chemical state has two electrodes that react with the chemical and each other to release energy. The battery's two metal ends are called terminals. Usually one terminal is flat (negative end) and the other is button-shaped (positive end). Most primary cell batteries have a center core or rod which is the positive terminal.

All rechargeable batteries have a connection from the positive electrode to the positive terminal. The negative terminal is usually the case that contains the chemicals. In a Carbon-Zinc battery, the positive terminal is a carbon rod and the negative terminal is the zinc case. The case is important also because it keeps the chemicals from leaking out.

- Ask the students to look for terminals on their batteries. How are they marked?

The ends are marked with a + and -.
3 Each battery consists of four main parts:
a) Positive Electrode - the active material that allows electric current to be generated.
b) Negative Electrode - the active material that allows electric current to be generated.

What is a Battery?

See Charts A and B - Illustrations of the inside of a battery. (pgs. 12, 13)
Activity #2 - This experiment demonstrates current, circuit, conductors and insulators. (pg. 9)
4

+ —

The voltage number is the number of volts in a battery and explains how hard the electrons are being pushed through the circuit from an area of high electrical potential to one of low potential. For instance, a 1.5 V battery contains a single cell whereas a 9 V battery contains six cells, with the current moving through all six cells.
o Ask the students what the number on a battery means - a stronger or weaker battery? Batteries with higher numbers have a higher strength. You can make a voltage stronger by using several batteries.
6 The chemical reactions in batteries occur when two dissimilar materials such as zinc and copper (called electrodes) react together when inserted into a chemical conduction solution called an electrolyte. The electrolyte solution begins to slowly dissolve the zinc electrodes which forms negative zinc ions (very tiny particles which carry the electrons). The electrons then travel around, completing the circuit to the positive terminal, thus creating an electrical flow of energy.
7 At the peak of a battery's life, the electrodes have given up their ion capability. With all ions having been taken up by the electrodes, the battery becomes exhausted. It no longer provides energy and is then disposed. Batteries are very sensitive to age, chargedischarge cycles, climate, location, temperature and usage patterns.
8 The most common household battery is a dry cell battery. One kind of dry cell is a primary cell battery. These batteries automatically convert chemical energy into electrical energy. This kind of battery CANNOT be recharged. It is designed to be used once. After the chemicals in the electrolyte solution

(that transmits the electric currents) have been used up, the energy is no longer available and the battery is said to be exhausted, used, or "dead," and is then discarded. An example of such a primary cell battery would be a Carbon-Zinc battery, often used in flashlights.

9 A secondary cell battery CAN be recharged and used repeatedly. The discharged energy can be restored by supplying electrical current to recharge the cell. An example of a secondary acid battery that has been used for a number of years is the car battery. It is continually recharged with electric current from the car.

Secondary cell batteries, including Lithium-ion, Nickel-Cadmium, Nickel Metal Hydride and Small Sealed Lead are becoming more common in everyday use. It is important to know that Lithium-ion, Nickel-Cadmium, Nickel Metal Hydride and small Sealed Lead batteries CAN BE RECYCLED once they can no longer hold a charge.

10 Most batteries have a specific use or purpose. The most common sizes of batteries are the "round cells" such as AAA, AA, C, and D.

o Ask students to think of items that use batteries. Bar code readers, beepers, camcorders, cellular phones, cordless power tools, cordless telephones, flashlights, hearing aids, heart monitors, laptop computers, pagers, electronic toys, and walkie-talkies. Point out that there are many battery types used in the commercial market.

See Chart C and D - Different Types of Primary and Secondary Batteries. (pgs. 14, 15)

1 Every year, more than 3 billion batteries are used and then thrown away by American households who use both single-use and rechargeable dry cell batteries. That equals 125,000 tons of batteries discarded every year.

o Ask the class to imagine AA batteries placed end to end around the world. Have them estimate the number of times the batteries would encircle the planet. Placed end to end, AA batteries would circle the earth six times. This is the amount thrown away in one year. These batteries would fill 600 large yellow school buses each year.

Although the types of batteries used are varied, batteries that contain heavy metals such as mercury, cadmium, and lead — which can enter our air, ground and surface water when the batteries are disposed of in landfills and Waste-to-Energy (WTE) Facilities — should be recycled.

2 It is expected that the demand for more portability in the future will lead to a greater demand for higher quality batteries — those that offer a longer life span and a higher performance. Research has determined that the demand for both primary and secondary batteries will increase 7.8 percent per year to more than $17 billion worth of batteries sold by the year 2000. Annual growth through 1995, for secondary and primary battery growth was fairly even at 7.8-7.9 percent. However, it is estimated that rechargeable batteries use will grow at a greater rate in the future.

3 Each type of battery has been designed with a particular use in mind. Each must be disposed of properly. When rechargeable batteries are used, the overall waste is reduced because rechargeable batteries can be recharged and used again many times before they need to be disposed.

Most rechargeable batteries can be recharged up to 1,000 times, while rechargeable Alkaline-Manganese batteries can be reused up to 25 times before being discarded. Once the rechargeable batteries have run its course, they can be recycled. When used in highpower products, one rechargeable battery can replace from 50-300 throwaway primary batteries, depending on the usage. Some rechargeable batteries can supply power every day for up to three years.

4 By using a rechargeable battery, the consumer can save money, even after purchasing the recharger unit, the battery, and the cost of electricity to recharge itself. Initially, the batteries and charger may cost more, however, they are less expensive over time as the batteries are recharged and reused. Solar-powered chargers can also be purchased. Rechargeable batteries have a cost savings and a positive environmental impact.

5 The nickel, cadmium and lead contained in Nickel-Cadmium and Small Sealed Lead Acid batteries can be recycled once the life of the battery is over. Most Nickel-Cadmium batteries now have the seal imprinted on it that informs the public that they are recyclable through the *Charge Up to Recycle!*® program run by the Rechargeable Battery Recycling Corporation (RBRC).

RBRC, founded in 1994 by five major rechargeable battery makers, operates a public education and collection program for rechargeable batteries. The program is funded by more than 300 of the industry's leading rechargeable battery manufacturers, importers, and distributors of consumer products that use rechargeable batteries.

6 Nearly 350 million units of Nickel-Cadmium

batteries are used each year. Because rechargeable batteries contain potentially harmful chemicals they should not be disposed of in normal household waste. The battery recycling program allows the batteries to be properly disposed. They should never be placed in

Activity #5 - Compare primary to secondary batteries. (pg. 11)

Why is Recycling Important?

Activity #4 - Calculate the number of batteries used and disposed. (pg. 10)

6

Activity #3 - Chart household use of primary and secondary batteries. (pg. 10, 16)

the trash but recycled through the recycling program or dropped off at a household hazardous waste collection site.

7 Most products using rechargeable batteries have been redesigned so that the batteries can be removed and replaced. Many state legislatures require products with batteries to make the batteries more easily removable instead of being sealed into the product, such as portable vacuums or cordless phones, thus enabling the consumer to dispose of the battery separately. *(NOTE: Mercury has been phased out of most batteries. The exception is the button cell batteries. The mercury and silver contained in these batteries can also be recycled.)*

8 When a battery is recharged, the stored energy that has been discharged is replaced. During the charging period, gas is generated by chemical reactions and then is consumed by the electrodes as the battery is recharged. Care must be taken to recharge only secondary batteries.

9 Batteries should be stored in a discharged state since they can self-discharge and therefore, may become inactive after a long storage period. They should not be stored for any length of time while connected to the product. Care must be taken to use the correct charger for each kind of battery. Storage should be within the temperature range specified for the batteries. If there is high humidity or temperatures, the battery materials may deteriorate, causing leakage or corrosion of the metal parts. If the battery short-circuits, it may overheat and possibly rupture. Batteries should not be disassembled because the corrosive electrolyte solution may damage the skin and eyes. They should not be incinerated or immersed in water.

10 An increased environmental awareness of the harmful effects of mercury in batteries has led to a 99.4 percent drop in the consumption of mercury batteries from 1984-1994. In that 10 year period, alkaline battery use in the United States increased 150 percent. Prior to 1992, batteries were the largest source of mercury entering the municipal solid waste.
Due to the law known as *The Mercury-Containing and Rechargeable Battery Management Act*, enacted in May of 1996, the nationwide disposal of mercury in batteries has substantially decreased. The act, signed into law by President Bill Clinton on May 13, 1996, states that all Nickel-Cadmium and Sealed Lead batteries must have the chasing arrows logo or similar recycling symbols and a phrase that says the "battery must be recycled or disposed" through regulated battery collection programs. It also phases out the use of mercury in nearly all batteries.
11 Since Carbon-Zinc and Alkaline batteries no longer contain mercury, any decision to recycle them must include the considerations of the overall cost and time needed to collect, transport and recycle them. In the United States, battery companies are investigating the possibility of recycling the zinc, manganese and/or steel in the batteries. Under federal law, Carbon-Zinc and Alkaline Manganese batteries are no longer considered to be hazardous waste since they no longer contain mercury. They can be disposed of in the normal manner. However, they are short-lived and contribute to the municipal solid waste. Many communities have passed laws that regulate the sale, disposal or mandatory recycling of all kinds of batteries.
12 The rechargeable batteries collected in this program are recycled at the International Metals Reclamation Company (INMETCO), a major North American recycling facility of metal wastes. The facility is located in Ellwood City, Pennsylvania. Cadmium is recovered in a special high-temperature metal recovery process with no by-products being sent to a landfill. The recovered cadmium is purified before being used once again to make new rechargeable batteries. The recycled nickel and iron go back to the steel industry to be used in making stainless steel products. Cobalt and lead are also extracted through a high temperature process. The plastic cases that have been separated from the cells prior to processing are used as a fuel in a special furnace.
See Chart F - Helpful battery tips. (pg. 17)

13 To learn how to recycle rechargeable batteries,

look for the RBRC Rechargeable Battery Seal. There are separate plans for consumers, retailers, businesses and communities. For retailers, RBRC handles the shipping costs and provides containers with pre-addressed, prepaid shipping labels, bags, shipping instructions, safety instructions and point ofsale materials once the retailer has signed up. Communities and governmental agencies are asked to consolidate their batteries and RBRC will pay the cost of shipping and recycling the rechargeable batteries.

(continued from page 7)

Why is Recycling Important?

8

Evaluations

1 What scientists were responsible for inventing the first primary cell and the first secondary cell battery?

2 Explain the difference between primary and secondary dry cell batteries.

3 What components make up a battery? Explain each part. *(See Chart C and D on pages 14 and 15.)*

Evaluations and Extensions

Businesses pay only transportation costs. For more information about the *Charge Up to Recycle!*® program and to find the collection site nearest you, visit **www.rbrc.org** or call **1-800-8-BATTERY**.

o Have students locate a participating collection site in their neighborhood or near the school by visiting the RBRC web site, www.rbrc.org or calling the toll free help line, 1-800-8-BATTERY.

4 What was the significance of the bill President Clinton signed in 1996?

5 Discuss when it is advisable to use a primary cell battery and when it is better to use a secondary cell battery.

6 Explain how a rechargeable battery can be recycled.

Extensions

1 Research companies that use rechargeable batteries. Learn what they are used for; why they are used; do they have the seal; how is it publicized on the packages. *(More than 350 companies have the seal.)*

2 Call the toll-free help line at **1-800-8-BATTERY** or visit the web site at **www.rbrc.org** to learn how to recycle rechargeable batteries in your community, in your neighborhood, near your school.

3 Ask the students to write a creative story in which they imagine living without the luxury of having batteries to run their appliances, games, electronic equipment, etc.

4 Research the properties of the different chemical elements used in the various batteries. Discuss the chemical reactions that occur through the use of the metals.
5 Investigate other elements with positive and negative electrodes that might work in specific electrolyte solutions.
6 Research what kind of battery provides the longest charge, the strongest. Devise an experiment to measure each kind of battery to compare charges, strength, etc.
7 Invent a product that is dependent on a battery to make it run.
8 How do other countries manage battery disposal? Divide the class into teams to research other countries.
9 Create a time line with historic references and art work to show the development of the primary and secondary batteries.
10 Write a paragraph to explain why the Battery Recycling Seal may have been designed as it was.

Activity #1

Make a home-made wet cell based on the Voltaic cell.

Meets objective 1, 4

Materials

Lemons, coins (such as copper pennies), paper towels, aluminum foil (or coins such as dimes), bowl, scissors, lemon juicer, wire strippers, plastic tape, paper tube (toilet paper or paper towel tube will work), plastic-covered electrical wire.

Steps

1 Wrap foil over one end of the paper tube and then secure it by taping it down.
2 With the wire cutters, strip 1-2'' of the plastic from the wire. Tape one end to the foil.
3 Squeeze the juice from the lemons. Soak the paper towels in the juice. Start with a small rolled piece of toweling, then a coin, followed by a piece of foil. Continue to layer the three materials, filling the tube and ending with a coin. Tape a second stripped wire to the coin.
4 Moisten a finger tip on each hand and touch the ends of the two wires. (Students will experience a small shock or tingle but it will be very harmless. Students may also try attaching a light bulb to each end of the battery. The battery will be weak, but the bulb may have a faint glow.)
5 This is an example of a wet cell, the parent of

today's battery. The lemon juice acts as the electrolyte that conducts the electricity created by the coins and the foil. This battery is an example of the very first one created by Alessandro Volta in 1800.

Activity #2

Experiment with various materials to determine how conductors and insulators work and circuit and current flow.

Meets objective 4

Materials:

1.5 V dry cell battery, aluminum foil, coin, electrical (copper) wire, glass jar, light bulb holder, metal nail, paper clip, plastic spoon, rubber band, small flashlight bulb, water, wooden spoon, wire strippers.

Steps

1 Cut the copper wire into three 8-inch lengths and scrape off the plastic coating on all ends.

2 Connect one end of one wire to the demonstration bulb holder and the other end to one of the terminals on the 1.5 V dry cell battery.

3 Place the bulb into the bulb holder. Attach the second piece of wire to both the second terminal and the bulb holder. The bulb should light.

4 Disconnect the wire from the bulb holder. Attach the third wire to the bulb holder and begin to touch both that wire end and the terminal wire end with each of the collected materials — aluminum foil, coin, nail, paper clip, plastic spoon, rubber band, wooden spoon — forming a bridge between the two.

5 When using water or salt water, dip both the wire ends into the water contained in a glass jar.

6 The students will see that the light bulb lights up when the material used to complete the circuit is a conductor. It does not light up when the material is a nonconductor or insulator.

Activities and Experiments

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Charge Up to Recycle!® Battery Lesson Plan www.rbrc.org 1-800-8-BATTERY

Steps:

1 Take a poll of the kinds of batteries used in each student's home.

2 Record data on Chart E (pg. 16) to show primary and secondary use for each item.

3 Following the poll, students should understand that the way a product is used is the key to purchasing the most efficient battery.

Note: Use the following guidelines:
• used less than one hour/day = primary
• more than one hour/day = secondary
• low-power usage = primary
• high-power usage = secondary
(continued from page 9)
Activities
10
3 Nearly three billion batteries are used and thrown away every year. If the number of batteries being used grows by 7.8 percent this year,
a) how many additional batteries will be used by next year?
b) How many will be used in two years?
c) What is the total number of batteries expected to be used and discarded in three years?
4 If a package of 4 AA primary batteries cost $4.79, and a package of rechargeable Nickel-Cadmium secondary batteries cost $8.64,
a) what is the difference in the cost of the two kinds of batteries? If the recharger costs $21.78,
b) what is the total cost for the secondary batteries? If a portable radio is played for a constant week, and you need to replace the primary batteries eight times,
c) what is the cost of the batteries now?
d) which is the best buy after two weeks of constant use?

Activity #3

Investigate and list batteries used in students' homes and graph data to show primary vs. secondary battery use.

Meets objectives 1, 2, 3, 7

Materials Research of battery usage in students' homes as outlined from Chart E (pg. 16).

Activity #4

Calculate the number of batteries used and disposed.

Meets objective 6

Materials Ruler, scale, pencil, worksheet, assorted batteries.

Steps

1 Measure the length of a single AA battery. If you placed AA batteries end to end;
a) how many would it take to create a straight line from your home to your school? You will have to know the length of that distance. *(Hint: measure the distance and convert to inches or determine how many batteries make up a linear foot.).*
b) How many would it take to reach from one end of your state to the other? *(Hint: Check in your geography book to discover that distance.)*
2 If you used primary cell batteries to create the line,

and the average cost of the batteries is $2.99 for a package of two,
a) how much would it cost to line up the batteries from your home to your school.
b) How much from one end of your state to the other?

Activity #5

Compares primary batteries to secondary batteries economically and environmentally.

Meets objectives 6, 7

Materials Primary batteries, secondary batteries, two battery-run products such as flashlights, pencils, secondary battery recharger, completed date on Chart E (pg. 16)

Steps

1 Students will compare the overall life expectancy and cost of primary cell batteries compared to secondary cell batteries. *(NOTE: For ease of experimentation, use flashlights. However, normally flashlights that are turned off and on infrequently are better served with primary batteries. Secondary batteries are more useful in frequent and repetitive on and off usage.)*

2 Have students create a cost comparison chart as well as a lifetime chart.

3 Purchase two same volt cells — one a primary cell and one a secondary cell — and place them in two identical products such as a flashlight. Make sure that the flashlight bulbs are both new. Keep track of the costs of the two kinds of batteries.

4 Turn the flashlights on after noting the time. Leave the flashlights on. Assign a student the responsibility of carrying the flashlights home at the close of the school day and bringing them back the next morning, keeping the light on the whole time. Keep track of the number of hours that the flashlight bulbs are on.

5 When either flashlight light burns out, note the time and whether it is a primary cell battery or a secondary cell battery. *(Make sure it is not the flashlight bulb that has burned out instead.)*

6 If it is a primary cell battery, replace the battery immediately and continue to note the date and time for that battery.

7 If it is a secondary battery, turn off the primary cell battery while recharging the secondary. When the secondary is recharged, replace it, and turn the primary cell back on. Keep track of the times.

8 Continue to do this until you get an average life span for the primary cell battery (possibly 4-5 times) and an average time before the secondary battery must be recharged.

9 You are now ready to compare the life of the batteries and their costs.
10 Although the original cost of the secondary battery is much higher, the secondary costs should level out and then decrease the longer the product is used.
11 Students may want to try this test with different kinds of products as well as batteries with different voltages.
For expensive products with long life spans, a secondary battery may prove to be a better buy. For items with built-in obsolescence or smaller products, primary cells may work better. Secondary batteries do not hold their charge for an extended period of time, and therefore SHOULD NOT be used in smoke detectors and other items that are infrequently used. They work well with equipment that requires a high flow of current for a longer period of time.

- Answer the following questions:

• How many primary cell batteries are equal to a secondary cell battery life (when it must be recharged).
• Which battery is exhausted first?
• What are the initial costs of each kind of battery?
• Assuming that a secondary cell battery can be recharged up to 1,000 times, how long could this battery run continuously? How many primary cell batteries would have to be pur chased to equal that time period?
• Once you have the number of primary cell batteries you would need to equal the life span of the secondary cell batteries, multiply the cost of all those primary cell batteries. Then compare it to the cost of the secondary cell batteries.
• If you included the costs of all the primary cell batteries in the cost of the product, what does that do to the price of that product? (Would escalate the cost of the product.)
• In the life span of the product, which battery becomes more economical to use?
• Which battery is more environmentally friendly?
• Why?
• What have they learned from this activity?
• When does it make sense to use a primary battery and when a secondary battery?

Cutaway View - Typical Alkaline Cell

Diagram of a Primary Cell Battery - Chart A

Source: Energizer Power Systems.

Positive Terminal
Plated Steel
Electrolyte - Potassium
Hydroxide/Water
Cathode - Maganese
Dioxide, Carbon
Separator - Non
woven Fabric
Metal Washer
Can - Steel
Metalized Plastic
Film Label
Anode - Powdered Zinc
Current Collector -
Brass Pin
Seal - Nylon
Negative Terminal
Plated Steel
Inner Cell Cover - Steel
Metal Spur

Cutaway View - Typical Nickel-Cadmium Cell

Diagram of a Secondary Cell Battery - Chart B

Source: Energizer Power Systems.

Current Conductor
Anode - Cadmium
Negative (-) Electrode
Cathode - Nickel Positive
(+) Electrode
Separator
Electrode - Potassium
Hydroxide/Water
Positive Tab - Welded to
Positive Terminal
Positive Terminal - Nickel
Plated Steel
Negative Terminal
Resealable Vent Mechanism
Insulating Seal Ring

Nickel Plated
Steel Case

Carbon Zinc The most popular and cheapest primary battery; average performance; good storage life; numerous sizes and shapes available. No mercury is contained in these batteries.
Characteristics - Low energy density, lowest cost
Disposal - Check with your local authority
Electrolyte - Ammonium Chloride, Zinc Chloride
Major Components - Zinc, Carbon
Uses - Flashlights, toys, remote controls
Voltage - 1.5 V
Alkaline Manganese Gaining in popularity; has better performance than the carbon-zinc primary battery; costs more due to better performance. Batteries manufactured after May 13, 1996, contain no added mercury with the exception of button cell batteries which contain a minute quantity of mercury.
Characteristics - Higher energy density, moderate discharge rate, and more expensive than carbon zinc
Disposal - Check with your local authority
Electrolyte - Potassium Hydroxide
Major Components - Zinc, Manganese Dioxide
Uses - Radios, smoke detectors, toys
Voltage - 1.5 V
Lithium Light weight; high energy density; long storage life; expensive. Lithium has a great reactivity with water and air, and disposal requires special attention.
Characteristics - High energy density, long shelf life, expensive
Disposal - Check with your local authority
Electrolyte - Organic Solvents
Major Components - Lithium and Manganese Dioxide or Polycarbonmonofluoride
Uses - Cameras, pagers, keyless locks
Voltage - 3.0 V
Zinc Air Specialty battery; light weight; good performance; inexpensive; safe.
Characteristics - High energy density, low discharge rate, inexpensive
Disposal - Check with your local authority
Electrolyte - Potassium Hydroxide
Major Components - Zinc, Carbon
Uses - Hearing aids, pagers
Voltage - 1.4 V
Silver Primarily found in button cell batteries; high energy density; moderately expensive; safe.
Characteristics - High energy density, low discharge rate, expensive

Disposal - Check with your local authority
Electrolyte - Potassium Hydroxide
Major Components - Zinc, Silver Oxide
Uses - Watches, calculators, hearing aids
Voltage - 1.55 V

Mercuric Oxide Primarily found in button cell batteries for electronics. This battery contains mercury. Federal legislation was enacted on May 13, 1996, that minimizes the amount of mercury contributed by batteries to municipal solid waste (MSW). No consumer recycling program (similar to RBRC's) has been established. (Button cells cannot be sold in US)
Disposal - Check with your local authority; special handling required
Electrolyte - Potassium Hydroxide
Major Components - Zinc, Mercuric Oxide
Uses - Specialized medical, military, emergency response equipment
Voltage - 1.35 V

Battery Characteristics - Chart C
Primary Batteries (non-rechargeable)

Nickel-Cadmium Most popular rechargeable battery; good performance; can be recharged up to 1,000 times; least expensive of the secondary batteries. This battery contains cadmium which is toxic, therefore it is important to recycle these batteries. They can be recycled through a national program offered by the Rechargeable Battery Recycling Corporation (RBRC).
Characteristics - Rapid discharge, moderate energy density, relatively inexpensive
Disposal - Recycle through RBRC program
Electrolyte Type - Potassium Hydroxide
Major Components - Nickel, Cadmium
Uses - Power tools, cordless telephones, professional radios
Voltage - 1.2 V

Nickel Metal Hydride Cadmium-free replacement for Nickel-Cadmium; more expensive; good performance; can be recharged up to 1,000 times; can be recycled. They can be recycled through the national program offered by RBRC.
Characteristics - Moderate discharge rate, high energy density, relatively expensive
Disposal - Check with your local authority
Electrolyte Type - Potassium Hydroxide
Major Components - Nickel, Various Rare Earth

Metals
Uses - Computers, cellular phones, camcorders
Voltage - 1.2 V
Lithium-ion Newest rechargeable technology; light weight, excellent performance; can be recycled. They can be recycled through the national program offered by RBRC.
Characteristics - High energy density, moderate discharge rate, expensive
Disposal - Check with your local authority; special handling required
Electrolyte Type - Organic Solvent
Major Components - Graphite, Lithium, Cobalt Oxide
Uses - Computers, cellular telephones
Voltage - 3.0 V
Lead-Acid These batteries are the main source of power for cars, trucks, boats, motorcycles, tractors, etc. These batteries contain lead. Because lead is a toxic material, it is important to recycle these batteries. Lead batteries are being recycled at a rate exceeding 90 percent. The active ingredient of lead and sulfuric acid can be very toxic if improperly disposed. Can be recycled. They can be recycled through the national program offered by RBRC.
Characteristics - High discharge rate, moderate energy density, inexpensive
Disposal - Recycling program exists
Electrolyte - Sulfuric Acid
Major Components - Lead
Uses - Emergency power, automobiles
Voltage - 2.0 V
Rechargeable Alkaline Moderate performance; can be recharged only a few times; requires special charger; costs less than Nickel-Cadmium; does not have to be recycled.
Characteristics - Moderate discharge rate, more expensive than primary alkaline
Disposal - Check with your local authority
Electrolyte Type - Potassium Hydroxide
Major Components - Zinc, Manganese Dioxide
Uses - Radios, toys, walkmans
Voltage - 1.5 V
Zinc-Air (see description on Primary Battery chart)
Characteristics - Moderate energy density, moderate discharge rate, expensive
Disposal - Check with your local authority
Electrolyte Type - Potassium Hydroxide
Major Components - Zinc, Carbon
Uses - Computers
Voltage - 1.4 V

Battery Characteristics - Chart D

Secondary Batteries (rechargeable)

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Battery Usage - Chart E

Product	High/Low Usage	Best Battery Ease Powered	Option of Removal
Cordless Drill	High 1 hr/mo	Secondary	Yes
Flashlight	Low 1 hr/mo	Primary	Yes
Cell Phone	High 2-4 hrs/ day	Secondary	Yes
Watch	Low 24 hrs/ day	Primary	Somewhat

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Battery Tips - Chart F

4You Can

1 Use rechargeable batteries whenever possible and then recycle them when they can no longer hold a charge.

2 Recycle your button batteries. Check with your community's solid waste program to determine where.

3 Remove your batteries from equipment that will be stored for any length of time because the battery terminals may leak, corrode and ruin the equipment.

4 Clean the contact surfaces when installing your batteries so power will not be wasted.

5 Purchase batteries as you need them since they do have a limited shelf life.

6 Remove the button batteries in disposable toys, watches, and calculators and recycle them before disposing of the item.

7 Follow the charging guidelines provided by the manufacturer. Depending on the individual product, there are specific initial battery charging times (usually overnight) before using the product for the first time. This will enable you to obtain maximum battery capacity.

8 Let your battery cool to room temperature before recharging. The charge efficiency of most batteries is greatly reduced at elevated temperatures.

9 Recharge batteries when they are near to fully discharged. You can tell that a battery is discharged by a sharp drop in power or speed.

10 Recycle your used rechargeable batteries when they can no longer hold a charge.

8 You Should Not

1 Mix old batteries with new ones because this will shorten the life of the new battery.
2 Place batteries or equipment with battery included where it will overheat since the heat will speed up the chemical reaction and shorten the battery's life.
3 Recharge a battery unless it is actually a rechargeable battery.
4 Mix batteries with other objects such as metal keys or change since this can short circuit the battery, causing heat and sparks.
5 Mix different kinds of batteries in the same piece of equipment or use rechargeable batteries with common disposable batteries. It may ruin the equipment, shorten the life of the batteries, or cause an explosion.
6 Throw away items powered by batteries with the batteries still inside. Remove the batteries and dispose in the proper manner.
7 Take apart or tamper with the case of the battery.
8 Reverse the positive and negative terminals of the batteries when installing in equipment or in a recharger.
9 Dispose of a battery in a fire or immerse in water.
10 Leave the battery in the equipment after it has been fully discharged.

RBRC is a nonprofit public service organization dedicated to rechargeable battery recycling. To find a participating collection in your area or for more information about the RBRC Charge Up to Recycle!® program, visit the web site at www www..rbr rbrc.c.org or call toll free 1-800-8-BA BATTER TTER TTERY.

1000 Parkwood Circle, Suite 450, Atlanta, GA 30339, Ph: 678-419-9990 Fax: 678-419-9986

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Aditional copies can be downloaded from www.rbrc.org/school.
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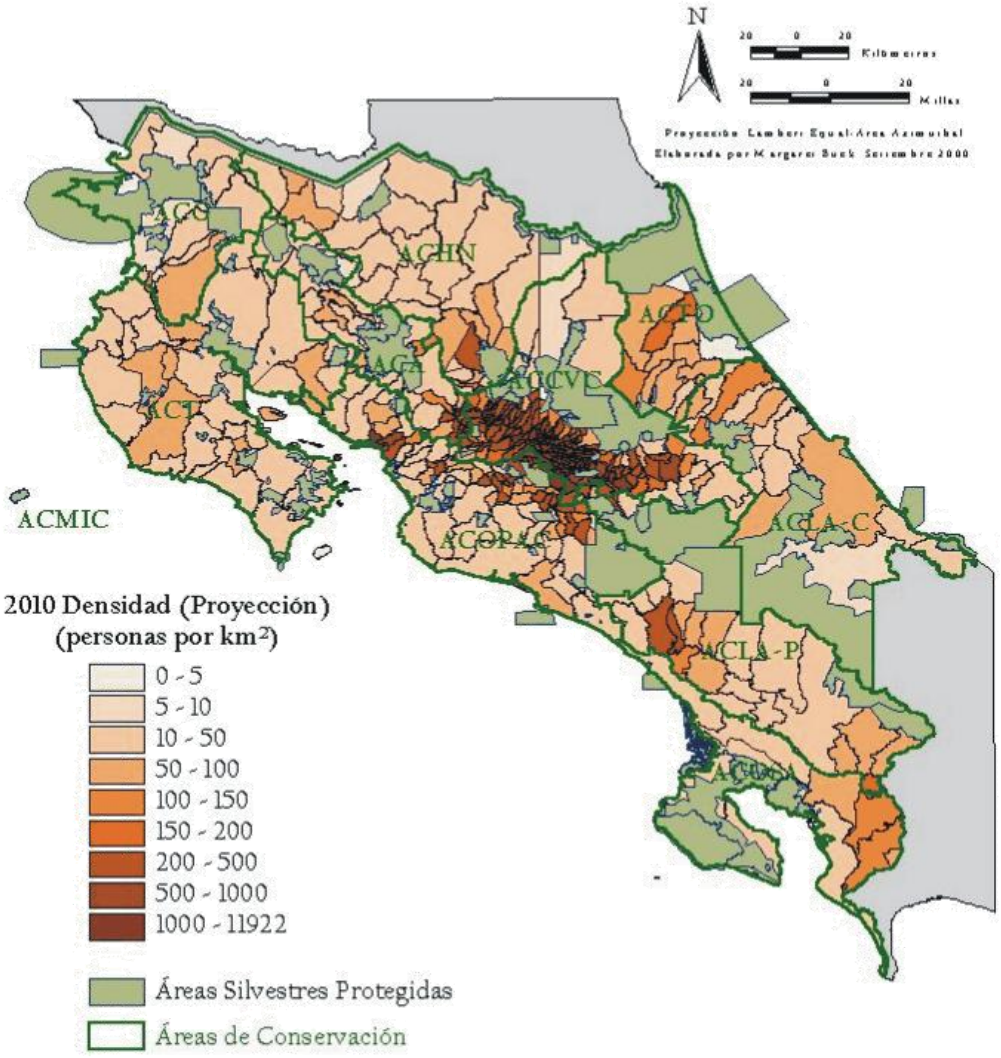
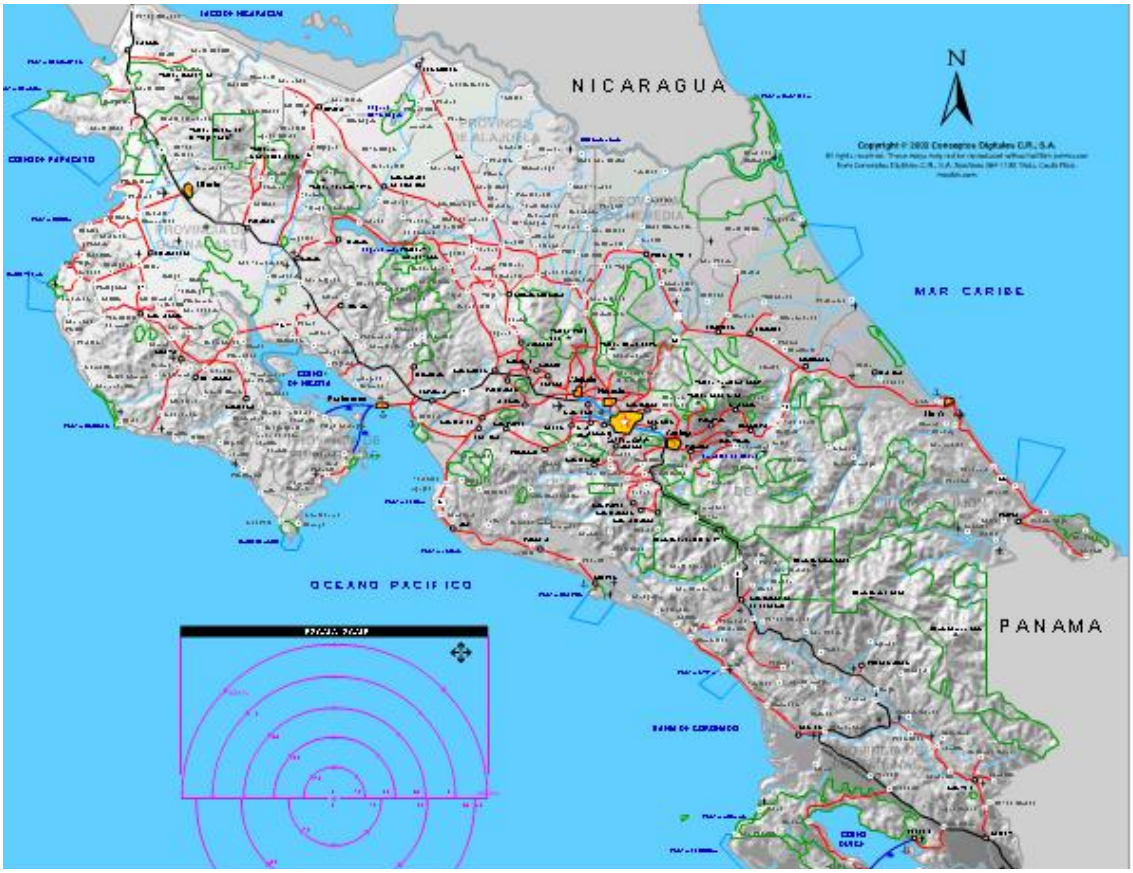
Appendix O: Population Density Map



*Fuente: Censo de Población 1984 (Proyecciones), INEC,
Áreas de Conservación y ASP- SINAC.

(Taken from INMOTICO.com, reference 209.15.138.224/inmotico/m_densidad1.htm)



(Taken from MapTak, reference www.maptak.com)

Appendix P: “Mercury-containing and rechargeable battery act”

Public Law 104-142
104th Congress

An Act

To phase out the use of mercury in batteries and provide for the efficient and cost-effective collection and recycling or proper disposal of used nickel cadmium batteries, small sealed lead-acid batteries, and certain other batteries, and for other purposes. <<NOTE: May 13, 1996 - [H.R. 2024]>>

Be it enacted by the Senate and House of Representatives of the United States of America in Congress <<NOTE: Mercury-Containing and Rechargeable Battery Management Act.>> assembled,

SECTION 1. <<NOTE: Environmental protection. 42 USC 14301 note.>> SHORT TITLE.

This Act may be cited as the ``Mercury-Containing and Rechargeable Battery Management Act''.

SEC. 2. <<NOTE: 42 USC 14301.>> FINDINGS.

The Congress finds that--

(1) it is in the public interest to--

(A) phase out the use of mercury in batteries and provide for the efficient and cost-effective collection and recycling or proper disposal of used nickel cadmium batteries, small sealed lead-acid batteries, and other regulated batteries; and

(B) educate the public concerning the collection, recycling, and proper disposal of such batteries;

(2) uniform national labeling requirements for regulated batteries, rechargeable consumer products, and product packaging will significantly benefit programs for regulated battery collection and recycling or proper disposal; and

(3) it is in the public interest to encourage persons who use rechargeable batteries to participate in collection for recycling of used nickel-cadmium, small sealed lead-acid, and other regulated batteries.

SEC. 3. <<NOTE: 42 USC 14302.>> DEFINITIONS.

For purposes of this Act:

(1) Administrator.--The term ``Administrator'' means the Administrator of the Environmental Protection Agency.

(2) Button cell.--The term ``button cell'' means a button- or coin-shaped battery.

(3) Easily removable.--The term ``easily removable'', with respect to a battery, means detachable or removable at the end of the life of the battery--

(A) from a consumer product by a consumer with the use of common household tools; or

(B) by a retailer of replacements for a battery used as the principal electrical power source for a vehicle.

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(4) Mercuric-oxide battery.--The term ``mercuric-oxide battery'' means a battery that uses a mercuric-oxide electrode.

(5) Rechargeable battery.--The term ``rechargeable battery''--

(A) means 1 or more voltaic or galvanic cells, electrically connected to produce electric energy, that is designed to be recharged for repeated uses; and

(B) includes any type of enclosed device or sealed container consisting of 1 or more such cells, including what is commonly called a battery pack (and in the case of a battery pack, for the purposes of the requirements of easy removability and labeling under section 103, means the battery pack as a whole rather than each component individually); but

(C) does not include--

(i) a lead-acid battery used to start an internal combustion engine or as the principal electrical power source for a vehicle, such as an automobile, a truck, construction equipment, a motorcycle, a garden tractor, a golf cart, a wheelchair, or a boat;

(ii) a lead-acid battery used for load leveling or for storage of electricity generated by an alternative energy source, such as a solar cell or wind-driven generator;

(iii) a battery used as a backup power source for memory or program instruction storage, timekeeping, or any similar purpose that requires uninterrupted electrical power in order to function if the primary energy supply fails or fluctuates momentarily; or

(iv) a rechargeable alkaline battery.

(6) Rechargeable consumer product.--The term ``rechargeable consumer product''--

(A) means a product that, when sold at retail, includes a regulated battery as a primary energy supply, and that is primarily intended for personal or household use; but

(B) does not include a product that only uses a battery solely as a source of backup power for memory or program instruction storage, timekeeping, or any similar purpose that requires uninterrupted electrical power in order to function if the primary energy supply fails or fluctuates momentarily.

(7) Regulated battery.--The term ``regulated battery'' means a rechargeable battery that--

(A) contains a cadmium or a lead electrode or any combination of cadmium and lead electrodes; or

(B) contains other electrode chemistries and is the subject of a determination by the Administrator under section 103(d).

(8) Remanufactured product.--The term ``remanufactured

product" means a rechargeable consumer product that has been altered by the replacement of parts, repackaged, or repaired after initial sale by the original manufacturer.

SEC. 4. <<NOTE: 42 USC 14303.>> INFORMATION DISSEMINATION.

The Administrator shall, in consultation with representatives of rechargeable battery manufacturers, rechargeable consumer product manufacturers, and retailers, establish a program to provide

[[Page 110 STAT. 1331]]

information to the public concerning the proper handling and disposal of used regulated batteries and rechargeable consumer products with nonremovable batteries.

SEC. 5. <<NOTE: 42 USC 14304.>> ENFORCEMENT.

(a) Civil Penalty.--When on the basis of any information the Administrator determines that a person has violated, or is in violation of, any requirement of this Act (except a requirement of section 104) the Administrator--

(1) in the case of any violation, may issue an order assessing a civil penalty of not more than $10,000 for each violation, or requiring compliance immediately or within a reasonable specified time period, or both; or

(2) in the case of any violation or failure to comply with an order issued under this section, may commence a civil action in the United States district court in the district in which the violation occurred or in the district in which the violator resides for appropriate relief, including a temporary or permanent injunction.

(b) Contents of Order.--An order under subsection (a)(1) shall state with reasonable specificity the nature of the violation.

(c) Considerations.--In assessing a civil penalty under subsection (a)(1), the Administrator shall take into account the seriousness of the

violation and any good faith efforts to comply with applicable requirements.

(d) Finality of Order; Request for Hearing.--An order under subsection (a)(1) shall become final unless, not later than 30 days after the order is served, a person named in the order requests a hearing on the record.

(e) Hearing.--On receiving a request under subsection (d), the Administrator shall promptly conduct a hearing on the record.

(f) Subpoena Power.--In connection with any hearing on the record under this section, the Administrator may issue subpoenas for the attendance and testimony of witnesses and for the production of relevant papers, books, and documents.

(g) Continued Violation After Expiration of Period for Compliance.--If a violator fails to take corrective action within the time specified in an order under subsection (a)(1), the Administrator may assess a civil penalty of not more than $10,000 for the continued noncompliance with the order.

(h) Savings Provision.--The Administrator may not take any enforcement action against a person for selling, offering for sale, or offering for promotional purposes to the ultimate consumer a battery or product covered by this Act that was--

(1) purchased ready for sale to the ultimate consumer; and

(2) sold, offered for sale, or offered for promotional purposes without modification.

The preceding sentence shall not apply to a person--

(A) who is the importer of a battery covered by this Act, and

(B) who has knowledge of the chemical contents of the battery

when such chemical contents make the sale, offering for sale, or offering for promotional purposes of such battery unlawful under title II of this Act.

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SEC. 6. <<NOTE: 42 USC 14305.>> INFORMATION GATHERING AND ACCESS.

(a) Records and Reports.--A person who is required to carry out the objectives of this Act, including--

(1) a regulated battery manufacturer;

(2) a rechargeable consumer product manufacturer;

(3) a mercury-containing battery manufacturer; and

(4) an authorized agent of a person described in paragraph (1), (2), or (3),

shall establish and maintain such records and report such information as the Administrator may by regulation reasonably require to carry out the objectives of this Act.

(b) Access and Copying.--The Administrator or the Administrator's authorized representative, on presentation of credentials of the Administrator, may at reasonable times have access to and copy any records required to be maintained under subsection (a).

(c) Confidentiality.--The Administrator shall maintain the confidentiality of documents and records that contain proprietary information.

SEC. 7. <<NOTE: 42 USC 14306.>> STATE AUTHORITY.

Nothing in this Act shall be construed to prohibit a State from enacting and enforcing a standard or requirement that is identical to a standard or requirement established or promulgated under this Act. Except as provided in sections 103(e) and 104, nothing in this Act shall be construed to prohibit a State from enacting and enforcing a standard or requirement that is more stringent than a standard or requirement established or promulgated under this Act.

SEC. 8. <<NOTE: 42 USC 14307.>> AUTHORIZATION OF APPROPRIATIONS.

There are authorized to be appropriated such sums as are necessary to carry out this Act.

TITLE <<NOTE: Rechargeable Battery Recycling Act.>> I--RECHARGEABLE

BATTERY RECYCLING ACT

SEC. 101. <<NOTE: 42 USC 14301 note.>> SHORT TITLE.

This title may be cited as the ``Rechargeable Battery Recycling Act''.

SEC. <<NOTE: 42 USC 14321.>> 102. PURPOSE.

The purpose of this title is to facilitate the efficient recycling or proper disposal of used nickel-cadmium rechargeable batteries, used small sealed lead-acid rechargeable batteries, other regulated batteries, and such rechargeable batteries in used consumer products, by--

(1) providing for uniform labeling requirements and streamlined regulatory requirements for regulated battery collection programs; and

(2) encouraging voluntary industry programs by eliminating barriers to funding the collection and recycling or proper disposal of used rechargeable batteries.

SEC. <<NOTE: 42 USC 14322.>> 103. RECHARGEABLE CONSUMER PRODUCTS AND LABELING.

(a) Prohibition.--

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(1) In general.--No person shall sell for use in the United States a regulated battery that is ready for retail sale or a rechargeable consumer product that is ready for retail sale, if such battery or product was manufactured on or after the date 12 months after the date of enactment of this Act, unless the labeling requirements of subsection (b) are met and, in the case of a regulated battery, the regulated battery--

(A) is easily removable from the rechargeable consumer product; or

(B) is sold separately.

(2) Application.--Paragraph (1) does not apply to any of the following:

(A) The sale of a remanufactured product unit unless paragraph (1) applied to the sale of the unit when originally manufactured.

(B) The sale of a product unit intended for export purposes only.

(b) Labeling.--Each regulated battery or rechargeable consumer product without an easily removable battery manufactured on or after the date that is 1 year after the date of enactment of this Act, whether produced domestically or imported shall bear the following labels:

(1) 3 chasing arrows or a comparable recycling symbol.

(2)(A) On each regulated battery which is a nickel-cadmium battery, the chemical name or the abbreviation ``Ni-Cd'' and the phrase ``BATTERY MUST BE RECYCLED OR DISPOSED OF PROPERLY.''.

(B) On each regulated battery which is a lead-acid battery, ``Pb'' or the words ``LEAD'', ``RETURN'', and ``RECYCLE'' and if the regulated battery is sealed, the phrase ``BATTERY MUST BE RECYCLED.''.

(3) On each rechargeable consumer product containing a regulated battery that is not easily removable, the phrase ``CONTAINS NICKEL-CADMIUM BATTERY. BATTERY MUST BE RECYCLED OR DISPOSED OF PROPERLY.'' or ``CONTAINS SEALED LEAD BATTERY. BATTERY MUST BE RECYCLED.'', as applicable.

(4) On the packaging of each rechargeable consumer product, and the packaging of each regulated battery sold separately from such a product, unless the required label is clearly visible through the packaging, the phrase ``CONTAINS NICKEL-CADMIUM BATTERY. BATTERY MUST BE RECYCLED OR DISPOSED OF PROPERLY.'' or ``CONTAINS SEALED LEAD BATTERY. BATTERY MUST BE RECYCLED.'', as applicable.

(c) Existing or Alternative Labeling.--

(1) Initial period.--For a period of 2 years after the date of enactment of this Act, regulated batteries, rechargeable

consumer products containing regulated batteries, and rechargeable consumer product packages that are labeled in substantial compliance with subsection (b) shall be deemed to comply with the labeling requirements of subsection (b).

(2) Certification.--

(A) In general.--On application by persons subject to the labeling requirements of subsection (b) or the labeling requirements promulgated by the Administrator under subsection (d), the Administrator shall certify that a dif

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ferent label meets the requirements of subsection (b) or (d), respectively, if the different label--

(i) conveys the same information as the label required under subsection (b) or (d), respectively; or

(ii) conforms with a recognized international standard that is consistent with the overall purposes of this title.

(B) Constructive certification.--Failure of the Administrator to object to an application under subparagraph (A) on the ground that a different label does not meet either of the conditions described in subparagraph (A) (i) or (ii) within 120 days after the date on which the application is made shall constitute certification for the purposes of this Act.

(d) Rulemaking Authority of the Administrator.--

(1) In general.--If the Administrator determines that other rechargeable batteries having electrode chemistries different from regulated batteries are toxic and may cause substantial harm to human health and the environment if discarded into the solid waste stream for land disposal or incineration, the Administrator may, with the advice and counsel of State regulatory authorities and manufacturers of rechargeable

batteries and rechargeable consumer products, and after public comment--

(A) promulgate labeling requirements for the batteries with different electrode chemistries, rechargeable consumer products containing such batteries that are not easily removable batteries, and packaging for the batteries and products; and

(B) promulgate requirements for easy removability of regulated batteries from rechargeable consumer products designed to contain such batteries.

(2) Substantial similarity.--The regulations promulgated under paragraph (1) shall be substantially similar to the requirements set forth in subsections (a) and (b).

(e) Uniformity.--After the effective dates of a requirement set forth in subsection (a), (b), or (c) or a regulation promulgated by the Administrator under subsection (d), no Federal agency, State, or political subdivision of a State may enforce any easy removability or environmental labeling requirement for a rechargeable battery or rechargeable consumer product that is not identical to the requirement or regulation.

(f) Exemptions.--

(1) In general.--With respect to any rechargeable consumer product, any person may submit an application to the Administrator for an exemption from the requirements of subsection (a) in accordance with the procedures under paragraph (2). The application shall include the following information:

(A) A statement of the specific basis for the request for the exemption.

(B) The name, business address, and telephone number of the applicant.

(2) Granting of exemption.--Not later than 60 days after receipt of an application under paragraph (1), the Administrator shall approve or deny the application. On approval of the application the Administrator shall grant an exemption to the

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applicant. The exemption shall be issued for a period of time that the Administrator determines to be appropriate, except that the period shall not exceed 2 years. The Administrator shall grant an exemption on the basis of evidence supplied to the Administrator that the manufacturer has been unable to commence manufacturing the rechargeable consumer product in compliance with the requirements of this section and with an equivalent level of product performance without the product--

(A) posing a threat to human health, safety, or the environment; or

(B) violating requirements for approvals from governmental agencies or widely recognized private standard-setting organizations (including Underwriters Laboratories).

(3) Renewal of exemption.--A person granted an exemption under paragraph (2) may apply for a renewal of the exemption in accordance with the requirements and procedures described in paragraphs (1) and (2). The Administrator may grant a renewal of such an exemption for a period of not more than 2 years after the date of the granting of the renewal.

SEC. <<NOTE: 42 USC 14323.>> 104. REQUIREMENTS.

(a) Batteries Subject to Certain Regulations.--The collection, storage, or transportation of used rechargeable batteries, batteries described in section 3(5)(C) or in title II, and used rechargeable consumer products containing rechargeable batteries that are not easily removable rechargeable batteries, shall, notwithstanding any law of a State or political subdivision thereof governing such collection, storage, or transportation, be regulated under applicable provisions of the regulations promulgated by the Environmental Protection Agency at 60 Fed. Reg. 25492 (May 11, 1995), as effective on May 11, 1995, except as provided in paragraph (2) of subsection (b) and except that--

(1) the requirements of 40 CFR 260.20, 260.40, and 260.41 and the equivalent requirements of an approved State program shall not apply, and

(2) this section shall not apply to any lead acid battery managed under 40 CFR 266 subpart G or the equivalent requirements of an approved State program.

(b) Enforcement Under Solid Waste Disposal Act.--(1) Any person who fails to comply with the requirements imposed by subsection (a) of this section may be subject to enforcement under applicable provisions of the Solid Waste Disposal Act.

(2) States may implement and enforce the requirements of subsection (a) if the Administrator finds that--

(A) the State has adopted requirements that are identical to those referred to in subsection (a) governing the collection, storage, or transportation of batteries referred to in subsection (a); and

(B) the State provides for enforcement of such requirements.

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TITLE <<NOTE: Mercury-Containing Battery Management Act.>> II--MERCURY-CONTAINING BATTERY MANAGEMENT ACT

SEC. 201. <<NOTE: 42 USC 14301 note.>> SHORT TITLE.

This title may be cited as the ``Mercury-Containing Battery Management Act''.

SEC. 202. <<NOTE: 42 USC 14331.>> PURPOSE.

The purpose of this title is to phase out the use of batteries containing mercury.

SEC. <<NOTE: 42 USC 14332.>> 203. LIMITATIONS ON THE SALE OF ALKALINE-MANGANESE BATTERIES CONTAINING MERCURY.

No person shall sell, offer for sale, or offer for promotional purposes any alkaline-manganese battery manufactured on or after the date of enactment of this Act, with a mercury content that was

intentionally introduced (as distinguished from mercury that may be incidentally present in other materials), except that the limitation on mercury content in alkaline-manganese button cells shall be 25 milligrams of mercury per button cell.

SEC. 204. <<NOTE: 42 USC 14333.>> LIMITATIONS ON THE SALE OF ZINC-CARBON BATTERIES CONTAINING MERCURY.

No person shall sell, offer for sale, or offer for promotional purposes any zinc-carbon battery manufactured on or after the date of enactment of this Act, that contains mercury that was intentionally introduced as described in section 203.

SEC. 205. <<NOTE: 42 USC 14334.>> LIMITATIONS ON THE SALE OF BUTTON CELL MERCURIC-OXIDE BATTERIES.

No person shall sell, offer for sale, or offer for promotional purposes any button cell mercuric-oxide battery for use in the United States on or after the date of enactment of this Act.

SEC. 206. <<NOTE: 42 USC 14335.>> LIMITATIONS ON THE SALE OF OTHER MERCURIC-OXIDE BATTERIES.

(a) Prohibition.--On or after the date of enactment of this Act, no person shall sell, offer for sale, or offer for promotional purposes a mercuric-oxide battery for use in the United States unless the battery manufacturer, or the importer of such a battery--

(1) identifies a collection site in the United States that has all required Federal, State, and local government approvals, to which persons may send used mercuric-oxide batteries for recycling or proper disposal;

(2) informs each of its purchasers of mercuric-oxide batteries of the collection site identified under paragraph (1); and

(3) informs each of its purchasers of mercuric-oxide batteries of a telephone number that the purchaser may call to get information about sending mercuric-oxide batteries for

recycling or proper disposal.

(b) Application of Section.--This section does not apply to a sale or offer of a mercuric-oxide button cell battery.

SEC. 207. <<NOTE: 42 USC 14336.>> NEW PRODUCT OR USE.

On petition of a person that proposes a new use for a battery technology described in this title or the use of a battery described in this title in a new product, the Administrator may exempt

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from this title the new use of the technology or the use of such a battery in the new product on the condition, if appropriate, that there exist reasonable safeguards to ensure that the resulting battery or product without an easily removable battery will not be disposed of in an incinerator, composting facility, or landfill (other than a facility regulated under subtitle C of the Solid Waste Disposal Act (42 U.S.C. 6921 et seq.)).

Approved May 13, 1996.