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REGIONAL ELECTRONICS STUDY AND CIRCULARITY ROADMAP IN THE LATIN AMERICA AND THE CARIBBEAN (LAC) REGION

MAPPING OF STAKEHOLDERS

in selected countries



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Disclaimer:

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More information about the project available here:

<https://saicmknowledge.org/topic/circularity-electronics-latin-america-and-caribbean>

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INTRODUCTION

Circularity provides a model to transform the current economic system towards a sustainable future. As outlined in the UNEP circularity platform, circularity's underlying objective is that materials should be kept at their highest possible value as they move and are retained within the value chain. This reduces the use of natural resources and environmental impacts per unit of economic activity or output, while continuing to enable improvements in human well-being. Circularity is built on the overall guiding principle of "Reduce by design", and value retention loops, as visualized in Illustration 1.

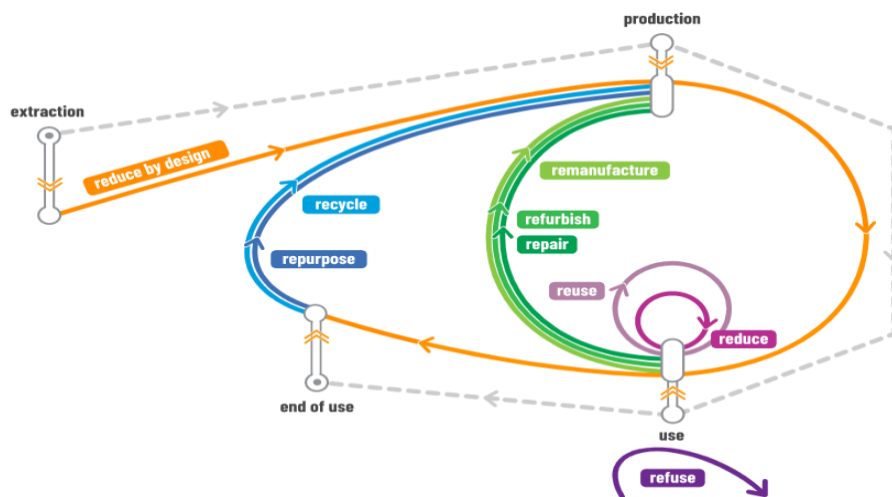


Illustration 1. UNEP circularity approach
Source: (UNEP, n.d.)

The circular economy provides an alternative to the current economic model in accordance with the principles of the 2030 Agenda and the Sustainable Development Goals, more specifically, with SDG 12 "Responsible production and consumption". An important aspect which can hinder the transition towards circularity are chemicals of concern – risking not only harmful impacts on human health and the environment along a products' life cycle but also threatening certain value retention loops, such as remanufacturing or recycling. A key element is therefore to identify and phase out or better manage chemicals of concern along value chains.

Considering the above, circularity is an opportunity to favour sustainable development, seen from its three components: economic, environmental (ecological), and socio-political. It is evident that there is a need to apply circularity to those productive sectors whose demand – and therefore its impact – has increased exponentially. The electronic sector is such a sector, having constant growth as a consequence of modern lifestyles based on technology that facilitates and provides a higher quality of life to the user / consumer.

Globally, it has been possible to show that the consumption of electronics increases 2.5 million metric tons per year (Forti, Baldé, Kuehr, & Bel, 2020). However, this consumption has been associated with considerable impacts on human health and the environment along the life cycle of these products ranging from extraction and transformation of raw materials to disposal at the end of life.



The electronics sector is characterized by multiple sustainability challenges, including the large number of resources used to manufacture products, and the use of various hazardous substances, but above all by the difficulty in recovering its waste for subsequent recirculation in new production processes (Gama, Fischer, & Herrmann, 2016). Compared to other consumer products, electronics are generally complex, consisting of a wide variety of components and materials that contain many chemical additives. Some of these chemical additives are considered to be hazardous and may be released during the product's life cycle, leading to environmental and human exposures and possible adverse impacts. Risks for such impacts are however especially pronounced during the end-of-life stages of EEE due to the high share of informal recycling, which can lead to the uncontrolled release of pollution.

While there are many approaches to address impacts of electronics at their end-of-life stages, it can also be effective to take action at upstream stages of the value chain, for example during the design phase. Action thus needs to consider a holistic perspective of the entire life cycle, including consumption patterns. This includes, for example, the choice of individual flame retardants during material engineering or designing a product in a way that hinders easy repair and thus accelerates the rate of products becoming obsolete. Taking a value chain approach is therefore key to reducing environmental and human health impacts of EEE along their life cycle and to increasing the electronic sector's contribution to more sustainable consumption and production patterns.

It is for this reason that it is important to analyze the electronics sector throughout the different phases that make up its life cycle, but further, to identify opportunities to generate circularity in each one, and this will be possible thanks to the synergy of the different countries.

The growth and impact of the electronics sector in Latin America and the Caribbean has shown a strong increase in the region and this is due to the relationship that exists between technological development and the use and consumption of electrical and electronic equipment (EEE), which have become essential products in today's societies. The opportunity to generate circularity through various value retention loops in the Latin American and Caribbean region is key to improve the current figures for electrical and electronic equipment waste (WEEE) generation, including chemicals of concern. For example, for 2017, of the total WEEE generated worldwide, Latin America represented approximately 9% with a generation of 4,400 kilotonnes (Jorisch et al, 2018).

The present document is an interim deliverable of a project to develop a life cycle study and circularity roadmap for the Latin America and Caribbean region, namely it outlines the stakeholder mapping conducted for the study¹. Throughout this document, different actors of each stage of the life cycle of EEE are identified and presented. This will provide insights into the activities that are carried out in each stage of the value chain and inform actions proposed to enable the transition towards a more circular electronics sector. The mapping of the stakeholders that follows aims to identify their specific

¹ More information at <https://saicmknowledge.org/topic/circularity-electronics-latin-america-and-caribbean>



motivations and their interest in willing ²to be. Aiming at a balanced but manageable selection of countries in the region, given time and resources, the following countries have been selected for closer analysis: Argentina, Brazil, Colombia, Mexico, Uruguay.

Some examples of national stakeholders that can be found throughout this document are: manufacturers of substances, machinery and equipment for metal recovery, suppliers of raw materials for the electronics industry, business associations, manufacturers and importers of electronics (including SMEs), electronic design companies, brands, professional associations in the electronics and chemical industry, logistics companies, technology chain stores, associated technology companies, groups of technology distribution companies, electronics consumers and consumer associations, retailers and shopping centers with collection points, waste management companies including Producer Responsibility Organizations, take-back associations, repair, remanufacturing and design companies for new electronic products, companies that recover metals and other e-waste streams, businesses dedicated to the final disposal of unusable streams, ministries (e.g. industry, environment, women, tourism), environmental and environmental licensing authorities, Chambers of Commerce and green chambers of commerce, universities and university networks, NGOs and centers of research in sustainable consumption and production, international and regional organizations that regulate and group the electronics industry and waste management.

The presence of these interested parties in the study will depend on their participation in each phase, taking into account the national infrastructure and capacity.

OBJECTIVE

Identify the stakeholders of each of the selected countries in the different parts of the value chain of the electronics sector and select the dissemination channels.

METHOD

In this document, the stakeholders mapping of each selected country will be carried out using a matrix which is presented in illustration 2. It includes the four quadrants: 1. Manage closely; 2. Keep satisfied; 3. Keep informed; and 4. Monitor. In order to define the different levels of participation in the project consultation process.

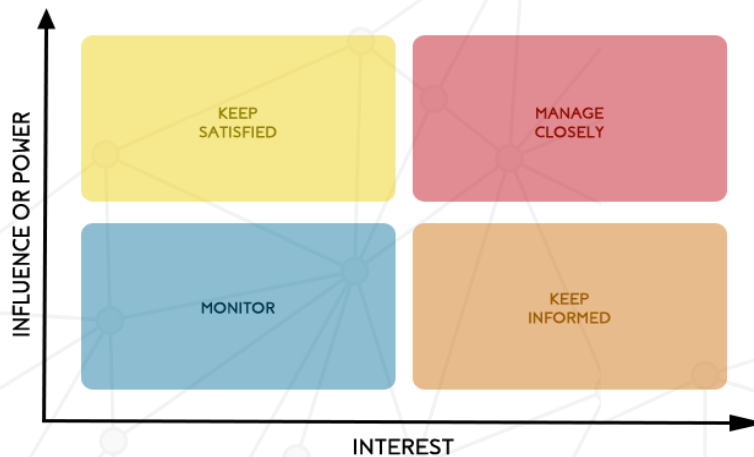
- 1. Manage closely:** This quadrant includes the leading stakeholders with the highest degree of interest and influence in the study. These should be contacted with greater importance for the development of this project, however, if this document is used in future initiatives, it should be reviewed regularly by the organization or person who formulates them. Likewise, their contact should be frequent in order to obtain their feedback, advice, among others.
- 2. Keep Satisfied:** These are leading stakeholders who have less interest because they're not impacted as directly or have a smaller team that will experience the change as group 1. However, this group is critical because they still have a high degree of influence on this

² Stakeholders will be from all stages of the value chain: design, extraction and transformation of raw materials, production, distribution, use, end of life and use

project. This group needs some degree of regular updates and a chance to provide feedback at critical junctures.

3. **Keep Informed.** Stakeholders in this category have less influence over the change but are highly interested in what's going on.
4. **Monitor.** These stakeholders do not need to be frequently contacted by the project's team, but they must be included in this study, however they don't have as much influence or interest. It is necessary to be monitoring them to ensure that this project haven't missed how they may be impacted by change.

However, before developing the matrix, the parties involved in each of the stages or phases of the electronics life cycle / value chain are identified. Even so, it is important to bear in mind that this first mapping of the stakeholders is prepared according to the interest and level of participation that we expect in the project, so once the results of the contact survey are obtained, they may vary considering the responses sent by the stakeholders contacted.



*Illustration 2. Stakeholder mapping matrix
Source: Adapted by the author*

COLOMBIA

Stakeholder identification

To identify and map the interested parties throughout the value chain, whether from the formal or informal sector, a review of the previous deliverables related to Colombia will be carried out. Likewise, the institutional framework of the National Policy for the Integral Management of WEEE will be considered, since their participation is essential for the control, management and formulation of plans and actions against the management of electrical waste and electronic.

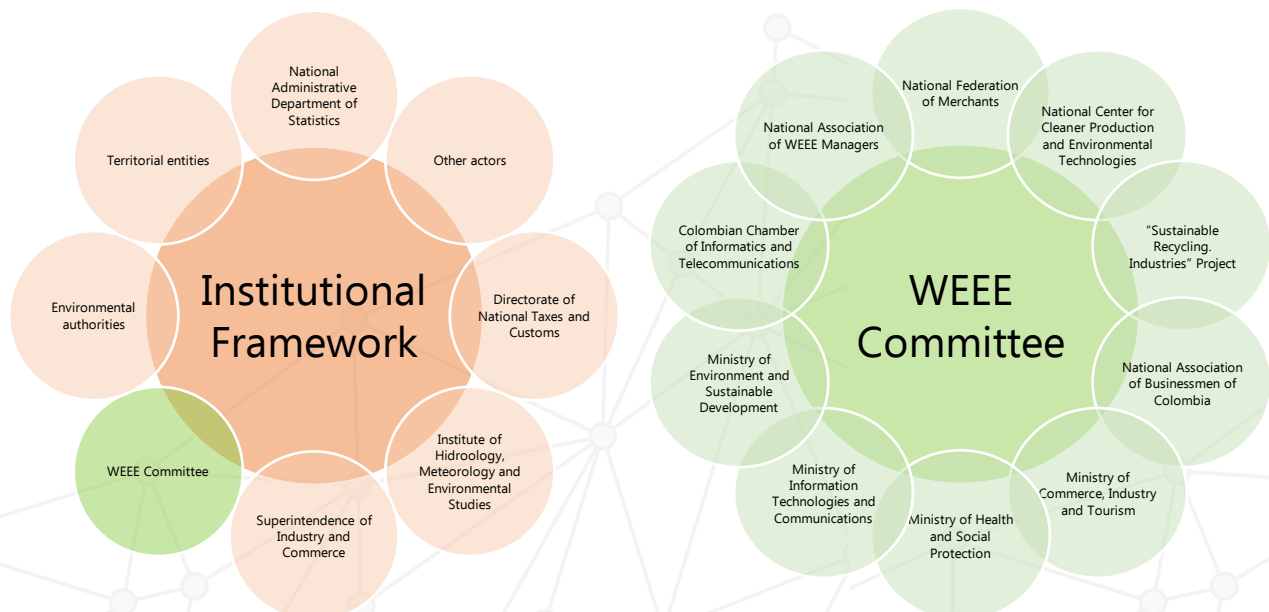


Illustration 3. Institutional framework related to WEEE in Colombia

Source: (Ministry of Environment and Sustainable Development, 2017) adapted by the author

According to illustration 3, we can conclude that within the formal sector there are actors at the government level such as environmental entities (Ministry of Environment and Sustainable Development), territorial entities, the National Administrative Department of Statistics, the Superintendence of Industry and Commerce, the Institute of Hydrology, Meteorology and Environmental Studies (IDEAM) and the National Tax and Customs Directorate. However, to go a little more in depth with the organizations and entities directly related to WEEE are:

- ✓ National Association of WEEE Managers
- ✓ National Federation of Merchants
- ✓ Colombian Chamber of Informatics and Telecommunications
- ✓ Ministry of Environment and Sustainable Development
- ✓ Ministry of Information Technologies and Communications
- ✓ Ministry of Health and Social Protection
- ✓ Ministry of Commerce, Industry and Tourism
- ✓ National Association of Businessmen of Colombia



- ✓ “Sustainable Recycling Industries” Project
- ✓ National Center for Cleaner Production and Environmental Technologies

Although the previous interested parties participated in the formulation of the National Policy related to WEEE, it is important to recognize the actors who allocate their actions to any of the stages of the life cycle or value chain of the electronics sector. After an analysis and referential search, the following are identified:

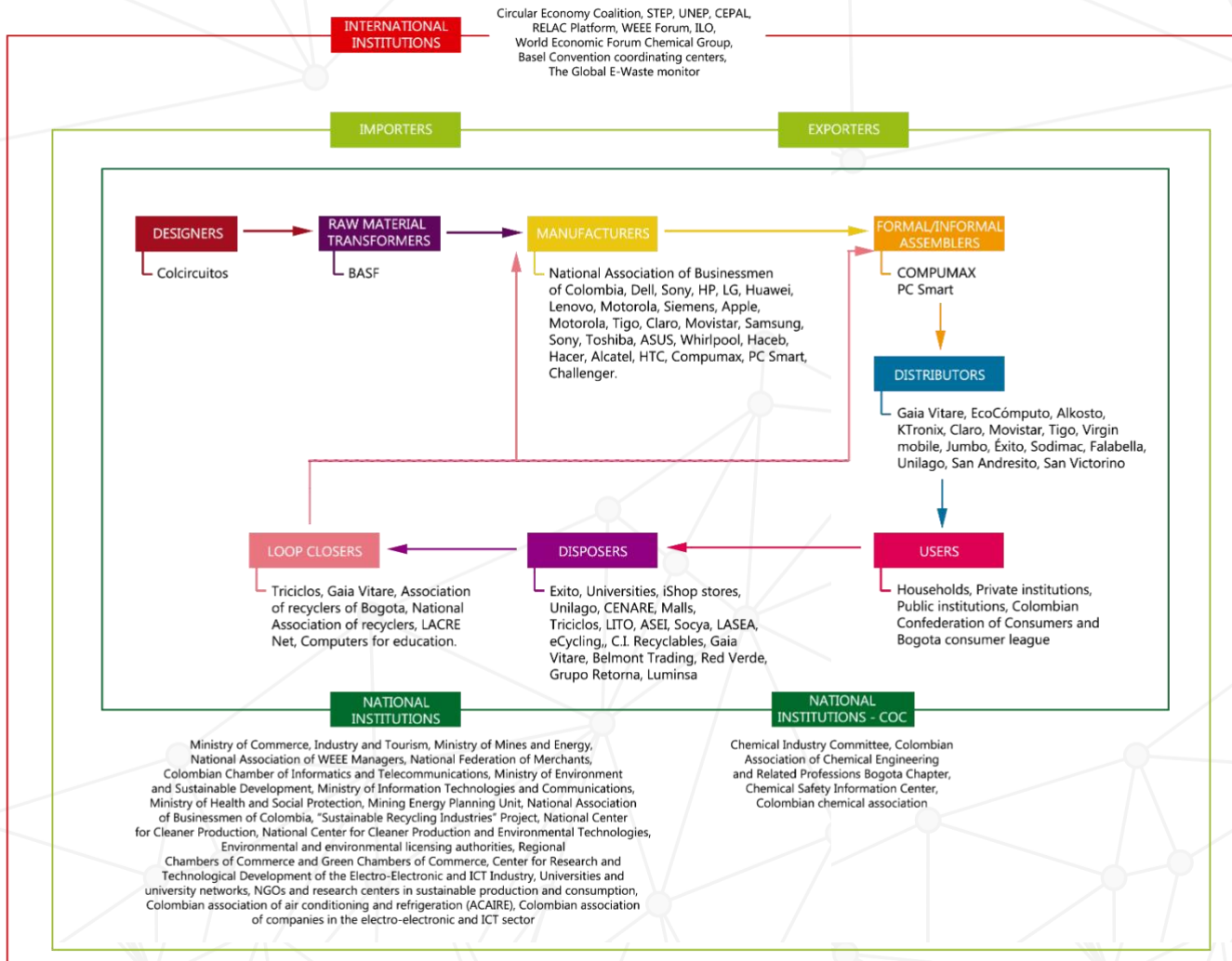
Life cycle phase	Stakeholder	Organization
Design	Electronic design companies	Colcircuitos
Raw material transformation	Raw material suppliers for the electronics industry	BASF (Chemical and plastics products)
Production - Manufacturers	Business associations	National Association of Businessmen of Colombia (ANDI)
	Electronics manufacturers and importers	Dell, Sony, HP, LG, Huawei, Lenovo, Motorola, Siemens, Apple, Motorola, Tigo, Claro, Movistar, Samsung, Mabe, Sony, Toshiba, ASUS, Whirlpool, Haceb, Hacer, Alcatel, HTC, Compumax, PC Smart, Challenger.
Distribution	Direct and reverse logistics companies	Gaia Vitare, EcoCómputo and transport services of distribution or production companies
	Technology store chains	Alkosto, Claro, Movistar, Tigo, Jumbo, Éxito, Sodimac, Falabella
	Clusters of technology distribution companies	Unilago, San Andresito, San Victorino
Use	Electronics consumers and consumers associations	Households, Private institutions, public institutions, Colombian Confederation of Consumers and Bogota consumer league
End of use – Disposal	Shopping centers with collection points	Exito, Universities (El Bosque University, Santo Tomas, Central, Manuela Beltrán, Javeriana, etc.), iShop stores, Unilago, CENARE, Malls (Palatino, Plaza Imperial, Galerías, Santafé, Titán Plaza, etc.)
	Waste management Companies	Triciclos, LITO, ASEI, Socya, LASEA, eCycling, CENARE, C.I. Recyclables, Gaia Vitare, Belmont Trading, Red Verde, Grupo Retorna (Ecocómputo and Pilas con el ambiente), Luminsa
Closing the loop	Recovery associations	Triciclos, Gaia Vitare, Association of recyclers of Bogota, National Association of recyclers, LACRE Net, Computers for education.
	Repair, remanufacturing and design companies for new electronics products	



	Companies that recover metals and other streams from electronics waste	
Transversal institutions	Companies dedicated to the final disposal of unusable streams	<p>Institutions related to AEE and WEEE (National and international):</p> <ul style="list-style-type: none"> -Ministry of Commerce, Industry and Tourism -Ministry of Mines and Energy -National Association of WEEE Managers -National Federation of Merchants -Colombian Chamber of Informatics and Telecommunications - Ministry of Environment and Sustainable Development - Ministry of Information Technologies and Communications - Ministry of Health and Social Protection - Mining Energy Planning Unit - National Association of Businessmen of Colombia -“Sustainable Recycling Industries” Project - National Center for Cleaner Production - National Center for Cleaner Production and Environmental Technologies - Environmental and environmental licensing authorities (ANLA – Acronym in Spanish) - Regional Chambers of Commerce and Green Chambers of Commerce - Center for Research and Technological Development of the Electro-Electronic and ICT Industry - Universities and university networks - NGOs and research centers in sustainable production and consumption - Colombian association of air conditioning and refrigeration (ACAIRE) - Colombian association of companies in the electro-electronic and ICT sector - International and regional organizations that regulate and group the electronics industry and waste management (Circular Economy Coalition, STEP, UNEP, CEPAL, RELAC Platform, WEEE Forum, ILO, World Economic Forum Chemical Group, etc.) <p>Chemicals of concern (National):</p> <ul style="list-style-type: none"> -Chemical Industry Committee (CIQ – acronym in Spanish) -Colombian Association of Chemical Engineering and Related Professions Bogotá Chapter (ACIQ –Acronym in Spanish) -Chemical Safety Information Center (CISPROQUIM – acronym in Spanish) -Colombian chemical association

*Table 1. Names of stakeholder organizations in the life cycle phases in the electronics sector in Colombia
 Source: (Pinzón & Urbina, 2015) adapted by the author*

Next, a graph with actors of the electronics value chain in Colombia is presented.

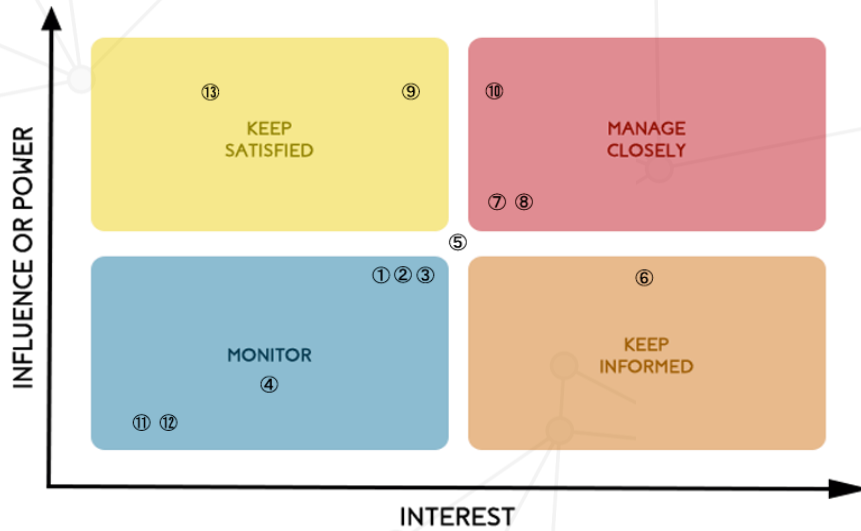


Graphic 1. Colombian stakeholders in the phases of the value chain of the electronics sector
 Source: (Pinzón & Urbina, 2015)

Stakeholder mapping

Mapping stakeholders allows for better and more strategic management of these. This is done through mapping matrices, which allow interaction with appropriate actors and related to the objectives set. These matrices are a visual representation of the relationship that stakeholders have with an organization and / or project, facilitating the visual monitoring of the evolution of these relationships (in both directions) over time. Each quadrant³ of the map determines the intensity, frequency and type of management that the stakeholders will require in the project. This mapping is possible thanks to the classification presented above (Robichaud, 2018).

³ Keep satisfied, Manage closely, Monitor and Keep informed.



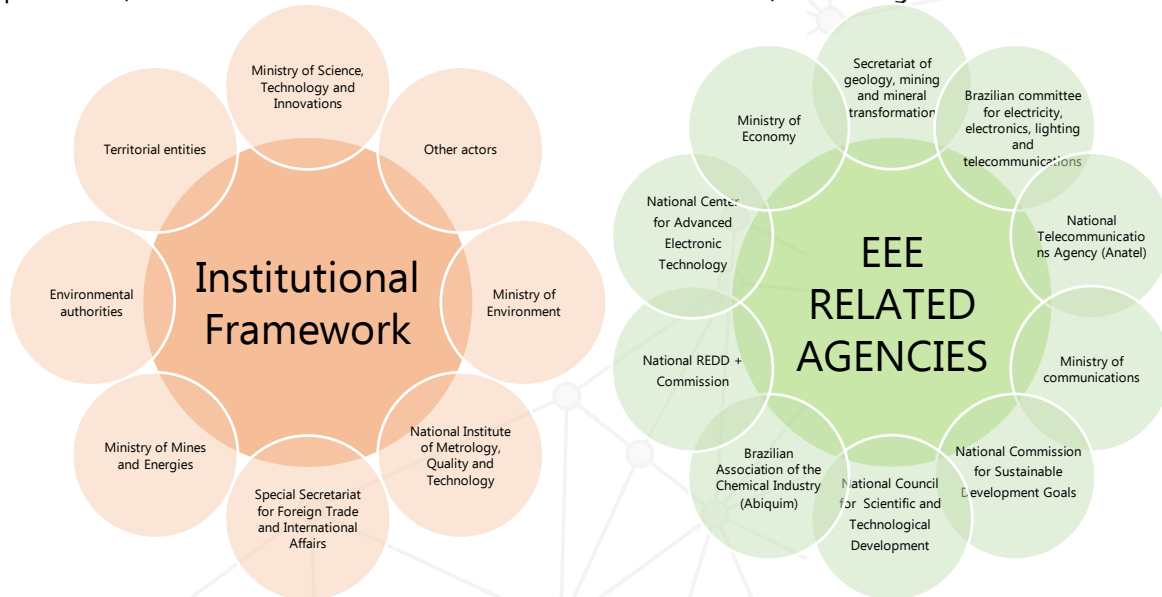
- ① Designers
- ② Raw material transformers
- ③ Manufacturers
- ④ Formal/informal assemblers
- ⑤ Distributors
- ⑥ Users
- ⑦ Disposers
- ⑧ Loop closers
- ⑨ National institutions
- ⑩ National institutions - CoC
- ⑪ Importers
- ⑫ Exporters
- ⑬ International institutions

Illustration 4. Stakeholder mapping matrix in Colombia according to the value chain phases
 Source: Author

BRAZIL

Stakeholder identification

To identify and map stakeholders along the value chain in Brazil, a review will be carried out of the private (either from the formal or informal sector) and governmental entities.



*Illustration 5. Institutional framework related to EEE in Brazil
Adapted by the author*

According to illustration 5, we can conclude that there are actors at the government level such as environmental entities (Ministry of Environment), territorial entities, the Ministry of Science technology and innovations, Special Secretariat for Foreign Trade and International Affairs, Institute of metrology, quality and metrology and Ministry of Mines and Energies. However, to go a little more in depth with the organizations and entities directly related to EEE are:

- ✓ Secretariat of geology, mining and mineral transformation
- ✓ Brazilian committee for electricity, electronics, lighting and telecommunications
- ✓ National Telecommunications Agency (Anatel)
- ✓ Ministry of communications
- ✓ National Council for Scientific and Technological Development
- ✓ National Commission for Sustainable Development Goals
- ✓ Brazilian Association of the Chemical Industry (Abiquim)
- ✓ National REDD + Commission
- ✓ National Center for Advanced Electronic Technology
- ✓ Ministry of Economy

Besides the above government agencies, it is important to consider actors that are part of the electronics value chain. After an analysis and referential search, the following are identified:



Life cycle phase	Stakeholder	Organization
Design	Electronic design companies	HTM Electronics Transire Electronics Center of Excellence in Electronic technology (CEITEC) Electronic Components Trade (CCE) Avell Cineral Multiláser
Raw material transformation	Raw material suppliers for the electronics industry	Datiquim Chemical Products Ltda. Delquimica BASF 3M Braskem Du Pont
Production – Manufacturers	Business associations	Brazilian Association of the Chemical Industry (Abiquim) Brazilian Committee for Electricity, Electronics, Lighting and Telecommunications – COBEI
	Electronics manufacturers and importers	Daikin Global, Canon, AOC, Black and Decker, Electrolux, Hikvision, LG, Hitachi, Metalfrio, NewellBrands, Panasonic, Philips, Samsung, Whirlpool, Siemens, 3M, Apple, Dell, HP.
	Electronics manufacturers and Exporters	Please consult: Link , for identify the enterprises according with differences productions lines establishes for the ministry of economy
Distribution	Direct and reverse logistics companies	Abinee, Abimo, Abilux, Electros, Sindicel, and transport services of distribution or production companies
	Technology store chains	National Center for Advanced Electronic Technology, Aquarius, Bematech, Clon, Metaltex, Micro-panel industry and electronic products trade Ltda, Multiláser, Qbex, Semp TCL, Telefónica Brasil, América Móvil (Claro), Telecom, Apple, Samsung, Positivo
	Clusters of technology distribution companies	Vvix Technology, Enviro, Technology purchases, Allied, CSEM Brazil.
Use	Electronics consumers and consumers associations	Households, Private institutions, Public institutions, Brazilian Consumers Association.
End of use – Disposal	Enterprises with collection points	E-Cycle, Recicloteca. SONY, Zyklus Apple, HP, Motorola, Samsung, Prorecicle, Techtrash, Popular Cooperative of Friends of the Environment COOPAMA, Positivo, Sony, GM&Clog, Leroy Merlin, Reciclus, Tramppo.



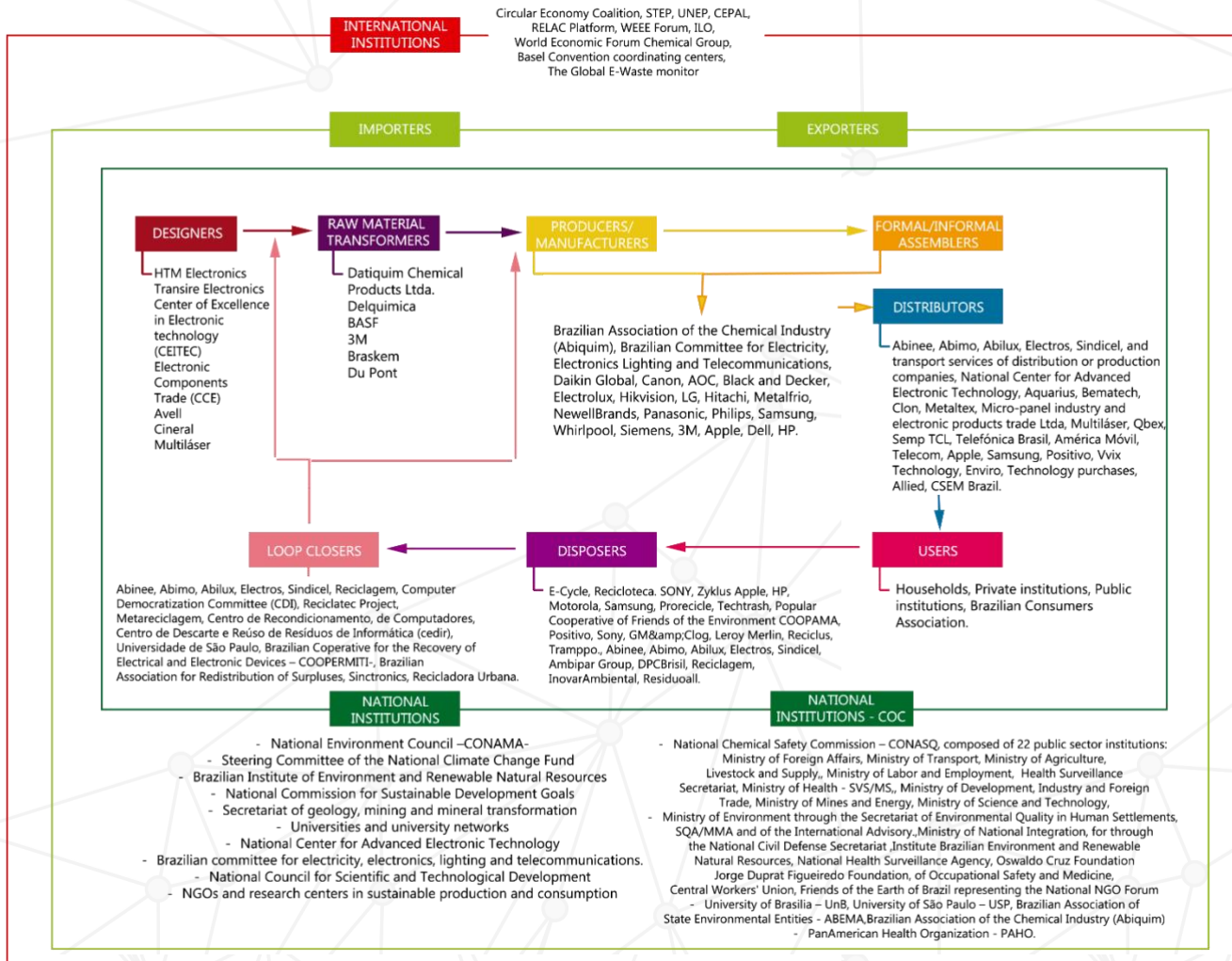
	Waste management Companies	Abinee, Abimo, Abilux, Electros, Sindicel, Ambipar Group, DPCBrisil, Reciclagem, InovarAmbiental, Residuoall.
Closing the loop	Recovery associations	Abinee, Abimo, Abilux, Electros, Sindicel, Reciclagem, Computer Democratization Committee (CDI), Reciclatec Project, Metareciclagem, Centro de Recondicionamento de Computadores, Centro de Descarte e Reúso de Resíduos de Informática (cedir), Universidade de São Paulo, Brazilian Coperative for the Recovery of Electrical and Electronic Devices – COOPERMITI-, Brazilian Association for Redistribution of Surpluses, Sinctronics, Recicladora Urbana.
	Repair, remanufacturing and design companies for new electronics products	
	Companies that recover metals and other streams from electronics waste	
	Companies dedicated to the final disposal of unusable streams	
Transversal institutions	<ul style="list-style-type: none"> - Institutions related to AEE and WAEE (National and international): - National Environment Council –CONAMA- - Steering Committee of the National Climate Change Fund - Brazilian Institute of Environment and Renewable Natural Resources - National Commission for Sustainable Development Goals - Secretariat of geology, mining and mineral transformation - Universities and university networks - National Center for Advanced Electronic Technology - Brazilian committee for electricity, electronics, lighting and telecommunications. - National Council for Scientific and Technological Development - NGOs and research centers in sustainable production and consumption - International and regional organizations that regulate and group the electronics industry and waste management (STEP, UNEP, CEPAL, RELAC Platform, WEEE Forum, etc.) - Chemicals of concern (National): - National Chemical Safety Commission – CONASQ, composed of 22 public sector institutions: <ul style="list-style-type: none"> - Ministry of Foreign Affairs – MRE - Ministry of Transport – MT - Ministry of Agriculture, Livestock and Supply – MAPA - Ministry of Labor and Employment – MTE - Health Surveillance Secretariat - Ministry of Health - SVS/MS - Ministry of Development - Industry and Foreign Trade – MDIC - Ministry of Mines and Energy – MME - Ministry of Science and Technology – MCT 	



	<ul style="list-style-type: none">- Ministry of Environment through the Secretariat of Environmental Quality in Human Settlements - SQA/MMA and of the International Advisory.- Ministry of National Integration, for through the National Civil Defense Secretariat - SEDEC/MI- Institute Brazilian Environment and Renewable Natural Resources – IBAMA- National Health Surveillance Agency – ANVISA- Oswaldo Cruz Foundation – FIOCRUZ- Jorge Duprat Figueiredo Foundation- of Occupational Safety and Medicine – FUNDACENTRO- Central Workers' Union – CUT- Friends of the Earth of Brazil representing the National NGO Forum- University of Brasilia – UnB- University of São Paulo – USP- Brazilian Association of State Environmental Entities - ABEMA- Brazilian Association of the Chemical Industry (Abiquim)- PanAmerican Health Organization - PAHO.
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*Table 2. Names of stakeholder organizations in the life cycle phases in the electronics sector in Brazil
Source: Author*

Next, a graph with actors of the electronics value chain in Brazil is presented.

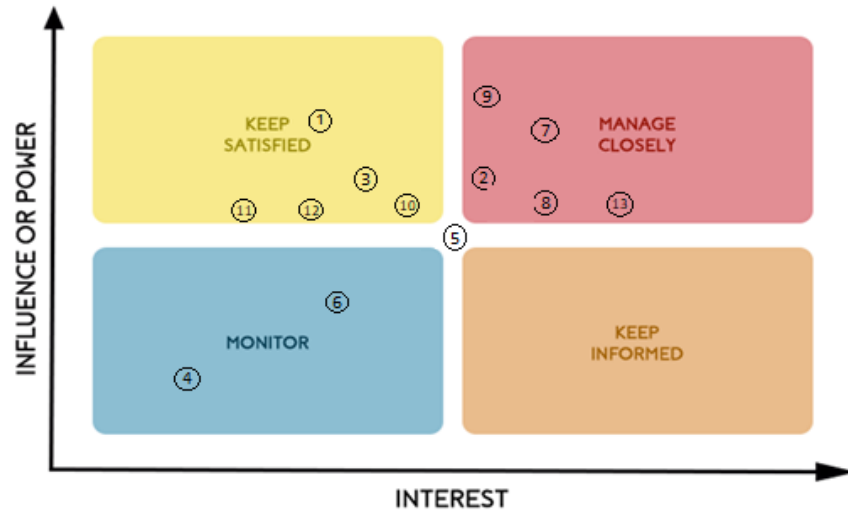


Graphic 2. Brazil stakeholders in the phases of the value chain of the electronics sector
 Source: Author

Stakeholder mapping

Stakeholder mapping allows for better management of these, and the importance of managing them strategically has been recognized. This is done through mapping matrices, which allow interaction with appropriate actors and related to the objectives set, these matrices are a visual representation of the relationship that stakeholders have with an organization and / or project, facilitating visual monitoring. of the evolution of these relationships (in both directions) over time. Each quadrant⁴ of the map determines the intensity, frequency and type of management that the stakeholders will require in the project. This mapping is possible thanks to the classification presented above (Robichaud, 2018).

⁴ Keep satisfied, manage closely, Monitor and Keep informed.



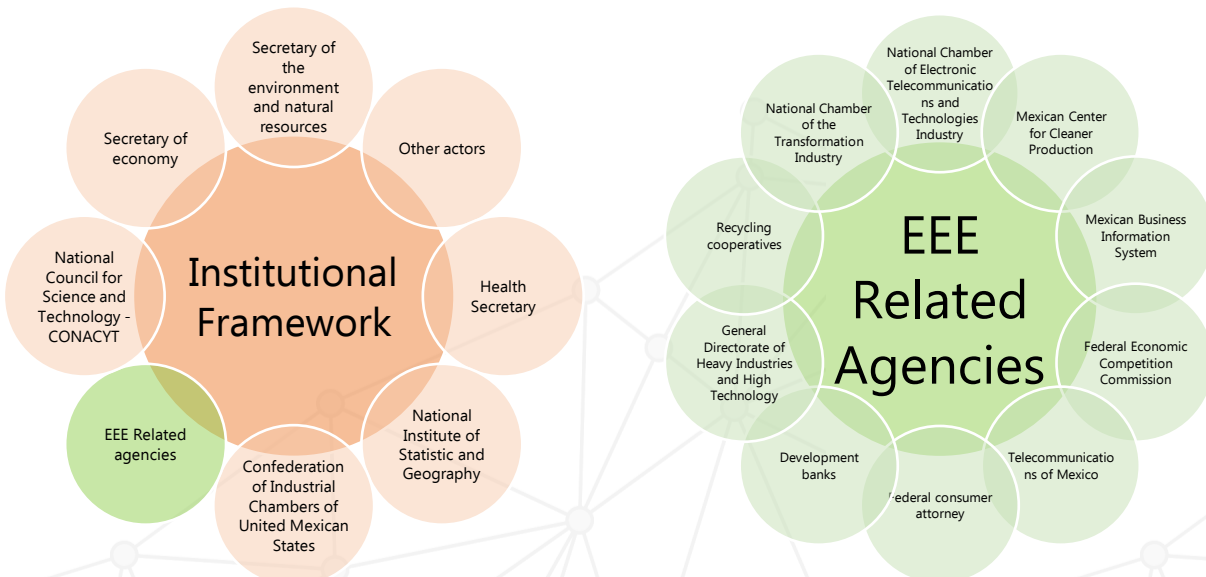
- | | |
|------------------------------|-------------------------------|
| ① Designers | ⑦ Disposers |
| ② Raw material transformers | ⑧ Loop closers |
| ③ Manufacturers | ⑨ National institutions |
| ④ Formal/informal assemblers | ⑩ National institutions - CoC |
| ⑤ Distributors | ⑪ Importers |
| ⑥ Users | ⑫ Exporters |
| | ⑬ International institutions |

Illustration 6. Stakeholder mapping matrix in Brazil according to the value chain phases
 Source: Author

MEXICO

Stakeholder identification

The identification and mapping of stakeholders is made from the review of the regulatory and institutional framework of Mexico, where it seeks to recognize the actors involved throughout the value chain. An important actor to consider is the industrial sector unions, which are made up of members from the same economic activity.



*Illustration 7. Institutional framework related to EEE in Mexico
 Source: author.*

According to illustration 7, two main groups of actors were identified. The first group are public control entities and institutions that capture and measure information for decision-making, which are related to the Institutional Framework. The second group is made up of the organizations related to the sectors that intervene in the electronics value chain, such as industrial associations, consumer defenders, and public regulatory entities of technical aspects. It is important to note that these are not two separate groups, but rather a group that makes decisions at the national level and dictates the general rules, and on the other hand, a group closer to the economic sector who determines aspects at the tactical and operational level. In general, the identified actors are:

- ✓ National Chamber of the Electronic Telecommunications and Technologies Industry -CANIETI
- ✓ Mexican Center for Cleaner Production
- ✓ Mexican business information system
- ✓ Federal economic competition commission
- ✓ Telecommunications of Mexico - TELECOMM
- ✓ Federal consumer attorney
- ✓ Development banks
- ✓ General Directorate of Heavy Industries and High Technology
- ✓ Recycling cooperatives



✓ National Chamber of the Transformation Industry – CANACINTRA

Once the institutional actors and representatives that intervene in the Electrical and Electronic Equipment sector have been identified, there are other stakeholders that are directly related to each of the phases of the value chain which are the following:

Life cycle phase	Stakeholder	Organization
Design	Electronic design companies	INELECTRONIC, VIELECTRONICS, Honpe, Technology, Grupo ABB, Alps Alpine, Semtech.
Raw material transformation	Raw material suppliers for the electronics industry	Digi-Key Electronics, Química Delta
Production	Business associations	National Chamber of the Transformation Industry - CANACINTRA
	Electronics manufacturers and importers	JM Distribuidores, Nuko Automatizacion S.A, Xaze Distribuidor de Tecnología.
	Electronics manufacturers and Exporters	LG, Foxconn, Samsung, HP, Motorola, Flextronics, Intel, Panasonic, Ericsson, BlackBerry, Alcatel, Siemens.
Distribution	Direct and reverse logistics companies	Recicla Electrónicos México S.A. de C.V., PROAMBI, AER Worldwide, Belmont Trading Company, Glezco.
	Technology store chains	Sodimac, Elektra, Wallmart, Best Buy, Home Depot México, El Palacio de Hierro.
	Clusters of technology distribution companies	There are 38 Clusters distributed in Mexico according to the National Chamber of the Electronic Telecommunications and Technologies Industry – CIANETI. Link
Use	Electronics consumers and consumers associations	Federal consumer attorney
End of use	Electronics consumers and consumers associations	Federal consumer attorney
	Enterprises with collection points	Recicla Electrónicos México S.A. de C.V., Recicla Computadoras México, Apple.
	Waste management Companies	Recicla Electrónicos México S.A. de C.V., PROAMBI, AER Worldwide, Belmont Trading Company, Glezco.
Closing the loop	Recovery associations	Centros de Reciclaje Recupera, S.A. de C.V.,
	Repair, remanufacturing and design companies for new electronics products	Recicla Electrónicos México S.A. de C.V., PROAMBI, AER Worldwide, Belmont Trading Company, Glezco, Silikn Network, Reciclables

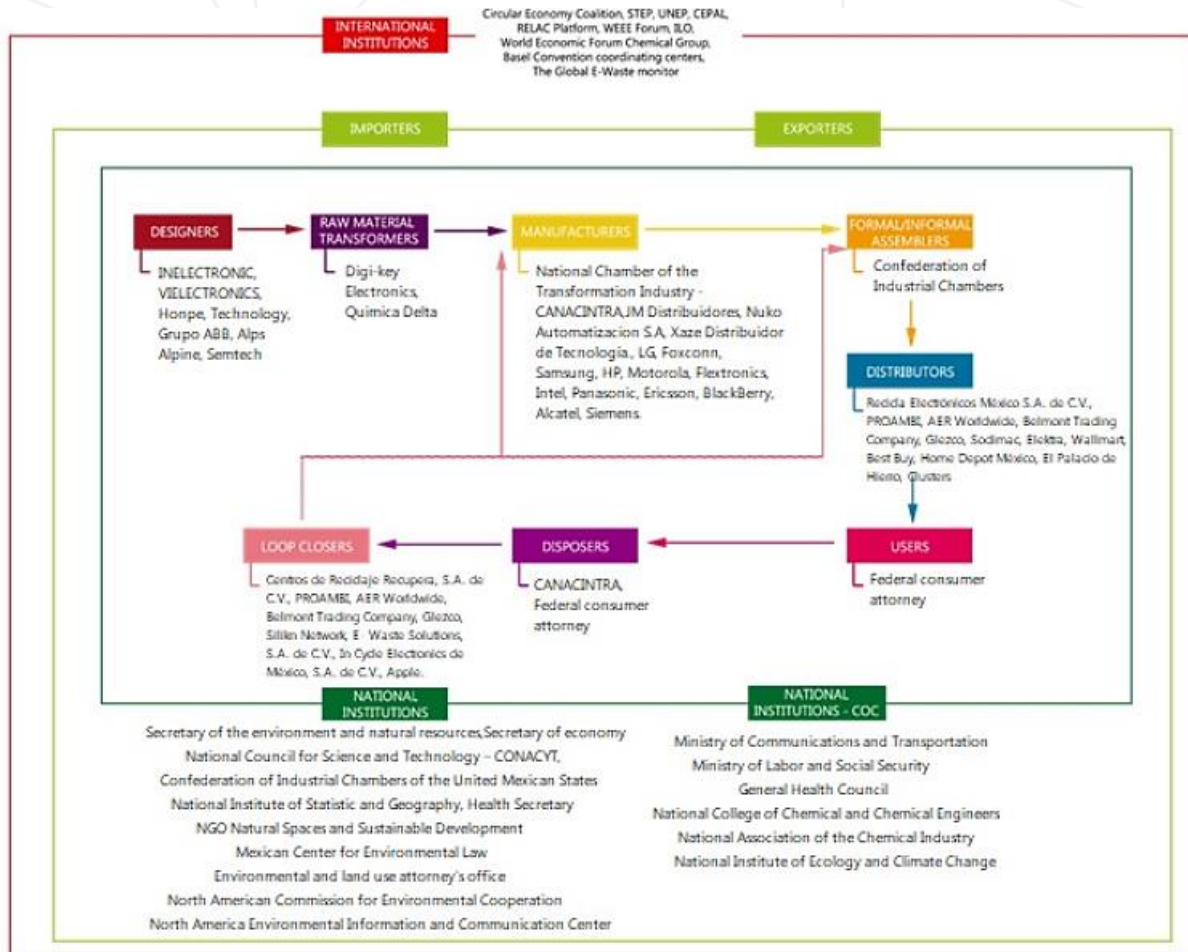


	Companies that recover metals and other streams from electronics waste	Los Gallos, E- Waste Solutions, S.A. de C.V., Reciclemos Juntos, In Cycle Electronics de México, S.A. de C.V., Reclicladora Eco Azteca S.A. de C.V., Recuperaciones Tinajero, S.A. DE C.V.
	Companies dedicated to the final disposal of unusable streams	
Transversal institutions	<ul style="list-style-type: none"> - Secretary of the environment and natural resources - Secretary of economy - National Council for Science and Technology – CONACYT - Confederation of Industrial Chambers of the United Mexican States - National Institute of Statistic and Geography - Health Secretary - NGO Natural Spaces and Sustainable Development - Mexican Center for Environmental Law - Environmental and land use attorney's office - North American Commission for Environmental Cooperation - North America Environmental Information and Communication Center <p>Chemicals of concern (National):</p> <ul style="list-style-type: none"> - Federal Commission for the Protection against Sanitary Risks - Inter-secretarial Commission for the Control of the Process and Use of Pesticides and Toxic Substances – CICOPLAFFEST - Evidence and Risk Management Commission - Ministry of Communications and Transportation - Ministry of Labor and Social Security - General Health Council - National College of Chemical and Chemical Engineers - National Association of the Chemical Industry - National Institute of Ecology and Climate Change 	

Table 3. Names of stakeholder organizations in the life cycle phases in the electronics sector in México

Source: Author

Next, a graph with actors of the electronics value chain in Mexico is presented.



Graphic 3. Mexican stakeholders in the phases of the value chain of the electronics sector
 Source: Author

Stakeholder mapping

Stakeholder mapping allows for better management of these, and the importance of managing them strategically has been recognized. This is done through mapping matrices, which allow interaction with appropriate actors and related to the objectives set, these matrices are a visual representation of the relationship that stakeholders have with an organization and / or project, facilitating visual monitoring. of the evolution of these relationships (in both directions) over time. Each quadrant⁵ of the map determines the intensity, frequency and type of management that the stakeholders will require in the project. This mapping is possible thanks to the classification presented above (Robichaud, 2018).

⁵ Keep satisfied, manage closely, Monitor and Keep informed.

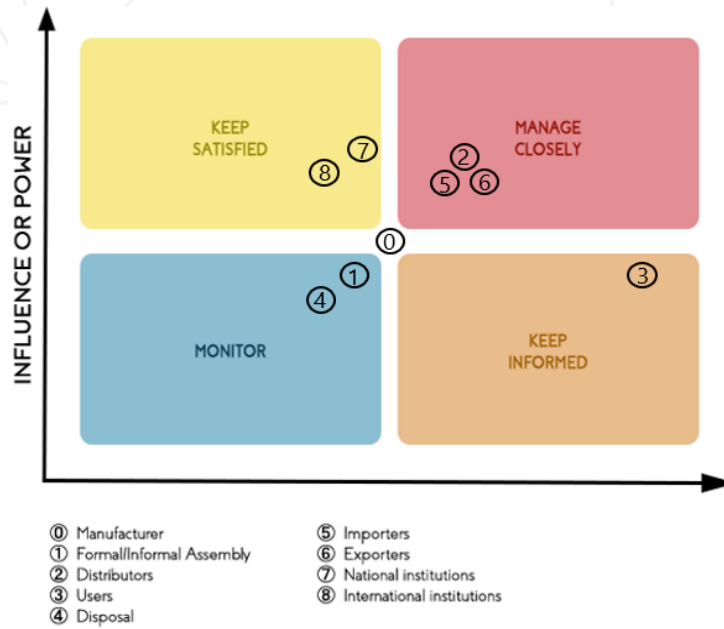


Illustration 8. Stakeholder mapping matrix in Mexico according to the value chain phases

Source: Author

ARGENTINA

Stakeholder identification

Public and private national regulatory entities were identified in order to distinguish the relationship that they have promoted to allow new interventions that ensure EEE durability. Eco design can provide a high-quality product through energy efficiency processes and at the same time fix equipment to be handled with better precision and quality. With this, WEEE concept has to be evaluated and perform new ways to achieve better results.

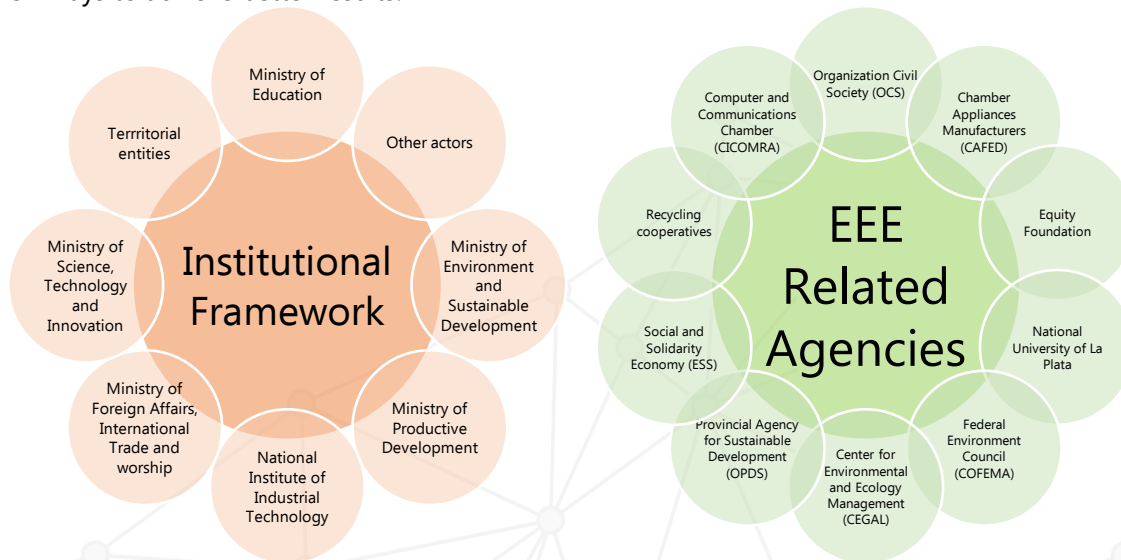


Illustration 9. Institutional framework related to WEEE in Argentina

Source: Author.

It can be concluded in illustration 9 that Argentina has created different organizations for environmental management over time. These are regulatory entities such as the Ministry of Education, the Ministry of the Environment and Sustainable Development, the Ministry of Foreign Affairs, International Trade and Worship, INTI, among other territorial authorities; for the respective management of the pre-consumption, during and post-consumption of WEEE.

Other entities carry out compliance with Argentine regulations, such as human rights laws and resolutions.

In general, the identified actors are:

- Computer and Communications Chamber (CICOMRA)
- Organization Civil Society (OCS)
- Universidad Nacional de la Plata
- Equity Foundation
- Federal Environment Council (COFEMA)



- Provincial Agency for Sustainable Development (OPDS)
- Social and Solidarity Economy (ESS)
- Chamber Appliances Manufacturers (CAFED)

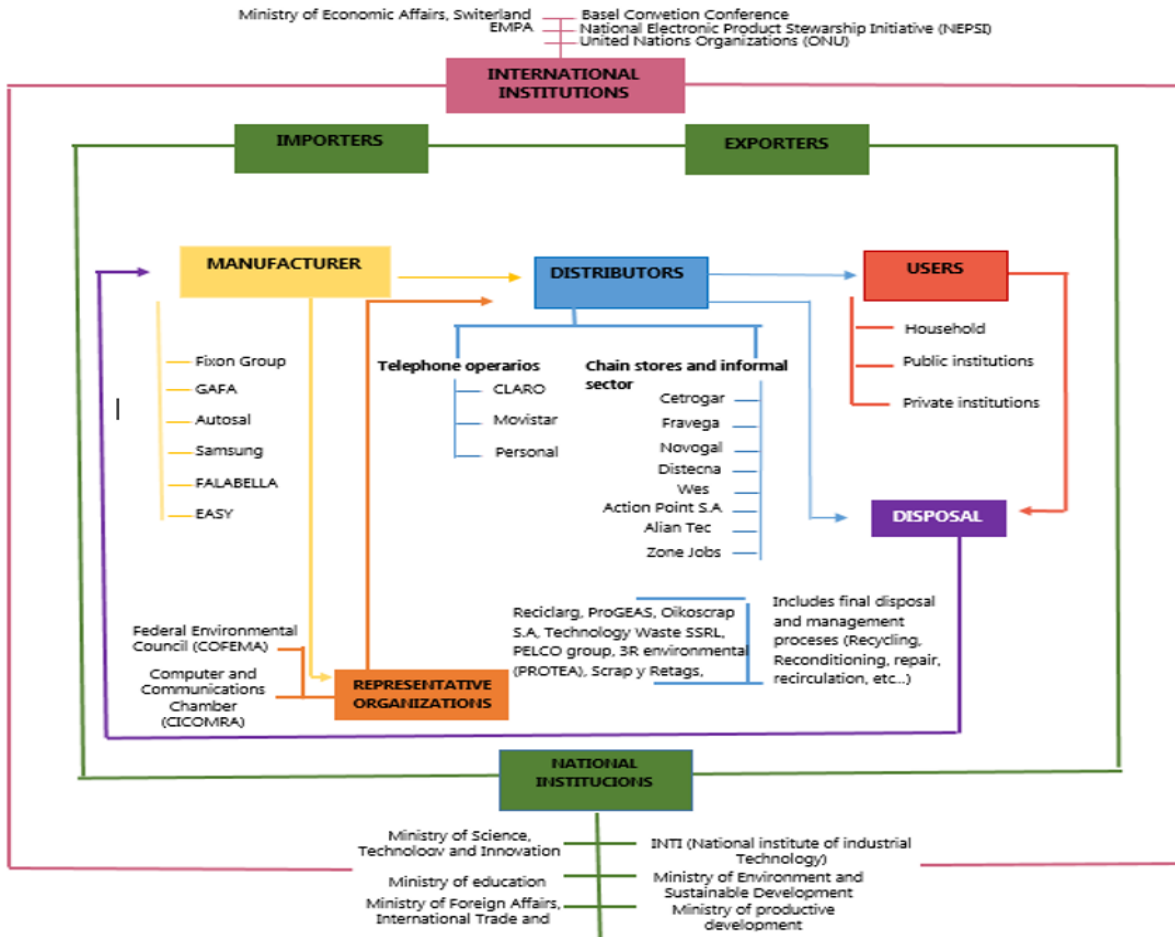
Life cycle phase	Stakeholder	Organization
Design	Electronic design companies	Codini, Zerweny, Liliana, Gafa, Alladio
Raw material transformation	Raw material suppliers for the electronics industry	Benvenuti Hnos S.A, Buenos Aires Components, Casa Correa, Electronical Univel.
Production	Business associations	Computer and Communications Chamber (CICOMRA)
	Electronics manufacturers and importers	Fixon Group, Ceven, GAFA, Liliana, Autosal
	Electronics manufacturers and Exporters	Longvie Mabe
Distribution	Direct and reverse logistics companies	Silkers S.A DALAFER industry
	Technology store chains	EASY, Falabella, Cetrogar, Garbarino, Estación Confort S.A, Fravega, Novogar.
	Clusters of technology distribution companies	Cluster Cordoba Technology, Technology Polo Rosario, Chamber of the Argentine Software Industry (CESSI), Cluster TICs Rosario, Cluster Tucuman Technology, Cluster TIC santafé, Bariloche Technology Cluster, Polo IT Corrientes, Polo It Buenos Aires, Polo It Chaco, Technology Polo Bahía Blanca.
Use	Electronics consumers and consumers associations	Households, Private institutions, Public institutions, Consumer associations.
End of use	Electronics consumers and consumers associations	Households, Private institutions, Public institutions, Consumer associations
	Enterprises with collection points	Reciclarg, Silkers, ProGEAS, Oikos, EMA environmental evaluation SRL, Center waste zero.



	Waste management Companies	Reciclarg, ProGEAS, Oikoscrap S.A, Technology Waste SSRL, PELCO group, 3R environmental (PROTEA), Scrap y Retags, Recycling Cooperatives and dignity job.
Closing the loop	Recovery associations	ECOTECH, Recycling SCRAP, Qualita Environmental Services S.A, NODO TAU, Program E- Waste, Goes Back, Dalafer Industry, Equity Foundation, Mary Association of Prinsons, 3R environmental (PROTEA), Scrap y Retags, Oikoscrap S.A, Reciclarg, ProGEAS, Silkers, PELCO group.
	Repair, remanufacturing and design companies for new electronics products	
	Companies that recover metals and other streams from electronics waste	
	Companies dedicated to the final disposal of unusable streams	
Transversal institutions	<ul style="list-style-type: none"> - Ministry of Environment and Sustainable Development - Secretary of Education - Ministry of productive development - Ministry of Science, Technology and Innovation - INTI (National institute of industrial technology) - Ministry of Foreign Affairs, International Trade and Worship - Territorial entities 	

Table 4. Names of stakeholder organizations in the life cycle phases in the electronics sector in Argentina
 Source: Author

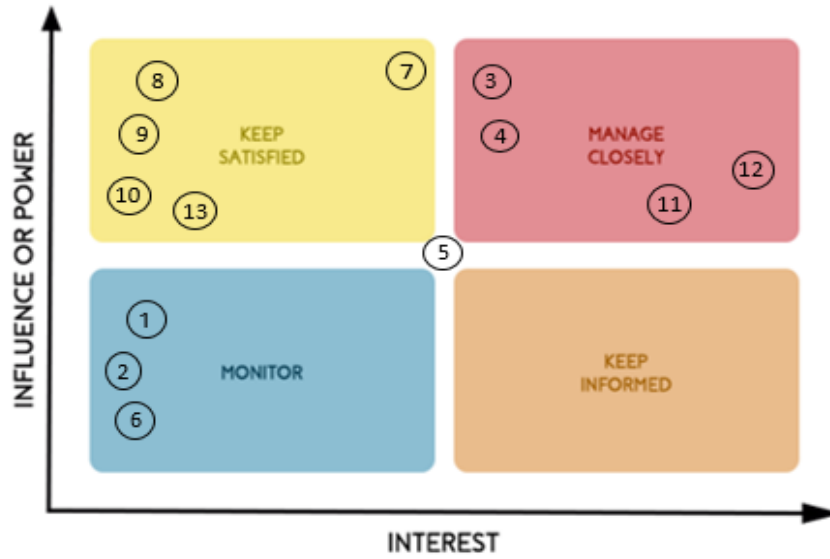
Next, a graph with actors of the electronics value chain in Argentina is presented.



Graphic 4. Argentine stakeholders in the value chain phases for electronics sector
 Source: Author

Stakeholder mapping

Stakeholder mapping allows for better management of EEE. The importance of strategical management has been recognized. Matrices mapping allow stakeholders interaction and objectives relationship set. Matrices are a visual representation of stakeholder’s relationship with an organization, and the evolution of these relationships over the time. Each quadrant^[5] determines the intensity, frequency and type of management that the stakeholders will require in the project. This mapping is possible thanks to the classification presented above (Robichaud, 2018).



- | | |
|------------------------------|-------------------------------|
| ① Designers | ⑦ Disposers |
| ② Raw material transformers | ⑧ Loop closers |
| ③ Manufacturers | ⑨ National institutions |
| ④ Formal/informal assemblers | ⑩ National institutions - CoC |
| ⑤ Distributors | ⑪ Importers |
| ⑥ Users | ⑫ Exporters |
| | ⑬ International institutions |

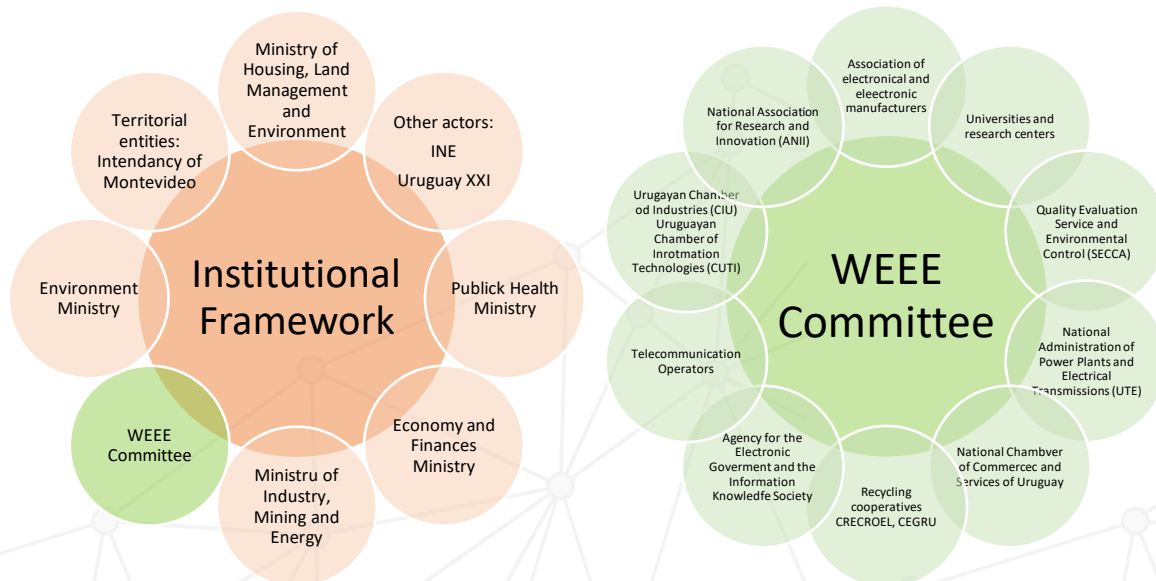
Illustration 10. Stakeholder mapping matrix in Argentina according to the value chain phases

Source: Author

URUGUAY

Stakeholder identification

To identify the stakeholders of Uruguay WEEE, it is crucial to present a review of all the actors and its organizations at different levels, from official state organisms that formulate the national plans and legislation on the matter, until the specific actors and associations through the value chain. Also, it is important to identify how the actors are articulated. In this sense, a scheme of the institutional framework of the sector is presented in illustration 11.



*Illustration 11. Institutional framework related to WEEE in Uruguay.
 Source: Official Sites of the Republic of Uruguay, adapted by the author*

According to the illustration, it is observed on the left the high-level government institutions that conduct all the policies and guidelines that influence the Uruguay WEEE management such as: The Environment Ministry, the National Environment Directorate (DINAMA), that under the jurisdiction of Ministry of Housing, Land Management and Environment (MVOTMA); the Ministry of Industry Mining and Energy, and other actors. On the right side of the image, there are the entities whose activities and operations are specifically related to the EEE Industry and that are mostly composed by organizations and associations of the EEE value chain, and concerns related to these EEE actors like strategies, operations, innovation, sustainability, guild interest, including both official and private organizations such as:

- ✓ Uruguayan Chamber of Information Technologies (CUTI)
- ✓ Uruguayan Chamber of Industries (CIU)
- ✓ Agency for the electronic government and Knowledge Society (AGESIC)
- ✓ National Association for Research and Innovation (ANII)
- ✓ Association of manufacturers of Electrical Electronics and Gas Domestic Articles (AFAEEG)
- ✓ Business Commitment to Recycling (CEMPRE)
- ✓ Uruguayan Chamber Office of Computers Machine Importers (CUIMOI)



- ✓ Chamber of Commerce of Electrical and Electronic Articles (CCAEE)
- ✓ Quality Evaluation Service and Environmental Control (SECCA)
- ✓ Telecommunication operators: Antel, Movistar, Claro.
- ✓ National Administration of Power Plants and Electrical Transmissions (UTE)
- ✓ National Chamber of Commerce and Service of Uruguay (CCSN)
- ✓ Uruguayan Chamber of Waste Management Companies (CEGRU)
- ✓ Recycling cooperatives: Cooperative for the recycling of electronic components (CRECROEL)

As an important complement, it is necessary to include a detailed list of the stakeholders through the EEE value chain in Uruguay as shown in the table below.

Life cycle phase	Stakeholder	Organization
Design	Electronic design companies	ENEKA, BQN, Neorol S.A., DIORS
Raw material transformation	Raw material suppliers for the electronics industry	N.D.
Production	Business associations	Association of Manufacturers of Electrical Electronics and Gas Domestic Articles (AFAEEG), Business Commitment to Recycling (CEMPRE), Uruguayan Chamber Office of Computers Machine Importers (CUIMOI), Chamber of Commerce of Electrical and Electronic Articles (CCAEE).
	Electronics manufacturers and importers	Dell, Sony, HP, LG, Huawei, Lenovo, Siemens, Apple, Motorola, Iphone, Alcatel, Logitech, Brother, Samsung, Toshiba, Acer, ASUS, AOC, Lexmark, Nikon, Peabody, 3NStar, Dahua, PHILIPS, SMART LIFE, ABB, JAMES, TDK.
	Importers	Antel, Tata S.A., Centro Ceibal, National Administration of Power Plants and Electrical Transmissions (UTE), Incotel Corp., Startcenter, Unicom,
Distribution	Direct and reverse logistics companies	Plan CEIBAL, Antel Integra
	Technology store chains	Tata y multiahorro, Disco Devoto y Geant, Tienda Inglesa, Claro, Movistar, Antel, Sodimac, Devoto Express, Multi Ahorro Express



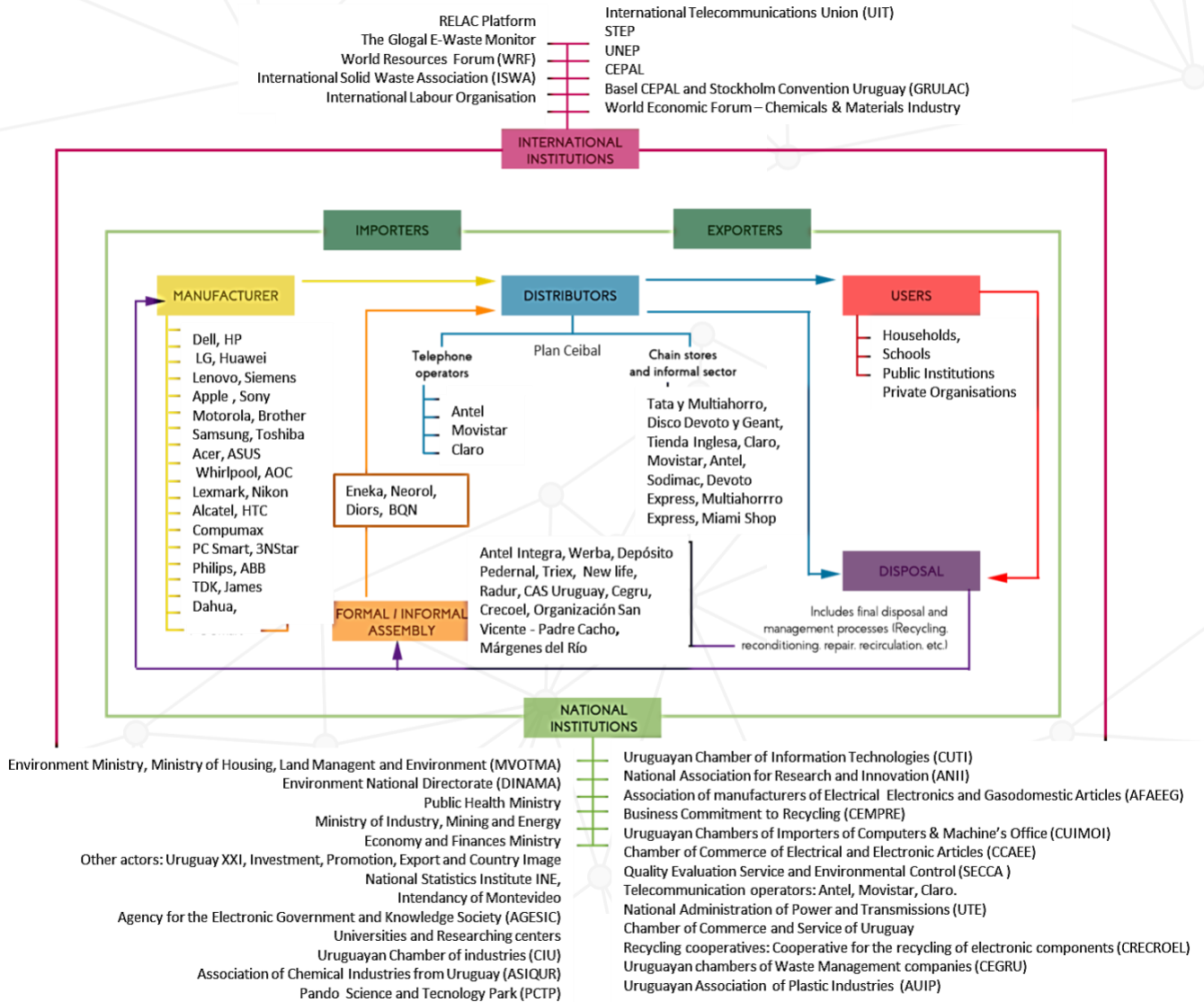
	Clusters of technology distribution companies	Miami Shop
Use	Electronics consumers and consumers associations	Households, schools, Public institutions, Private institutions, Consumer associations: Uruguayan Consumer Defense League, Consumer Defense Area
End of use	Electronics consumers and consumers associations	Uruguayan Consumer Defense League, Consumer Defense Area
	Shopping centers with collection points	Abitab, Red Pagos.
	other collection points	Abito, Platerán, Universidad Católica de Uruguay
	Waste management Companies	Werba, Depósito Pedernal, Triex, NewLife, Radur, CAS Uruguay
Closing the loop	Recovery associations	Uruguayan Chamber of Waste Management Companies (CEGRU).
	Repair, remanufacturing and design companies for new electronics products	Antel Integra, Movistar, Claro.
	Companies that recover metals and other streams from electronics waste	Cooperative for the Recycling of Electronic Components (Crecoel), WERBA, Organización San Vicente (Padre Cacho).
	Companies dedicated to the final disposal of unusable streams	Intendance of Montevideo, Márgenes del Río (Parque tecnológico e Industrial del Cerro), Depósito Pedernal.
Transversal Institutions	<ul style="list-style-type: none"> - Ministry of Housing, Land Management and Environment (MVOTMA) - National Environment Directorate (DINAMA) - Environment Ministry - Uruguayan Chamber of Information Technologies (CUTI) - Quality Evaluation Service and Environmental Control (Secca) - Asociación Nacional de Investigación e Innovación (ANII) - Agency for the Electronic Government and Knowledge Society (AGESIC) - Uruguay XXI, Investment, Promotion, Export and Country Image - Economy and Finances Ministry 	



	<ul style="list-style-type: none"> - Industry and Commerce Ministry - National Administration of Power Plant and Transmissions (UTE) - Universities and university net Works: Catholic University of Uruguay (UCU) - Universidad de la República - NGOs and Research Centers in Sustainable Production and Consumption: - National Association for Research and Innovation (ANII) - Association of Chemical Industries from Uruguay (ASIQRU) - Pando Science and Technology Park (PCTP) - Uruguayan Association of Plastic Industries (AUIP)
	<ul style="list-style-type: none"> - International and regional organizations that regulate and group the electronics industry and waste management: - ISWA (The international Solid Waste Association) - CEPAL (Economic Commission for Latin America and The Caribbean) - United Nation Industrial Development Organization (UNIDO- ONUDI) - Global Environment Facility (FMAM) - Basel and Stockholm Convention Uruguay (GRULAC) - RELAC Platform - International Telecommunications Union (UIT) - STEP (Solving the e-waste Problem) - EMPA - Materials Science and Technology - WRF (World Resources Forum) - BOKU (University of Natural Resources and Life Sciences, Vienna) - United Nations University (Tokyo, Japan) - UNEP (UN Environment Program)

*Table. 5. Names of stakeholders' organizations in the life cycle phases in the electronics sector in Uruguay.
 Source: Author*

On the next graph is presented a diagram that shows how the entities and the specific actors on the value chain are articulated, as follows:

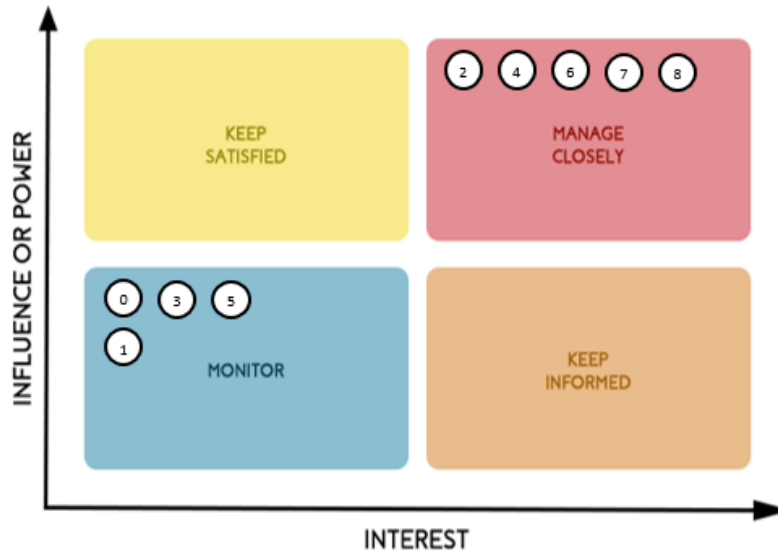


Graphic 5. Uruguayan stakeholders in the phases of the value chain of the electronics sector

Source: Author

Stakeholder mapping

The next illustration is a matrix that allows to arrange all the actors previously identified in four groups organized according to the interaction's frequency, contact, monitoring and necessity of responses required for the development of the project. Additionally, this mapping allows to better distribute the required further activities for a more productive execution of the project.



- | | |
|----------------------------|------------------------------|
| ① Manufacturer | ⑤ Importers |
| ① Formal/Informal Assembly | ⑥ Exporters |
| ② Distributors | ⑦ National institutions |
| ③ Users | ⑧ International institutions |
| ④ Disposal | |

Illustration 12. Stakeholder mapping matrix in Uruguay according to the value chain phases.

Source: Author

CONCLUSIONS

In order to transition to circularity in the electronics sector, it is essential to identify the actors involved in the electronics value-chains in the analyzed countries. Giving continuity to the previous deliverables, it was possible to map the interest groups present throughout the electronics life cycle and value chain in the countries selected by the study, considering that the phases were included where the country presents a greater strength and presence. Likewise, it was possible to identify each of the actors present in each of the stages in order to subsequently define the interest and influence of each one in the project. These actors belong to the formal, informal, public and private sectors.

As mentioned in previous documents, Colombia carries out (mostly) imports of EEE, which is based on the stakeholders of the first stages of the cycle (production and distribution) where there are more actors from international organizations and companies. It is similar for phases such as design and extraction of raw materials where the country does not have a significant presence. It is evident that for this country there is a great participation of actors in the management, final disposal and closing of the cycle phases of EEE waste. However, it is recommended to close gaps between those involved



throughout the different phases of the life cycle in order to initiate a narrow level of circularity within the same country, in order to identify the strengths that can be replicated at the regional level.

In the analysis of the value chain in Brazil, we can say that this country in addition to importing is one of the largest influencers in the manufacture and distribution of electrical and electronic devices in Latin America. Also, we have identified that they have an especially important actor participation in the distinct phases the value chain, which can be strategic for building circularity in the electronics sector.

As a result of the analysis of the life cycle of EEE in Argentina, its economic impact is identified as one of the main traders and distributors in Latin America. It has also generated social and environmental changes due to its commitment to human health and the environment, promoting sustainable practices and developing progress towards circularity in the electronics sector.

On the other hand, Uruguay has important actors from the processing until the management and disposal of EEE. However, extraction of raw materials in this country is rather scarce, as costs and market size from neighboring countries result more attractive for mining. In spite of this, Uruguay has developed strong public & private initiatives to implement the circularity in the EEE sector by stimulating reuse of computers, mobile phones and other EEE.

Although it is true that from the normative part it can be established that there is still a long way to go in strengthening the management of EEE, WEEE and hazardous substances, its regulations have prompted companies to create post-consumer programs through corporate alliances that allow the recovery, reuse, reassembly, refurbish among others, in addition to social inclusion projects for knowledge building and professional skills development.

It should be noted that all the identified actors are important because they behave as links in a chain that works together, however, it is possible to highlight some important actors for this project that may have greater influence on the rest due to the nature of their operations. For instance, the manufacturing sector, distributors and consumers can directly influence the effectiveness of recycling processes.

This country level analysis will inform the study, where it is recognized that a transition towards a circular electronics sector requires regional, and global, actions. The planned study will therefore translate the national analysis into regional level recommendations, also building on wider stakeholder consultations.



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