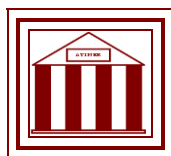


**Athens Institute for Education and Research
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**ATINER's Conference Paper Series
ENV2018-2536**

**EPR for E-Waste Efficiency in Brazil and USA:
A Comparative Analysis**

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This paper should be cited as follows:

Ferreira Guarda, G., Whitaker Kitajima, L. F. and Rodrigues de Barcelos, B.
(2018). "EPR for E-Waste Efficiency in Brazil and USA: A Comparative Analysis", Athens: ATINER'S Conference Paper Series, No: **ENV2018-2536**.

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www.atiner.gr

URL Conference Papers Series: www.atiner.gr/papers.htm

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ISSN: 2241-2891

19/09/2018

EPR for E-Waste Efficiency in Brazil and USA: A Comparative Analysis

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Abstract

Nowadays, it is assumed that the recycling or prevention of high production of electronic waste is a necessary thing to do. However, there are still some questions about how to do it and who should do it. In this way, this article analyzes one of the main means of doing so: the Producer of Extended Responsibility (EPR). In analyzing the EPR, it is assumed that the liability is the majority for the producer for some reason. This article also brings an economic approach to EPR so that producer responsibility is profitable for it and hence applicable. In addition, the concept of circular economy, its benefits, successes, and failures is used both to support the EPR and to analyze laws in Brazil and the United States, making a comparison and drawing some conclusions, advising and lessons. The selection of Brazil and the United States is important because, in the first case, there is the largest producer of electronic waste in South America, the second because it is the largest consumer of consumer electronics in the world. In the US case, the country produced about 16.9% of all global electronic waste (in 2014), EPR laws work better than in the first case, however, they still have a considerable lack of efficiency in some aspects. In Brazil there are not even precise numbers on the total of recycled electronic waste, although for comparison purposes, the country only recycled 3% of the total solid waste, and therefore the actual total values are expected to be correspondingly small. In the United States, the same number is 25% (in the year 2012). These data consider both waste from EPR systems or not. In the Brazilian case, this inefficiency may be related mainly to a National Waste Policy that was not fully implemented, low consumer awareness regarding Reverse Logistics, corruption, among others and in the United States, with illegal exports, corruption and low number of legal proceedings.

Keywords: Circular Economy, Electronic waste, Environmental Legislation, Producer of Extended Responsibility, Reverse Logistics.

Acknowledgments: The authors wish to thank the DF Foundation for Research Support – FAP –DF for their financial support to this work.

Introduction

Wastes “are substances or objects which are disposed of or are intended to be disposed of or are required to be disposed of by the provisions of national law” (UNEP, 1989, p. 10). In a more specific scope, this article considers electronic waste (e-waste) as “a term used to cover items of all types of electrical and electronic equipment (EEE) and its parts that have been discarded by the owner as waste without the intention of re-use” (Step Initiative, 2014, p. 4). Additionally, the e-waste is considered as a hazardous waste mainly because, in accordance to its Annex I¹, it has constituents such as mercury, copper, brominated flame-retardants and lead.

One of the most important parts of the e-waste definition are the electrical and electronic equipment (EEE). This article defines EEE as “any household or business item with circuitry or electrical components with power or battery supply” (Step Initiative, 2014, p. 4).

The production of this kind of waste has presented a constantly growth due to its fast obsolescence and raise of production. Baldé et al. (2015) estimate that by 2018 the global production of e-waste will grow to 49.8 mega tonnes, that is to say, 6.7 kg/inhabitant. A 19% growth in relation to the quantity produced in 2014, 41.9 mega tonnes, according to Baldé et al. (2015). The problem raised by this growth is the great possibility that more e-wastes will be inappropriately disposed because, according Rucevska et al. (2015, p. 4) “without [...] good governance illegal activities may only increase, undermining attempts to protect health and the environment, as well as to generate legitimate employment”.

At the same time, an important aspect of the management of such waste is the question of Extended Producer Responsibility (EPR), which can be understood as a market strategy to promote the integration of environmental costs associated with products throughout their life (OECD, 1999). EPR imposes liability throughout the entire life cycle of products and packaging placed on the market. This means that companies that manufacture, import and / or sell products and packaging are required to be physically or financially responsible for these products after their useful life and companies must have the resources to manage them through reuse, recycling or delegate this responsibility to a third party. Thus, EPR transfers responsibility for government waste to private industry, forcing producers, importers and / or vendors to internalize the costs of waste management in the prices of their products (Hanisch et al., 2000).

In this sense, the objective of this research is to analyze the function of the Producer of Extended Responsibility (EPR) in the light of the American and Brazilian environmental legislations, bringing as a possible solution an economic approach to EPR in the context of circular economy.

This paper is divided as follows: The next section presents the literature review as well as the justification. Then, the methodology section comes, that is followed by the results section, which is divided into two subsections, analysis of US and Brazilian environmental legislation. Finally, the objectives and targets will

¹UNEP, 1989, p. 46-48.

be highlighted in the last section, in order to conclude the purpose of this article, as well as to report the perspective of future results.

Literature Review

As stated in the introduction, it is necessary to explain the topics such as socio-environmental responsibility, a survey on the laws governing solid waste policy and American and Brazilian environmental management for comparison purposes in the discussions and results chapter, as well as, the theoretical aspects of circular energy as follows.

Social and Environmental Responsibility

The effects related to elements or problems to society and the environment are described as "socio-environmental". In this sense, in the global scenario, companies that seek to act in order to minimize the impacts in these fields are entitled as "socio-environmental responsibility". Such characterization, however, does not only refer to compliance with norms and/or laws in the segments that affect the environment.

In Brazil, this movement was driven by actions of nongovernmental entities, research institutes and companies already active in the field in the 1990s. Currently, social and environmental concerns are significant in organizational, governmental, academic and civil society guidelines (Martins, 2011).

Almeida Neto (2013) locates production/consumption-organization-management in a universal and intrinsically entropic context, emphasizing the need to focus on the qualification of this "Transformation" of inputs into goods, which in fact characterizes what is meant by "Production". For the author, from the organizational point of view, a productive work structure and an approach to production management, it is fundamental to consider the quality of the transformation. This must be a significant variable in the productive context and can be understood as the "yield" (not in the economic sense, but in the physical sense of the term) of any energy transformation machine. The "yield" of the transformation is directly proportional to the quality of the production and, therefore, inversely proportional to the entropy (Almeida Neto, 2013, p. 151).

Finally, the generation of waste is a physical phenomenon usually harmful to one or another way of life, and directly or indirectly to human life. An energy-wasteful (more "entropic") productive process will have less yield on the transformation, resulting in more waste.

In this sense, it is justified, a care in the evidence and treatment of this question in the economic and administrative fields (Almeida Neto, 2013, p.151). These considerations are fundamental in the creation of the "8R's Management Model", in which the management of "Waste" and "Social Responsibility", including its environmental, cultural and economic aspects, must be systematically and structurally managed by productive organizations, towards a sustainable future (Almeida Neto, 2013, p. 409).

US Environmental Legislation

American Environmental law is the fruit of the development of centuries of common law doctrines that seek, even today, the protection of people and property against damages caused by the actions of others. Notably, common law is based on the doctrines of nuisance to solve environmental issues, although conduct that results in physical invasion of properties can be analyzed based on trespass doctrine. The doctrine of nuisance is applied to protect the owner in his rights to use and enjoy the land, while the doctrine of trespass protects the exclusive possession of the land against disturbances and invasions (Percival et al., 2013).

It can be said that the complex structure of US Environmental Law is composed of common law doctrines and federal and state laws that lead federal agencies to issue various regulations and also to broker agreements between states. Federal agencies in the United States have the authority to judge administratively, execute public policies and regulate laws by delegation of Congress, under certain circumstances, as decided and signed by the Supreme Court in the notorious Chevron case (Farber et al., 2006).

According to Tarlock, Environmental Law in the United States, as defined today, is the synthesis of the rules of the pre-environmental era of the common law, principles of other areas of Law and the laws of the post-environmental era passed in Congress. The latter are influenced by the application of concepts derived from the fields of ecology, ethics, science and economics (Tarlock, 2004).

The most relevant environmental legislation in the American system can be organized chronologically as follows:

1. National Environmental Policy Act (NEPA), in force since 1970, sets broad objectives for national environmental policy and mandates federal agencies to provide environmental impact assessments when actions that may cause them to be relevant.
2. Clean Air Act: The 1970 Clean Air Act amendments provide a framework for federal air pollution control regulations and supersede the Clean Air Act of 1963. They provide a set of deadlines for EPA to enact air quality standards to be implemented by states and national standards for hazardous air pollutants. The citizen suit has been foreseen in the legislation, so that the citizen has a procedural instrument of tutela of air quality. The law was amended in 1977 to require stricter controls in regions that fail to comply with national standards for hazardous air pollutants, with the primary objective of tackling the serious problem of acid rain. It was amended in 1990, creating new regulatory modulation for air quality verification.
3. The Federal Water Pollution Control Act: passed in 1972, the law prohibits discharges of pollutants on the surface of the waters, requires the use of technology based on controls on discharges and establishes a national program, the National Pollutant Discharge Elimination System (NPDES), which should be implemented by States subject to EPA supervision. It authorizes subsidies and concessions for the construction of sewage treatment plants and provides for the citizen suit so that citizens can

promote the defense of water quality. This legislation was substantially amended by the Clean Water Act Amendments of 1977 and the Water Quality Act of 1987.

4. Federal Insecticide, Fungicide and Rodenticide Act (FIFRA): This pesticide control law amended the original 1947 legislation and required the registration of pesticides and authorized the EPA to ban these when hazardous. The legislation was amended in 1988 to require a faster and more timely review of pesticide registrations and, in 1996, with the approval of the Food Quality Protection Act, was to require more stringent protection against pesticide residues on food.
5. Marine Protection, Research, and Sanctuaries Act of 1972 (Ocean Dumping Act): approved in 1972, prohibits the dumping of waste in the ocean except with permission and at EPA designated sites.
6. Endangered Species Act (ESA): This legislation prohibits federal actions that endanger the habitats of species at risk of extinction and prohibits the appropriation of any animal of these species by any person.
7. Safe Drinking Water Act (SDWA): adopted in 1974, requires the EPA to set maximum permitted limits for pollutants in public drinking water systems. It was amended in 1996 to require faster promulgation of standards to make the standards already established more flexible.
8. Toxic Substances Control Act of 1976 (TSCA): Gives the comprehensive EPA authority to regulate or prohibit the manufacture, distribution, or use of chemicals posing unreasonable risks. Requires EPA notification prior to handling, new chemicals or new uses of existing chemicals.
9. Resource Conservation and Recovery Act of 1976 (RCRA): mandates that the EPA establish regulations ensuring the safe management of hazardous wastes. The law was amended by the Hazardous and Solid Waste Amendments in 1984 (HSWA), which imposes new technologies based on landfill standards that have hazardous waste and increased federal authority on the dumping of non-hazardous solid waste.
10. Comprehensive Environmental Response, Compensations, and Liability Act of 1980 (CERCLA): establishes the objective liability system for the release of hazardous substances and creates a superfund to finance actions for cleanup. It was amended in 1986 to expand the superfund and imposed numerical targets and deadlines for cleaning up polluted areas. Specifies standards and procedures to follow and determines the level and scope of cleanup actions.
11. Emergency Planning and Community Right-to-Know Act (EPCRA): This legislation requires corporations and companies to report in detail to local authorities on the use of any toxic substance and to chemicals released into the environment (Percival et al., 2013).

Brazilian Environmental Legislation

The Brazilian Environmental Law is composed at the federal level in part by the Federal Constitution in its article 255 and partly by a set of Laws, Decrees and

Resolutions integrated the National Policy of the Environment and expands for specific subjects also with a set of pertinent legislations which are: Flora, Water, Wildlife, Environmental Education, Conservation Units, Environmental Administrative Crimes and Crimes, Genetic Heritage, Protection and Access to Associated Traditional Knowledge, Benefit Sharing, Genetically Modified Organisms and Traditional Peoples and Communities.

The most relevant environmental legislation in the Brazilian system can be organized chronologically as follows:

1. Law 6.938, dated August 31, 1981 Provides for the National Policy on the Environment, its purposes and mechanisms for formulation and application, and other measures.
2. CONAMA Resolution No. 1, dated January 23, 1986 Provides basic criteria and general guidelines for the Environmental Impact Report (RIMA).
3. CONAMA Resolution No. 9 of December 3, 1987 Provides for the issue of public hearings.
4. Law No. 7.797, of July 10, 1989 Creates the National Environment Fund and gives other Provisions.
5. Decree No. 99,274 of June 6, 1990 Regulates Law No. 6,902, of April 27, 1981, and Law No. 6.938, of August 31, 1981, which provide, respectively, for the creation of Ecological Stations and Environmental Protection Areas and the National Environmental Policy, and other measures.
6. CONAMA Resolution No. 237, of December 19, 1997 Regulates the aspects of environmental licensing established in the National Environmental Policy.
7. Decree No. 4.297, of July 10, 2002 Regulates art. 9, item II, of Law No. 6.938, dated August 31, 1981, establishing criteria for the Ecological-Economic Zoning of Brazil-EEZ, and makes other provisions.
8. CONAMA RESOLUTION No. 401, of November 4, 2008 Establishes the maximum limits of lead, cadmium and mercury for batteries and batteries sold in the national territory and the criteria and standards for its environmentally sound management, and other measures.
9. Law no. 12; 305, of August 02, 2010 Institutes the National Solid Waste Policy; amends Law No. 9,605 of February 12, 1998; and makes other arrangements.

Circular Energy

The Circular Economy is a model that allows to rethink the economic practices of the current society and that is inspired in the operation of the own nature. It is inseparable from innovation and product and system design. It is included in a framework of sustainable development based on the principle of "closing the life cycle" of products, allowing a reduction in the consumption of raw materials, energy and water. It promotes the development of new relationships

between companies, which become both consumers and suppliers of materials that are reincorporated into the production cycle (Ellen MacArthur Foundation, 2012, 2013, 2014).

This new paradigm of sustainability stimulates new management practices and opens up new opportunities adding value to the organization and to customers, in harmony with the environment. As a source of innovation and allowing a reduction in demand for natural resources to the recovery of waste and scrap, the Circular Economy opens excellent prospects to be seen by companies as advantage and motivation to growth with solid foundations and future, in addition to competitive advantages in the context of a highly dynamic global market.

This circular concept of economics has been extended to environmental issues. Instead of economic surplus used in luxury consumption, what is at issue is the use of the physical surplus of the production process and consumption and by-products generated. The concept of CD is associated with the use of materials at the end of life, in which the term waste does not exist (Stahel, 1984, 2010).

Methodology

This chapter specifies the materials used for the development of the study, as well as the explanation regarding the methodology used for analyzes and results.

The method used to perform this work consists of the bibliographic review to identify concepts and structure that the Circular Economy as a sustainable development strategy encompasses, and its applicability to new business opportunities.

The work is based, therefore, on hermeneutics, that is, on the interpretation, understanding and analysis of existing literature. International organizations, governments and government agencies, nongovernmental organizations and civil society related to the implementation of a Circular Economy and related topics, have identified a substantial number of scientific and other studies.

These documents were classified and organized according to a set of aspects of interest with a view to their selection (or not) for further review, namely whether the study contained a definition of Circular Economy if the study contained a cycle perspective if the study provided some kind of quantitative cost-benefit analysis from a Circular Economy if the study contained policy strategies for the development of a Circular Economy if the study contained case studies.

Based on these criteria, those that were most relevant for an adequate response to the objective of this study were analyzed in a more detailed way, providing a broad knowledge on the subject.

Materials

The materials used throughout the development of this work are listed below:

1. Set of American environmental laws described in subsection “US Environmental Legislation”;

2. Set of Brazilian environmental laws described in subsection “Brazilian Environmental Legislation”;
3. Scientific articles regarding Circular Energy as described above.

Findings/Results and Discussion

This chapter specifies the results of the bibliographic review and presents a summary of the aspects of the legislation - characteristics identified - for discussion purposes.

US Environmental Legislation

In relation to US environmental legislation, according to (Percival et al., 2013) it is divided into six historical stages: the common law and conservation era (prior to the year 1945); from federal assistance to state problems (1945-1962); of the growth of the modern ecological movement (1962-1970); the construction of federal regulatory infrastructure (1970-1980); the expansion and refinement of regulatory strategies (1980-1990); and the current phase of regulatory retreat and reinvention.

This evolution, which goes through centuries of construction of law with the precedents and doctrinal evolutions of the common law, by the Keynesian and welfare state, the awareness of the international community on issues related to development and environmental crisis, the era of recent neoliberalism and the current times in the promotion of sustainable development in the era of climate change.

The protection of the environment in the United States is therefore not only promoted by the state and federal agencies, but also by citizens with the filing of lawsuits. There are several requirements for recognition of the standing of the environmental plaintiff in the United States, which make justice not always accessible to this. In this case, the citizen must demonstrate:

- ✓ To have legitimacy, to be analyzed in the specific case, to challenge state act or omission or federal agency;
- ✓ Exhaustion of administrative route prior to legal action;
- ✓ The case is instructed and able to be judged;
- ✓ Be present current or future damage, not necessarily economic, affecting individual rights of the plaintiff.

In this context, there is a vast state environmental legislation that authorizes any citizen, or anyone, to propose a citizen suit for violation of the law or for disagreement with the pollutant emission standards. Although the citizen suit prediction in paragraph 304 of the Clean Air Act serves as a model for most of these actions, it is the citizen suit's prediction in the Clean Water Act that has supported most of the demands of the style as outlined by Doremus et al., (2008).

The citizen suit can be promoted against the state, state entity or corporation that is violating an effluent standard or limiting what is provided in the regulation legislation or, still, not complying with the order issued by the federal agency and by the State itself regarding the emission levels.

Still according to (Doremus et al., 2008) Citizen in the sense of the law "is any person who has an interest or right that can be adversely affected by the environmental damage". As already recognized by the case law, the citizen suit is only a supplement, not a substitute for state action on environmental protection. The Legislature did not intend that the citizen is always a potential intruder on the discretion of the federal agencies.

In both water and air pollution regulation, a citizen cannot sue if the administrator or the State has previously filed a civil or criminal action in a state or federal court, in accordance with the doctrine of diligent prosecution.

In short, some environmental lawsuits in the United States are based on old common law doctrines and most, contrary to what is sometimes claimed, and are based on environmental legislation passed in Congress. State, federal agencies, and citizenship have legitimacy for judicial environmental protection, as long as they violate private rights and interests, since the 1787 Constitution, Bill of Rights amendments and other constitutional amendments, as well as Supreme Court precedents, do not have elevated the environment to a very autonomous and deserving constitutional protection as specific in Brazil.

Regarding solid waste, federal legislation on the subject has a different approach, although it also makes use of the polluter pays principle and responsibility for the waste generated.

In 1965, the Federal Solid Waste Disposal Act was issued, which, among other things, responded by financing state inventories of landfills and "landfills". In 1976, this law was supplemented at important points by the US Environmental Protection and Recovery Act (RCRA) (US ENVIRONMENTAL PROTECTION AGENCY, 2008), in order to deal with the huge volume of municipal and industrial solid waste which were generated in that country.

The objectives set out in that law were: to protect human health and the environment from the potential hazards of waste disposal; conserve energy and natural resources; reduce the amount of waste generated; and ensure that waste management occurs in an environmentally sound manner. Through this law, the Environmental Protection Agency (EPA) was mandated to establish national standards for solid waste management.

In 1984, amendments to the Conservation and Recovery Act on Hazardous and Solid Waste Amendments to the Resource Conservation and Recovery Act were approved in response to society's concern that hazardous waste disposal methods in use at the time, particularly soil disposal, were not safe.

The law gives differential treatment to general (non-hazardous) solid waste and hazardous waste. In relation to the former, EPA has developed federal criteria for the proper design and implementation of municipal solid waste landfills. In view of these minimum criteria, states may be allowed to develop their own programs. Most programs related to non-hazardous solid waste are supervised by

states. Compliance with the requirements is ensured through state permits as explained above.

To address the growing amount of municipal solid waste, the EPA recommends that communities adopt "integrated waste management" systems tailored to their needs. The term "integrated waste management" refers to the complementary use of a variety of safe and effective municipal solid waste management practices, including source reduction, recycling, incineration or disposal in landfills. In designing such systems, the EPA encourages communities to consider the following hierarchy of priorities: reducing the source, both the volume and the toxicity of waste, and increasing the useful life of manufactured products; recycling, which includes composting of garden and food waste; and, finally, incineration or disposal in landfills.

In its consolidated form over the years, the main content of the Solid Waste Law is the disciplining of a national policy, defining the competencies of the EPA and other agents in terms of regulation and inspection, and establishing minimum national guidelines to be in particular with regard to hazardous waste. As far as non-hazardous waste is concerned, there are only recommendations to the municipalities by the EPA. This is an important differential in relation to, for example, German law.

Finally, it should be mentioned that in 1990 the Pollution Prevention Act came into force, whereby pollution should be avoided or reduced at source whenever possible; pollution that cannot be avoided or recycled (waste) should be treated in an environmentally safe manner wherever possible; and final disposal or other release into the environment should be used only as a last resort and should be performed in an environmentally safe manner.

Brazilian Environmental Legislation

Regarding Brazilian Environmental Legislation, it is known to be one of the most complete in the world, but with many gaps, one of them related to solid waste management. The theme was only incorporated in legislation in 2010, with the publication of Law No. 12,305, of August 2, 2010, establishing the National Policy on Solid Waste (PNSR).

This is an innovative law to be exclusive to solid waste, organically and consistently bringing together numerous legal provisions that were previously scattered in various normative instruments, such as resolutions and ordinances. In addition, it brings to the level of law in strict sense commands that were in infra legal acts, which, because they did not have the support of a law with general directives on solid waste, had its constitutionality questioned by some analysts (Araujo and Juras, 2011).

It has a broad scope, since it involves not only the public power, but also the various productive sectors, including all actors of the productive chain, manufacturers, importers, distributors and traders, and the final consumer. Thus, the law includes natural and legal persons, both public and private, whose activities generate solid waste and expressly includes consumption. However, it should be noted that Law 12,305/2010 does not apply to radioactive waste but

includes mining waste, which differs from the European Union which has specific waste legislation.

Brazilian policy establishes that actions related to the management of household waste are mainly the responsibility of municipalities, which have administrative autonomy defined in our Constitution. Thus, the federal law establishes the general norms, applicable to the whole country, without exhausting the possibility of having additional state legislation.

Another important definition contained in this law is the product life cycle, which associates the biological concept of life cycle (birth, growth, maturity and death) with the stages that encompass product development, raw materials and inputs, the production process, the consumption and the final destination of the generated waste (Araujo and Juras 2011, page 47). Such a definition becomes essential with the establishment of the reverse logistics instrument established by law, which, based on the principles of environmental law, polluter pays and the protector-recipient, provides that economic agents are responsible for the environmental costs associated with their activities.

That is, the modern approach to solid waste management requires much more than the implementation of an efficient collection, treatment and disposal system, and it is essential to pay attention to production and consumption patterns. Those who generate it are not paying the costs of environmental degradation caused by the generation of solid waste, these costs become externalities for the economic system, and that is, they are external to the functions of cost and demand. Treated as free resources or very low cost, natural resources tend to be overexploited. Moreover, the cost of degradation does not directly affect what degrades, but falls upon society as a whole. Therefore, it is necessary to internalize environmental costs in production and consumption activities, in order to induce a change in the pattern of use of natural resources (Seroa da Motta, 1996, 1998).

Based on the principles that permeate politics, those who preserve natural resources are entitled to some form of compensation, including economic benefits. The agent, public or private, who protects a natural good for the benefit of the community, should receive financial compensation as an incentive for the environmental protection service rendered. It should be noted that Law 12,305 / 2010 was the first Brazilian law to explicitly adopt the principle of the protector-receiver (Araujo and Juras, 2011, page 62) and is not in the foreign laws on solid waste analyzed for this this principle.

Selective collection, reverse logistics systems and sectoral agreements, essential elements to the implementation of shared responsibility for the product life cycle, thus contributing to the effectiveness of the principles outlined above.

Finally, in Brazil, the approval of Law 12,305 / 2010 was an important step towards facing one of the most serious urban problems - deficiencies related to solid waste management. The long wait for the norm - 21 years, considered only the period of process in the National Congress - was not in vain. The Law is among the modern laws of the most advanced countries in this field, such as those of the European Union, Canada and Japan.

Two important advances should be highlighted in the Law. The first refers to the importance given to planning in the sector. For the first time, there will

be a national plan on solid waste, which is under discussion now, in addition to two state, regional and municipal plans, not to mention management plans by certain sectors of the economy.

The second advance embodied in the Law is undoubtedly the shared responsibility for the product life cycle, inspired by the models of extended or extended responsibility of the producer. After all, with the growing generation and the change in the content of household waste, with an increasing proportion of non-biodegradable wastes, it was not socially just to make the whole society, through the sole responsibility of the public power, the burden of proper management of urban waste.

Intersection between US Environmental Legislation and Brazilian Environmental Legislation and the Circular Economy

Although the evolution of the Laws governing the issues discussed in this paper is noticeable, a negative point is the postponement, once again, of the definition of the beginning of the obligation of manufacturers and merchants to implement the reverse logistics of lamps, products electronics and, especially, packaging in both countries studied.

As far as non-hazardous waste is concerned, there are only recommendations to municipalities. In Brazil, Decree 7404/2010 should have made progress in this area, including concrete targets for the collection and environmentally adequate disposal of these wastes. Nonetheless, apart from these regulations, there are other important instruments, also provided for in the law, such as sectoral agreements and terms of commitment, which can be used to ensure that the obligations of the productive sector are actually fulfilled.

In this way, the concept of Circular Energy emerges as a plan of action that supports this approach throughout the value chain - from production to consumption, repair, and manufacturing, waste management and secondary raw materials.

This ambition has a pragmatic basis: we now consume around 62 billion tonnes of resources per year, of which we only recycle 7%. In 2050, we will consume between 85 and 186 billion tons, to feed a global economy with 9 billion people. The European Union can only supply 9% of the supply of the 54 critical raw materials for its economy.

In this sense, the economy requires a broad and participative involvement of all actors, in order to identify the policy options considering the impact in the various sectors of a development model based on the circular economy.

Circular economics is an economic model that meets human needs and fairly distributes the resources mobilized without harming the functioning of the biosphere or crossing any physical limits of the planet. This model depends on the development of strategies - technological, product, service, use or consumption - that induce the continuous reuse of materials and resources in their maximum productive potential (maximum financial value and usefulness for the longest possible time) in cycles duly energized by renewable sources. Not only are resources preserved, as it is possible to restore and regenerate natural capital

extracted into the biosphere, such as water and nutrients. We reduce dependence on the extraction or import of raw materials and minimize emissions and waste to be disposed of.

This presents an opportunity to develop strategies that accelerate this economic model, for solutions centered on "traditional" recycling, along the entire value chain and with transversal gains: for the company, the city or the region, reducing costs and risks with the acquisition of materials and waste management, making investments profitable, loyalty to customers and inhabitants, fostering employment; for the user, who performs better, paying effectively for what he needs; to the ecosystem, by removing pressure on its natural capital.

Conclusions

The business segment has sought the balance between environmental and economic relations, in order to improve its products and services, aiming at a differentiated environmental responsibility and, consequently, an explicit competitive advantage in the sector. This is due to the economic-technological scenario that imposes on organizations the need for continuous changes in the way they operate and manage their businesses, so that they adapt to the new reality and remain competitive. Thus, even if the main objective of the company is profit, the environmental function has become increasingly important due to the increase in consumer awareness and its increasing interest in the processes surrounding the products and services.

In addition, the environmental function is presented through tools that promote the development and application of clean technologies. Given this, the environmental effort of companies is a factor that affects the performance and competitiveness of companies, as well as helping organizations to comply with environmental regulations.

Changing patterns of production and consumption is one of the essential steps for us to have truly sustainable development. One consequence of current standards has been the generation of increasing amounts of solid waste. Among the factors that affect waste production, is the increase in income, which leads to increased consumption, increasing preference for disposable items and technological obsolescence. Some studies show that the amount of waste increases with GDP growth, and in this case, the major challenge for environmental sustainability is to decouple waste generation from economic growth.

Thus, the modern approach to waste management should not be focused solely on proper management and disposal. In order to change the unsustainable patterns of production and consumption, the "integrated management of the life cycle" concept must be used, as several countries have done, like Germany, followed by the European Union and its member countries, as well as Canada and Japan.

The added risk of improper disposal of WEEE comes from the heavy metals that constitute the parts of the electronic equipment and are responsible for the deleterious effects of WEEE. It is also worth noting that improper disposal or the

grounding and incineration without previous treatment of electro-electronic waste results in contamination of water, soil or air due to the emission of substances harmful to the environment. Incineration, in turn, can result in the emission of mercury, lead and other toxic substances. In addition to loss of material with high-added economic value, such as gold and silver, which can be recycled, as well as loss and increase in energy costs.

In relation to the American Environmental Legislation, regarding the producer has extended liability isn't found in federal legislation. However, some states and cities have their own laws adopting extended producer responsibility for some products. For electronics, for example, there are 24 states with laws in this regard; for batteries, the rule applies in 9 states and, for mercury, in 17 states (EARTH911, 2011). As for packaging, 11 states instituted the deposit-return system with a view to increasing recycling.

Regarding the Brazilian Environmental Legislation, in general, it is possible to observe that the legal aspects referring to the most diverse residues are simply to guide the flow through reverse channels and to express where the waste disposal should not occur. However, the resolutions and laws do not indicate how the final disposal should occur, leaving a gap to be filled by manufacturers and governments.

In this sense, it becomes interesting to adopt the use of Circular Energy as an economic model strategy whose benefits can be highlighted:

- a) improving the efficiency and productivity of the resources used by economic agents in the value chains involved, including the end user;
- b) Establish a business case for the circular economy, with evidence of economic profitability and reduction of environmental impacts associated with the preservation of value and utility of resources through circularity strategies;
- c) Create collaborative movements of economic agents along the value chain, around identifying and acting on opportunities for improvement in the efficient and productive use of resources;
- d) To reinforce the profitability and growth of the agents involved (eg SMEs), combining and transferring new and / or existing knowledge, converting it into innovative and competitive solutions, taking advantage of business opportunities;
- e) To design and disseminate, at the international level, technologies, products and services developed in Portugal, with a view to fostering the internationalization capacity of companies;
- f) Raise awareness and contribute to raising awareness of the importance of a systemic approach to the development of products, processes and business models in the context of limited resource availability.

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