Electronic waste management in Brazil and the Basel Convention

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ABSTRACT

This paper aims to analyse the context, goals and main features of the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (BC), with a particular focus on electronic waste management, taking into account the risk society and the fundamental right and duty of everyone to a healthy and ecologically balanced environment. Besides presenting the regulatory instruments which allowed the internalization of BC in Brazil, we intend to verify the extent to which the National Solid Waste Policy (NSWP) enacted on August 2nd, 2010 consolidated the international efforts of BC towards a more efficient e-waste management in the country, and in what way the NSWP deals with the Brazilian import of refuses, hazardous solid wastes and other ones whose characteristics can cause damages for the environment, as well as for human, animal or plant health.

Keywords: Basel Convention; electronic waste; hazardous waste; transboundary movements; shared liability for product lifecycle; reverse logistics; Brazilian regulation; National Solid Waste Policy.

1. Introduction

The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (BC) is a multilateral treaty with a global scope in force since 1992, which was adopted in 1989 by 51 signatory countries, in view of the increasing concern of part of international community with the massive movements of hazardous

waste between countries, especially to be disposed of in developing ones. That alarming scenario was partially related with the sharp increase of costs for disposal of hazardous waste in industrialized countries, while their environmental legislation became ever tighter and more effective.

Brazil joined the BC in 1992 and its content came into force in the country by means of Federal Decree n. 875 on July 19th, 1993. Since then, the National Environment Council (CONAMA), which is the advisory and decision-making body of Brazilian National Environment System, has published and updated non-statutory Resolutions on hazardous waste, notwithstanding the lack of a comprehensive waste management legal framework at the federal level existing until 2010.

After a long delay, the National Solid Waste Policy (NSWP), instituted by the Federal Law n. 12.305 on August 2nd 2010 and regulated by the Federal Decree n. 7.404 on December 23th, 2010, established a shared responsibility scheme for product lifecycle (a kind of extended responsibility mechanism), providing for legal duties for supply chain (from the cradle to the grave), such as the obligation of structuring and implementing take-back systems for electronic products and their components, and also eco-design duties in order to reduce e-waste generation and its dangerousness (Lemos, Mendes, 2013).

Moreover, the NSWP deals with rules on import of refuses, hazardous wastes and others ones. In that sense, it is worth to highlight that the NSWP distinguishes in its article 3 "waste" from "refuse", which is defined, in turn, as a species of solid waste that, after exhausting all possibilities of treatment and recovery through technological processes available and economically feasible, presents no other possibility than environmentally sound final disposal in landfills. In another way, solid waste is broadly defined as any material, substance, object or good discarded, in solid or semisolid state (under certain conditions, even liquids or gases in containers), whose environmentally sound final destination (including reuse, recycling, composting, recovery and energy exploitation, among others) is accomplished, intended or mandatory.

A polemic question could be whether and the extent to which e-waste would be a hazardous waste, not only from a scientific or toxicological standpoint, but also from a legal approach, since the governments could differently deal with the hazards, assuming or not a more precautionary attitude (BAN, SVTC, 2002).

2. Objectives and Methodology

We intend to analyse the context and main objectives of the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, with a particular focus on electronic waste management in Brazil, through national regulation and literature review, in order to verify the extent to which the NWSP may address the issue of transboundary movements of hazardous wastes, especially derived from electronic and electrical equipment.

3. Risk society, Basel Convention and hazardousness of electronic waste

Risk situation has escalated in contemporary society and authors have described it as a "risk society" (Beck, 2006). Although in the past the exposure to risk already existed (García-Tornel, 2001), industrial and consumer society led to the creation of new and increasingly complex risks, and the relation population-risk came to be naturalized (November, 2002).

There is no doubt that electronic waste imposes serious risks to human lives and other life forms, which urges regulation of its movements between countries (El-Fadel et al., 2002). Contemporary society and its massive industrial waste production have led to an unacceptable level of hazardous waste and transboundary movements in the planet.

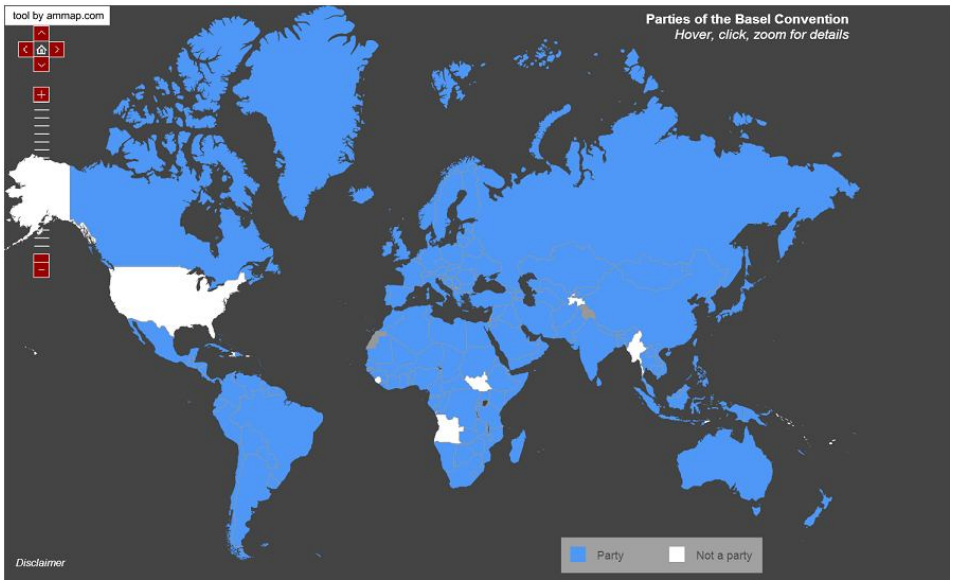
During the 1980's, environmental laws from industrialized countries became tighter and the costs for recycling or disposal of hazardous waste in their own territory increased substantially. Consequently, there was a booming of transboundary movements of hazardous waste to poor and developing countries, which still didn't have legislation on the issue (Fan, Chang, Ni, 2005).

Such movements have generated pressure on governments and environmentalists worldwide to ban these unfair trades since preoccupation with human and environmental health was almost inexistent. That discussion resulted in the regulation of the matter through an International Treaty (Martinez-Alier, 2007) and in the expression "Not In My Back Yard" or NIMBY Principle (Barlabace, 2001). First manifestations towards that international instrument occurred in 1981 during a meeting with legal experts in Montevideo, under the United Nations Environmental Programme (UNEP).

In 1989, in the Conference of Plenipotentiaries, a world reference document was born, known as Basel Convention, with 51 Signatories, aiming to control transboundary movements of hazardous wastes and their disposal at global level. The BC entered in

into force on May 5th, 1992 (not ratified by the United States) and currently encompasses 181 Parties[1].

Figure 1: Basel Convention and current status of ratification



Source: www.basel.int (last visited July 19th, 2014)

The protection of human health and environment against hazardous wastes' adverse effects can be appointed as the overall objective of the BC, which can unfold in three principal aims (Peiry, 2011): (i) reducing hazardous waste generation and ensuring its environmentally sound management and disposal; (ii) restricting transboundary movements; (iii) establishing a regulatory system for permissible transboundary movements.

The scope of the Basel Convention comprises a broad and complex spectrum of materials defined as "hazardous wastes", taking into consideration their characteristics, origin or composition, as set forth in its Article 1, n. 1, and Annexes I, III, VIII and IX, and also two categories of wastes requiring special consideration referred as "other wastes" (household waste and incinerator ash), provided for in its Article 1, n. 2, and Annex II. Radioactive materials and wastes derived from the normal operation of a ship are excluded from the BC scope, to the extent that other international instruments can be applied to them (Article 1, n. 3 and 4).

[1] Information available at <http://www.basel.int> (last visited July 19th, 2014).

In the Annex VIII[2], the "List A" contains wastes characterized as hazardous under Article, 1, n. 1 (a), of Basel Convention, among which we can find some types of electronic waste:

> A1180 Waste electrical and electronic assemblies or scrap containing components such as accumulators and other batteries included on list A, mercury-switches, glass from cathode-ray tubes and other activated glass and PCB capacitors, or contaminated with Annex I constituents (e.g. cadmium, mercury, lead, polychlorinated biphenyl) to an extent that they possess any of the characteristics contained in Annex III (note the related entry on list B B1110).

Under BC, electronic wastes specified in the entry "A1180" are deemed hazardous, although the list of hazardous characteristics of Annex III (such as being explosive, flammable, toxic, oxidizing or corrosive) can be used to demonstrate that such e-waste is not hazardous.

In the Annex IX, in turn, the "List B" contains wastes not covered by Article 1, n. 1(a), of BC, being deemed non-hazardous, unless they contain Annex I material to an extent causing them to exhibit an Annex III characteristic. Among the wastes specified in the "List B", we can find other entry related to electronic wastes:

> B1110 Electrical and electronic assemblies:
> • Electronic assemblies consisting only of metals or alloys;
> • Waste electrical and electronic assemblies or scrap[3] (including printed circuit boards) not containing components such as accumulators and other batteries included on list A, mercury-switches, glass from cathode-ray tubes and other activated glass and PCB capacitors, or not contaminated with Annex I constituents (e.g., cadmium, mercury, lead, polychlorinated biphenyl) or from which these have been removed, to an extent that they do not possess any of the characteristics contained in Annex III (note the related entry on list A A1180);
> • Electrical and electronic assemblies (including printed circuit boards, electronic components and wires) destined for direct reuse and not for recycling or final disposal.

Thus, regardless of eventual scientific discussion on the matter, the Basel Convention does not necessarily include e-waste as "hazardous" for its normative purposes. Moreover, the BC warns that in some countries the materials from electrical and electronic assemblies destined for direct reuse and not for recycling or final disposal are not considered wastes, but some kind of commodities. In that sense, direct reuse includes repair, refurbishment or upgrading, but not major reassembly.

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[2] The Annex VIII was added to the BC through an Amendment, which entered into force on November 6th, 1998, being successively updated with new entries.

[3] According to BC, this entry doesn't include scrap from electrical power generation.

According to Articles 4, 5, 6, 10, 13 and 20, the BC holds the following commitments, among others: sovereign right of every country to prohibit the entry or disposal of foreign hazardous wastes or other wastes in its territory; need for prior and specific informed consent in writing from the State of import; adoption of measures to minimize waste generation, which take into account social, technological and economical aspects; making available adequate disposal facilities, located, to the extent possible, in the generating countries; preventing human health and environmental adverse effects from hazardous waste movements and disposal; internal measures to support BC's implementation; possibility of transboundary movements between member States and non-member ones only under cooperation agreement; compliance with international norms and standards for packing, labeling and transport; permission for transboundary movement of hazardous waste, as long as waste is needed for recycling and recovery industries within importer country; criminal nature for cases of illegal traffic in hazardous wastes or others wastes; international cooperation.

To endorse its recommendations, the BC provided for in Article 12 the adoption, as soon as possible, of a protocol with appropriate rules and procedures on civil liability and compensation for damages derived from transboundary movements and disposal of hazardous wastes and other wastes, including cases resulting of illegal traffic.

That Basel Protocol on Liability and Compensation was finally signed in 1999, during COP-5, but has not yet entered into force, pending the deposit of the twentieth instrument of ratification, acceptance, formal confirmation, approval or accession. Currently, that Protocol counts with 13 Signatories[4].

In 2002, COP-6 set up a partnership program with commerce and industry, with special highlight for two successfully launched public-private partnerships, aiming to develop specific technical guidelines for the management of end-of-life electronic devices and e-waste – to be used by the pertinent industry and authorities, and also to start relevant pilot projects at country level, even in companies (Peiry, 2011).

In that sense, Mobile Phone Partnership Initiative (MPPI) developed between 2003 and 2008 guidelines for each stage of management of end-of-life mobiles phones, whereas in 2008 there was the creation of the Partnership for Action on Computing Equipment (PACE) by COP-9, with the perspective of enhancing environmentally sound management of used and end-of-life computer equipment (Peiry, 2011).

[4] Information available at <http://www.basel.int> (last visited July 19th, 2014).

After more than two decades, the BC has achievements and deadlocks. Improvements can be seen when million tonnes of hazardous wastes generated across the globe every year meet the barrier of the necessity of having their transport declared to the Secretariat of the BC. However, conflicts and setbacks can also be seen when countries refuse to report transport or have not yet included the BC into their national contexts.

Notwithstanding the BC efforts, the generation of e-waste continues to grow enormously as a result of expansion of global demand for electrical and electronic equipment, including in developing countries. The total amount of globally generated e-waste jumped from 6 million tonnes in 1998 to 20-50 million tonnes in 2005, with a highly heterogeneous waste stream. It has been estimated that just in 2004 315 million PC's rendered obsolete worldwide and that in 2005 130 million mobile phones have reached their end of life (UNEP, 2011).

Table 1: Estimates of e-waste generation in developing countries (tonnes per year)

Countries	Assessment Date	PCs	Printers	Mobile phones	TVs	Refrigerators	Total
South Africa	2007	19,400	4,300	850	23,700	11,400	59,650
Kenya	2007	2,500	500	150	2,800	1,400	7,350
Uganda	2007	1,300	250	40	1,900	900	4,390
Morocco	2007	13,500	2,700	1,700	15,100	5,200	38,200
Senegal	2007	900	180	100	1,900	650	3,730
Peru	2006	6,000	1,200	220	11,500	5,500	24,420
Colombia	2006	6,500	1,300	1,200	18,300	8,800	36,100
Mexico	2006	47,500	9,500	1,100	166,500	44,700	269,300
Brazil	2005	96,800	17,200	2,200	137,000	115,100	368,300
India	2007	56,300	4,700	1,700	275,000	101,300	439,000
China	2007	300,000	60,000	7,000	1,350,000	495,000	2,212,000

Table 1: Estimates of e-waste generation (tonnes per year)
Source: Adapted from UNEP and UNU (2009)

Source: UNEP (2011)

Further, the United Nations (2010) estimates that more than 90% of discarded computers from developed countries are exported to developing ones, such as India, China, Pakistan and Ghana, supposedly for recycling, but that often end up in disposal sites, where the heavy metals and toxic chemicals contaminate soil, water supply and atmosphere. Within this scenario, it has been recognized the importance of extended producer responsibility (EPR) to be adopted as legislative option both by developed countries and by developing ones, in order to reduce the growing amount of e-waste, making the supply chain responsible for product lifecycle, from the cradle to the grave.

Figure 2: Export of e-waste

Source: ILO (2012)

4. Hazardous waste management and e-waste regulation in Brazil

The Brazilian National Congress approved the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal by means of the Legislative Decree n. 34, on June 16th, 1992. One year later, the BC entered into force in in the country, by Federal Decree n. 875, published on July 20th, 1993. From that moment, the National Environment Council (CONAMA) has launched and updated some non-statutory Resolutions on hazardous waste, even before Brazil presents a comprehensive waste management legal framework at the federal level.

In fact, even a bit before the promulgation of BC in Brazilian territory, the CONAMA had already instituted in 1991 a Resolution, which prohibited the entry of residual materials destined to final disposal and incineration in Brazil (CONAMA Resolution n. 8/1991, now repealed by the Resolution n. 452/2012).

Subsequently, taking into account the BC regulation in the country, the CONAMA Resolution n. 7/1994 was finally issued, defining “hazardous waste”, “other wastes” and “unwanted wastes”, as well as banning imports and exports of any species of hazardous wastes in all national territory, in any form and for any purpose, including recycling.

In the same year, the Resolution n. 7/1994 had to be replaced by the CONAMA Resolution n. 37/1994, due to the COP-2 Decision II-12 which came to prohibit, after

December 31th, 1997, all transboundary movements of hazardous wastes from OECD members to non-OECD countries, both destined for recycling or recovery operations and for final disposal. Such Resolution also prohibited the import of hazardous wastes (Class I) in all national territory, in any form and for any purpose, including recycling and "reuse" (previously, the latter was not expressly provided for).

Two years later, the Resolution n. 37/1994 was revoked by CONAMA Resolution n. 23/1996, including as hazardous wastes also those which, though not listed in the Annexes 1-A.to 1-C, present any of the characteristics described in the Annex 2 of that Resolution.

Additionally, the ABNT NBR 10004:2004, which is a Brazilian technical norm on solid waste classification, has defined the "hazardousness of a waste" as characteristic exhibited by a waste, which due to its physical, chemical, infectious or contagious properties, may present: (i) risk to public health, causing mortality, disease incidence or enhancing their levels; (ii) risks to the environment when the waste is managed improperly.

According to this technical norm, it is deemed as hazardous waste that which holds specific characteristics: inflammable, corrosive, reactive, toxic and pathogenic or that it is nominated. Brazil submitted ABNT NBR 10004:2004 to BC Secretariat so that the Parties could recognize such characteristics required within Brazilian territory. Topics presented in this norm are certainly used as inspiration to other countries' standardization.

After more than 20 years of legislative process, the National Solid Waste Policy (NSWP) was finally instituted by the Federal Law n. 12.305 on August 2nd 2010, solving the lack of a comprehensive waste management legal framework at the federal level until then existing, especially in relation to electronic waste, for which there was not even CONAMA Resolution. That Federal Law was regulated by Federal Decree n. 7.404, on December 23th, 2010, which created the Inter-ministerial NSWP Committee and also the Steering Committee for the Implementation of Reverse Logistics (CORI).

The NSWP established a shared responsibility scheme for product lifecycle (quite different from the traditional extended producer responsibility mechanisms), involving various actors of production and consumption chain, such as manufacturers, importers, distributors, retailers, consumers and the government, with individualized and chained assignments in the waste management processes.

Thus, the supply chain shall design and implement take-back systems, including for electronic products and their components (Article 33, VI[5]), as well as invest in the development, production and placing on the market of electronic equipment that is able, after use by consumers, to reuse, recycling or other form of environmentally sound final destination, and whose production and use generate the least amount of waste (Article 31, I).

It is worth highlighting that e-waste management is not only related to environmental problems, but also to opportunities, such as the possibility of recovery of precious metals or rare materials often contained in electronic products (Herat, Agamuthu, 2012). Unlike the packages, which usually have a more homogeneous composition (Aragão, 2003), electrical and electronic equipment are often made of hazardous materials (such as heavy metals), hardly recyclable materials (like some plastics), materials with no market value (such as silica) or inversely with substantial economic value (as silver, gold and platinum).

With regard to reverse logistics, consumers shall return electronic products and components, after their use, to retailers or distributors. These, in turn, shall deliver them to the manufacturers or importers of such products, which shall promote environmentally sound final destination of their e-waste, and environmentally sound final disposal of their refuses in landfills.

In comparison with WEEE European framework and even to Brazilian regulatory status of other types of waste subject to mandatory take-back systems (as agro-toxins, scrap tires and lubricant oil waste), the electronic waste regulation is still timid in the country, lacking nowadays a federal regulatory instrument that provides, for example, convergent definitions and terminology for e-waste (Mendes, Lemos, 2013), notwithstanding the booming of its production, consumption, disposal and socio-environmental impacts in Brazil and worldwide (Miguez, 2010), and some legislative initiatives at State and Municipal levels.

Furthermore, the NSWP states that the installation and operation of a project or activity which generates or operate hazardous wastes may only be authorized or licensed by the relevant authorities, provided that the responsible legal entities can prove, at least,

[5] In accordance with the NSWP and the Federal Decree n. 7.404/2010, the procedure for implementation of household electronic waste take-back systems nationwide, through preparation of Sector Agreement, is currently in progress in the country (Mendes, Lemos, 2013). On June 12th, 2013, four proposals of Sector Agreement for implementing such take-back system in Brazil were delivered by the relevant electronic segment to Ministry of the Environment, which will evaluate it, according to the minimum requirements set forth in the Call Notice n. 1/2013, and subsequently submit it to the CORI approval (Tolentino, 2013).

technical and economic capacity, and conditions to provide the necessary care for their management (Article 37). Such legal entities involved are required to enroll in the National Database on Hazardous Waste and also to elaborate a hazardous waste management plan to be submitted to relevant environmental authorities, in compliance with the minimum content laid down in its Article 21.

In order to incorporate the rules and procedures established by NSWP[6], the CONAMA Resolution n. 23/1996 on the control of hazardous wastes transboundary movements had to be replaced by the Resolution n. 452, of July 2nd, 2012, which considers as "hazardous wastes (Class I)" those contained in the Annex I (since has any of characteristics described in the Annex III), as well as the wastes listed in the Annexes II and IV[7] of that Resolution, according to Federal Decree n. 4.581/2003, that promulgated the Amendment to Annex I and the Adoption of Annexes VIII and IX of the Basel Convention in Brazil.

In relation to transboundary movements, as strengthened by CONAMA Resolution n. 452/2012, the NSWP prohibits in its Article 49 the import of "hazardous wastes and refuses", and also of "solid waste whose characteristics can cause damages for the environment, as well as for human, animal or plant health", even though if they are destined for treatment, retread, reuse, reutilization or recovery.

Based on prevention and precautionary principles often applied on environmental matters in Brazilian legal system and also expressly stipulated as NSWP principles in its Article 6º, I, it could be hold that the import of any electronic solid waste or refuse is, in any form and for any purpose, forbidden in Brazilian territory, taking into account including the fundamental right and duty of everyone to a healthy and ecologically balanced environment. Thus, nor even under the label of "commodities", obsolete electronic equipment could be imported to the country.

In that sense, e-waste presents harmful effects on environment as a whole and on public health, sometimes on grounds of its potentially dangerous composition, sometimes as a result of its tendency of accumulation in large volumes in inappropriate places (Mendes, Lemos, 2013).

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[6] For example, by distinguishing "solid wastes" from "refuses", as outlined by NSWP and already explained in the introduction of this paper.

[7] The list of hazardous wastes of the Annex IV of CONAMA Resolution n. 452/2012 corresponds to the "List A" of the Annex VIII of Basel Convention, in which is included the entry "A1180" already mentioned.

In Brazil, the environmental liability unfolds in civil, criminal and administrative approaches, which are autonomous and complementary legal instruments to ensure full protection for environment and human health (Article 225, § 4, Brazilian Constitution of 1988).

Through the Federal Decree n. 7.404/2010, the Article 71-A was included in the Federal Decree n. 6.514/2008, which provides for administrative infractions and sanction concerning environment, establishing that if someone imports hazardous solid wastes, refuses or other solid wastes whose characteristics can lead to environmental and health damages, even though if they are destined for treatment, retread, reuse, reutilization or recovery, a administrative fine between R$ 500 to R$ 10.000.000 (Brazilian Real) may be applied to the violator.

In the criminal liability field, in compliance with Basel Convention (Article 4, n. 3), if someone imports or exports a product or substance, which is toxic, dangerous or harmful to human health or environment, against requirements laid down in laws and regulations, a criminal sanction of imprisonment from 1 to 4 years plus a fine may be applied to the violator, according to the Federal Law n. 9.605/1998 (Article 56, *caput*). Anyone who handles, packages, stores, collects, transports, reuses, recycles or disposes of hazardous wastes is subject to the same penalty (Article 56, § 1º, II, included in Federal Law n. 9.605/1998 through the NSWP in 2010).

At last, the Brazilian environmental civil liability can be appointed as an important instrument to ensure health and environmental quality, to the extent that it not only provides reparation or compensation for individual, collective or diffuse damages, but can also be engaged for prevention of environmental damages, for example, related to electronic waste management in the country.

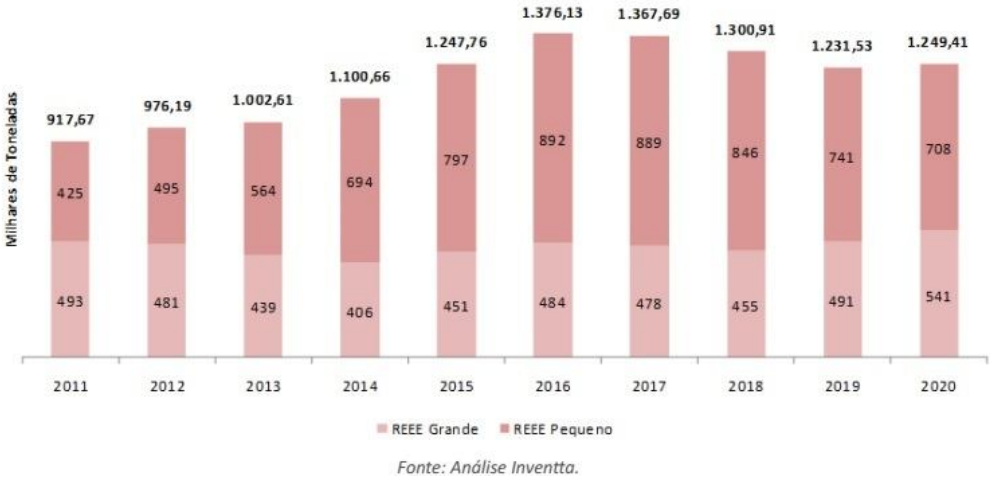
According to a UNEP report (United Nations, 2009), which collected data from eleven developing countries, including Brazil, for estimating their electronic waste generation in the present and future, the information on Brazilian e-waste management is still scarce and comprehensive assessment studies are unknown.

Notwithstanding, from a study[8] commissioned by the Ministry of Development, Industry and Foreign Trade (MDIC) and Brazilian Association on Industrial Development (ABDI), it has been estimated that Brazil will generate about 1.1 million

[8] That study corresponded to the analysis of technical and economic feasibility of e-waste reverse logistics in Brazil, which preceded the procedure for preparation of Sector Agreement currently in progress.

tonnes of electronic wastes, whereof 694.000 tonnes consist of small-sized e-waste (ABDI, Inventta, 2013).

Figure 3: Large and small-sized e-waste generation in Brazil (per thousands of tonnes)



Source: ABDI, Inventta, 2013.

5. Results and discussion

Based on the analysis of literature and regulations on transboundary movements of hazardous wastes (HW), with focus on e-waste management in Brazil, we could verify that the massive transboundary movements of HW from industrialized countries to developing ones in 1980's, related to tightening of national environmental legislation in the former, where there has been a drastic increase of costs for HW recovery and disposal within their own territory, brought about the need for regulating the matter at global level by means of the signing of Basel Convention (BC).

Since then, Brazil has sought to reach the main goals of BC on the control of HW hazardous movements, even before having a comprehensive waste management legal framework at the federal level. In that sense, a series of CONAMA Resolutions have been enacted and updated according to BC evolution and implementation.

The National Solid Waste Policy (NSWP) and the CONAMA Resolution n. 452/2012 have further restricted the transboundary movements, by prohibiting the import of

hazardous wastes and refuse, as well as solid wastes whose whose characteristics can cause environmental and health damages for the environment, even though if they are destined for treatment, retread, reuse, reutilization or recovery.

Notwithstanding the BC and national regulation efforts, the e-waste generation continues to grow hugely in view of booming of global demand for electronic appliances, including in developing countries, like Brazil, China and India. In that scenario, extended responsibility mechanisms should be adopted by countries, in order to reduce the growing amount of e-waste, making the supply chain responsible from the cradle to the grave.

6. Conclusions

In any form and for any purpose, the import of any electronic solid waste or refuse is forbidden in Brazilian territory, taking into account NSWP, CONAMA Resolution n. 452/2012 (in dialogue with BC), prevention and precautionary principles, as well as the fundamental right and duty of everyone to a healthy and ecologically balanced environment. In that sense, nor even under the label of “commodities”, obsolete electronic appliances could be imported to the country, in view of the broad definition for “solid waste” and its “environmentally final destination” existing in the NSWP.

In Brazil, shared responsibility for product lifecycle can be appointed as an important initiative towards a more efficient e-waste management, to the extent that establishes for manufacturers, importers, distributors and retailers the obligation of structuring and implementing take-back systems for electronics products and their components, as well eco-design duties aiming to reduce e-waste generation and its dangerousness.

The electronic waste regulation is still timid in the country, lacking nowadays a federal regulatory instrument that provides, for example, convergent definitions and terminology for e-waste. Reliable data are scarce about Brazilian e-waste generation and management, and nationwide comprehensive assessment studies are also unknown.

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REFERENCES

ABDI and Inventta (2013) *Logística reversa de equipamentos eletroeletrônicos: análise de viabilidade técnica e econômica*. Brasília, MDIC. Available at <http://www.mdic.gov.br/arquivos/dwnl_1367253180.pdf>. (last visited July 18th, 2014).

Aragão M. A. S. (2003) *O direito dos resíduos*. Coimbra, Almedina Publisher.

Associação Brasileira de Normas Técnicas. *ABNT NBR 10004:2004: solid waste: classification*. Available at <www.aslaa.com.br/legislacoes/NBR%20n%2010004-2004.pdf> (last visited July 18th, 2014).

BAN and SVTC (2002) *Exporting harm: the high-tech trashing of Asia*. Seattle. Available at <http://www.ban.org/E-waste/technotrashfinalcomp.pdf> (last visited July 18th, 2014).

Barbalace R. C. (2001) Environmental Justice and the NIMBY principle. *EnvironmentalChemistry*.com. Available at <http://environmentalchemistry.com/yogi/hazmat/articles/nimby.html> (last visited July 18th, 2014).

Brazil (1988) *Constitution of the Federative Republic of Brazil, of Oct. 5th, 1988*. Available at <http://www.planalto.gov.br/ccivil_03/constituicao/constituicao.htm> (last visited July 18th, 2014).

Brazil (1991) Ministry of the Environment. *CONAMA Resolution n. 8, of Sep. 19th, 1991*. Available at <http://www.mma.gov.br/port/conama/legiabre.cfm?codlegi=122> (last visited July 18th, 2014).

Brazil (1992) *Legislative Decree n. 34, of June 16th, 1992*. Available at <http://legis.senado.gov.br/legislacao/ListaPublicacoes.action?id=136503> (last visited July 18th, 2014).

Brazil (1993) *Federal Decree n. 875 of July 19th, 1993.* Available at <http://www.planalto.gov.br/ccivil_03/decreto/D0875.htm> (last visited July 18th, 2014).

Brazil (1994) Ministry of the Environment. *CONAMA Resolution n. 7, of May 4th, 1994*. Available at <www.mma.gov.br/port/conama/legiabre.cfm?codlegi=148> (last visited July 18th, 2014).

Brazil (1994) Ministry of the Environment. *CONAMA Resolution n. 37, of Dec. 7th, 1994*. Available at <www.mma.gov.br/port/conama/legiabre.cfm?codlegi=178> (last visited July 18th, 2014).

Brazil (1996) Ministry of the Environment. *CONAMA Resolution n. 23, of Dec. 12th, 1994*. Available at <www.mma.gov.br/port/conama/legiabre.cfm?codlegi=222> (last visited July 18th, 2014).

Brazil (1998) *Federal Law n. 9.605, of Feb. 12th, 1998*. Available at <www.planalto.gov.br/ccivil_03/leis/l9605.htm> (last visited July 18th, 2014).

Brazil (2003) *Federal Decree n. 4.581, of Jan. 27th, 2003*. Available at <www.planalto.gov.br/ccivil_03/decreto/2003/D4581.htm> (last visited July 18th, 2014).

Brazil (2008) *Federal Decree n. 6.514, of Jul. 22th, 2008.* <www.planalto.gov.br/ccivil_03/_ato2007-2010/2008/decreto/D6514.htm> (last visited July 18th, 2014).

Brazil (2010) *Federal Law n. 12.305, of Aug. 2nd, 2010*. Available at <http://www.planalto.gov.br/ccivil_03/_ato2007-2010/2010/lei/l12305.htm> (last visited July 18th, 2014).

Brazil (2010) *Federal Decree n. 7.404, of Dec. 23th, 2010*. Available at <http://www.planalto.gov.br/ccivil_03/_ato2007-2010/2010/Decreto/D7404.htm> (last visited July 18th, 2014).

Brazil (2012) Ministry of the Environment. *CONAMA Resolution n. 452, of Jul. 2nd, 2012*. Available at <www.mma.gov.br/port/conama/legiabre.cfm?codlegi=676> (last visited July 18th, 2014).

Brazil (2013) Ministry of the Environment. *Call Notice n. 1/2013, of Feb. 6th, 2013*. Available at <http://www.mma.gov.br/images/editais_e_chamadas/SRHU/fevereiro_2013/edital_ree_srhu_18122012.pdf> (last visited July 18th, 2014).

Beck U. (2006*) La sociedad del riesgo: hacia una nueva modernidad*. Barcelona, Paidós Publisher.

El-Fadel M., Zeinati M., El-Jisr K. and Jamali D. (2001) Industrial-waste management in developing countries: the case of Lebanon. *Journal of Environmental Management*, vol. 61, n. 4, apr. Available at <http://dx.doi.org/10.1006/jema.2000.0413> (last visited July, 18 2014).

Fan K., Chang T. C. and Ni S. (2005) Transboundary hazardous waste management. Part I: waste management policy of importing countries. *Waste Management & Research*, n. 23, dez., pp. 505-513.

García-Tornel F. C. (2001*) Sociedades y territorios en riesgo*. Barcelona, Del Serbal Publisher.

Herat S. and Agamuthu P. (2012) E-waste: a problem or an opportunity? Review of issues, challenges and solutions in Asian countries. *Waste management & research:*

special issue: waste electrical and electronic equipment. Los Angeles, SAGE, ISWA, vol. 30, n. 11, pp. 1113-1129.

ILO (2012). *The global impact of e-waste: addressing the challenge*. Genève, International Labour Organization. Available at <http://apgreenjobs.ilo.org/resources/the-global-impact-of-e-waste-addressing-the-challenge/at_download/file1> (last visited July 19th, 2014).

Lemos P. F. I. and Mendes J. M. A. (2013) Resíduos eletroeletrônicos e seu panorama jurídico no Brasil: desafios regulatórios e oportunidades de implementação de sistemas de logística reversa. *Revista de Direito Ambiental, n. 72*, p. 39-66, oct.-dec. São Paulo, Revista dos Tribunais Publisher.

Martinez-Alier J. (2007) *O ecologismo dos pobres*. São Paulo, Contexto Publisher.

Mendes J. M. A. and Lemos P. F. I. (2013) Waste electrical and electronic equipment and its regulatory challenges in Brazil: opportunities for implementation of WEEE take-back systems. *Proceedings Sardinia 2013, 14th International Waste Management and Landfill Symposium*, Cagliari, CISA Publisher.

Miguez E. C. (2010) *Logística reversa como solução para o problema do lixo eletrônico: benefícios ambientais e financeiros*. Rio de Janeiro, Qualitymark Publisher.

November V. (2002) *Les Territoires du risque: le risque comme objet de refléxion géographique*. Bern, Peter Lang Publisher.

Peiry K. K. (2011) Introduction. In *Basel Convention*, Genève, Secretariat of the Basel Convention. Available at <http://www.basel.int/Portals/4/Basel%20Convention/docs/text/BaselConventionText-e.pdf> (last visited on July 19th, 2014).

Tolentino L. Descarte de celulares, computadores, geladeiras e televisões terão normas para proteger o meio ambiente. *InformMMA: notícias*. Brasília, June 6th. Available at <www.mma.gov.br/informma/item/9416-responsabilidade-compartilhada> (last visited on July 19th, 2014).

UNEP (2009) *Recycling: from E-waste to Resources: Final Report*. Nairobi. Available at <http://www.unep.org.br/admin/publicacoes/texto/EWaste_final.pdf> (last visited on July 19th, 2014).

UNEP (2011) *Waste: investing in energy and resource efficiency*. Nairobi. Available at [www.unep.org/greeneconomy/Portals/88/documents/ger/GER_8_Waste.pdf] (last visited on July 19th, 2014).

United Nations (2010) *Trend in sustainable development: chemicals, mining, transport and waste management*. New York, DESA. Available at <sustainabledevelopment.un.org/content/dsd/resources/res_pdfs/publications/trends/trends_Chemicals_mining_transport_waste/Trends_chem_mining_transp_waste.pdf> (last visited July 18th, 2014).

United Nations (2011). *Basel Convention on the control of transboundary movements of hazardous wastes and their disposal: Protocol on Liability and Compensation: Texts and Annexes*. Available at <www.basel.int/Portals/4/Basel%20Convention/docs/text/BaselConventionText-e.pdf> (last visited July 18th, 2014).