The Economic Sustainability of Global Hazardous Waste Production

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Introduction

Production levels of hazardous wastes and related toxic substances have been on the increase in recent decades and are projecting no signs of decline. As both historical evidence arising from tragedies and incessant research have shown, toxic substances in the form of hazardous wastes can have catastrophic consequences on the health of humans and on ecologies everywhere. While many attempts have been made to reorient economic and other factors underlying the generation and movement of this waste, none seem to have succeeded completely without creating new problems. Since these difficulties are always entirely contextual and because they are source of persistent economic disadvantages, economic sustainability in affected regions is very unlikely to be reached in the near future for this area of activity.

Among the problems is the unequal level of media attention given to damages, repercussions and costs involved with hazardous waste between OECD (i.e. developed) and non-OECD (i.e. underdeveloped) countries. This problem is manifested in the form of the “Not In My BackYard” syndrome and has become increasingly widespread in hazardous waste generating countries as well as a very evident source of market price distortions. Additional to the NIMBY in OECD countries are a number of other complementing realities such as rampant corruption in vulnerable economies. Combined they establish inviting conditions for irresponsible imports of hazardous waste and also create the market inefficiencies to support them.

When disposal is successful, it is only a temporary solution to the problem since the lifespan of the hazardous waste outlasts that of its containment. Through interdependencies, social, human and ecological capital are all affected and ultimately influence economic growth patterns worldwide. Cleaner production strategies as well as other attempts to alleviate generation and ultimately the irresponsible spreading of waste, can only be achieved to a limited degree using economic policy such as taxes, subsidies, standards and transferable discharge permits. Success and progress in this area varies according to the economic region in which it is attempted since it depends largely on the performance of law and institutions found therein.

In this study, I begin by developing the context in which the problem is situated, elaborating on the origins, characteristics and effects of hazardous waste. Next, I define the scope of the problem by offering quantitative indications of the generation levels, carefully recognizing the challenges inherent to the exercise. An empirical analysis of the trade flows follows verifying the movement and relative intensities of a sample trading activity. At this point, the basis is set to embark in the discussion about the economic forces found in the form of trade factors and market inefficiencies that dictate the activity in this field. This last section attempts to synthesise the findings with the economic forces at play in hopes to shed light on possible solutions to the problem.

Part 1: Context

1.0 GENESIS

Propelled perhaps by the idealism of the day, it is in the sixties that the environmental awakening began. The chemical industry, shortly after the war, was at its heyday and still benefiting from the expansions it had experienced during the high demand years as well as from the economic boom following them. New chemicals were fuelling the plastics revolution[1] while at the same time finding new uses in the miracle drugs, in more effective solvents and adhesives, in dyes, paints and wood preservatives.

This massive and largely uncontrolled growth of the industry, truly a human experiment in remodelling nature's raw resources, was bound to eventually meet up with the consequences of its negligence. Rachel Carson, in her classic best-selling book *Silent Spring*[2], was the first to effectively attract the public's attention to the issue by explaining the interdependencies existing between the chemicals released into the environment and the ensuing ecological, economical and human health damages. In hindsight, while her work played a key role in raising awareness about the *hazardous* part in hazardous waste[3], it seemingly did not suffice to slow down the growth of the industry as a whole. Accordingly, it is within such a context that the decade of the fifties would live on to earn the nickname of the "Throwaway Society".[4]

Damages caused during that period and during the decades that followed are still being felt today taking the form of expensive remedial work, lawsuits, opportunity costs of contaminated land, severe health problems and so on. Their consequences are proving to be drastically more expensive to manage than previously anticipated. Thus, amidst an era filled with new environmental scientific evidence and governed by a generation having witnessed a fair share of tragedies, one would expect to see today, a comparatively more ethical and responsible approach to hazardous waste management. Instead, temporary and ineffective quick fixes artificially only displace problems elsewhere and allow them to grow both in strength and in complexity leading them to reach levels at which they are no longer manageable. In sum, while these quick fix "solutions" are often caused by forces deeply rooted in market inefficiencies, they mostly occur due to deficiencies in governance, institutions and / or judiciaries. Such

[1] R.A. Freeze, *The Environmental Pendulum : A Quest for the Truth about Toxic Chemicals, Human Health, and Environmental Protection*, 8.
[2] Rachel Carson, Lois Darling, and Louis Darling, *Silent Spring, (*Boston; Cambridge, Mass.: Houghton Mifflin; Riverside Press, 1962).
[3] The terms "hazardous" waste/substance and "toxic" waste/substance will be used interchangeably throughout this work. Likewise, terms such as "chemical substances", "waste" or other similar terminology referring to the hazardous matter will also be used interchangeably.
[4] R.A. Freeze, *The Environmental Pendulum : A Quest for the Truth about Toxic Chemicals, Human Health, and Environmental Protection*, 12.

are the reasons why the economic aspects of hazardous wastes production and trade deserve immediate but careful attention.

2.0 DEFINITION

What is waste? What is *hazardous* waste? Agreements on such seemingly basic definitions have been far from common in the international community. Consequently, this rarity has added much complexity and challenge to the researcher interested in data collection and formulation of comparative analyses. The attempt herein is no exception and thus has unfortunately not been spared from the obstacles associated with the exercise. It is therefore important to devote the following section to the clarification of terms and to explanations dealing with the complications arising from them.

2.1 Terms

Throughout the hazardous waste literature, definitions of fundamental descriptive terms vary greatly. The word "waste" itself does not appear to be problematic. Policy makers generally agree that waste can be considered a by-product of industrial or household activity and that it can exist in many forms. From a microeconomics perspective, waste occurs when a resource is not put to its highest valued use. This may sometimes take the physical form of residuals resulting from inefficient production or consumption activities.

Consensus comes to a halt however when the adjective "hazardous" is added to the terminology. "It turns out that there are as many legal definitions of hazardous waste as there are environmental statutes, and as many academic definitions as there are textbooks."[5] Studying the definitions used for hazardous waste in various countries indicates that no two systems are alike, and that some are even inconsistent with each other, which creates numerous problems.[6] Citizens, technicians, businesspersons, politicians, activists - all use different approaches to describe waste and as a result, each end up with a different definition for the very same substance.

Classifying certain materials as *hazardous* is also sometimes very political; especially when it involves major internationally traded commodities within the framework of a highly regulated market. What's more, the use of

[5] R.A. Freeze, *The Environmental Pendulum: A Quest for the Truth about Toxic Chemicals, Human Health, and Environmental Protection*, 57.
[6] J.P. Hannequart, *Identification of Responsibilities in Hazardous Waste Management*, (Paris, 1985).

hazardous or *toxic* is highly context-specific: what is toxic to some (i.e. sewage sludge to those without treatment facilities) can often be beneficial to others (i.e. methane production from biodegradation of sludge).

Despite these many differences, some common elements are found across most definitions. For instance, the majority of descriptions fundamentally recognize that the use of the word *hazardous* implies that the waste is source of harm to the human health and / or ecosystems to which it is exposed. Some definitions offer more precision explaining that the substance may reasonably be anticipated to cause death, disease, behavioural abnormalities, cancer, genetic mutation, physiological malfunction, or physical deformation in human beings.[7]

Equally, if not more controversial is the term *recycling*.

Recycling, as it is intended here, arrived on the scene by means of debates arising from the *Basel Convention on the Control of Transboundary Movements of Hazardous Wastes*. At the 1998 Malaysia meeting of the parties, proposed amendments to remove loopholes hitherto allowing for uncontrolled movements of hazardous waste "destined for recycling", ignited into debate. At the table, an intransigent global recycling industry, worth some U.S. $160 billion per year and employing some 1.5 million people around the world in the late 1990's[8], was not prepared to alter its lucrative operations. Keeping the pressure on high, environmentalists ultimately prevailed but the issue has remained tenuous ever since.

The difficulty with *recycling* lies in determining exactly what may be (or become) hazardous once under the control of the recyclers. When proper facilities exist and recycling takes place under conditions meeting or exceeding environmental standards, the industry can be very profitable from both an environmental and economic perspective since a considerable share of residuals can be recovered and reused in production operations. On the flip side, the same operations can encourage fake recycling schemes, i.e. the use of the label of recycling for disposal operations that would otherwise be prohibited.[9] Also, some recycling activities

[7] R.A. Freeze, *The Environmental Pendulum: A Quest for the Truth about Toxic Chemicals, Human Health, and Environmental Protection*, 58.
[8] Jennifer Clapp, *Toxic Exports: The Transfer of Hazardous Wastes from Rich to Poor Countries* (Ithaca: Cornell University Press, 2001), 83.
[9] Katharina Kummer International Management of Hazardous Wastes : The Basel Convention and Related Legal Rules (Oxford; New York: Clarendon Press; Oxford University Press, 1995) 10.

are themselves sources of pollution. The recycling of newspapers, for example, generates hazardous chemical waste from the de-inking process.[10]

In the end, such definition problems make it extremely difficult to monitor with accuracy and consistency changes and / or patterns existing or developing in hazardous waste generation or its international movement.

2.2 Classification

Victory will be short-lived for the researcher if and when the world ever agrees on definitions for *hazardous* and *recycling.* Many other complications persist and among them are the severe inconsistencies across waste classification systems.

Clearly, there is a multitude of reasons why increased clarity in the domain of hazardous waste makes good sense. To begin with, a clearer definition coupled with a corresponding unambiguous classification system, would clarify what law is applicable where but also assist authorities in implementing and enforcing legislation to monitor and control hazardous waste.[11] A likely outcome is that civil and environmental law would become more effective in regulating areas such as property rights. The reality however is that many countries, in their attempt to develop a classification system, have simply resorted to testing various substances and then produce a list of those they considered to be particularly hazardous. This chaotic and disorganized approach to classification is problematic since the quality of testing processes in many countries has not kept pace with the exponential increase of new chemical on the world market.[12]

Another dimension of the problem is that, from one country to the next, statistical definitions involved in the classifying process vary significantly. It is difficult for instance to compare waste in rich and poor countries. This problem also applies for advanced or highly collaborative union of countries such as the European Union which adds in its report entitled *Hazardous waste generation in EEA member countries* the following note of caution:

> "In general, it is recognised that, at the European level, data on hazardous waste are not comparable. It is not currently possible to say to what extent the variations found in the reported statistics can be explained by different: i) classification of hazardous waste; ii) systems and obligations for collecting

[10] R. A. Freeze, *The Environmental Pendulum: A Quest for the Truth about Toxic Chemicals, Human Health, and Environmental Protection*, 160.
[11] Christopher Hilz, *The International Toxic Waste Trade*, (New York: Van Nostrand Reinhold, 1992), 14.
[12] O'Neill, *Waste Trading among Rich Nations: Building a New Theory of Environmental Regulation*, 27.

hazardous waste; iii) reporting systems on hazardous waste data; iv) industrial structures; v) levels of application of cleaner technology, etc."[13]

Other players in the field, such as the Basel Convention Secretariat, initially proposed and now uses a system that has unfortunately managed to collect only a small amount of information from only a few countries. The Basel data collection nonetheless remains the most extensive and consistent of all that exist. In contrast to the Europeans with their waste catalogue and hazardous waste lists, are the many individual countries that have their own domestic systems characteristically and frequently at odds with those used internationally. This is the case for instance with the Russian Federation and the United States.

In the end, it is in this elaborate web of complexities that the careful analytical researcher must navigate in hopes of identifying trends and drawing conclusions from this very controversial area of economic activity.

3.0 HISTORICAL EVIDENCE

3.1 Cumulative Disasters

During the seventies and eighties within the context of a newly developing world economy, economic arguments were used to justify the flow of very poisonous chemicals from rich to vulnerable and ill-equipped poor nations of the world. Inexistent treatment technologies and inadequate disposal facilities of the type needed for the absorption of such shipments were shortly afterwards, found to be direct causes of numerous devastating tragedies. What was witnessed at these events caught the attention of the international community and ultimately allowed for the problem to acquire the sufficient political traction needed for action to finally occur. Yet, before such action arrived, delays and politics, often known to be inseparable, continued to fuel the procrastination taxing all attempts of progress on this issue. Meanwhile, societal awareness expanded incrementally for every new tragedy responsible for the loss of lives – lives often easily taken given the atrocious power inherent to these chemical creations.

On the European continent, the interest of the EC/EU in hazardous waste management issues was first sparked by the 1976 Seveso Incident, when several drums of dioxin vanished from a plant in Italy following a severe chemical explosion, only to reappear eight years later in a disused abattoir in France.[14]

[13] Henrik Jacobsen, Matthew Crowe, Jens Brodersen, European Environment Agency, and European Topic Centre on Waste. *Hazardous Waste Generation in EEA Member Countries: Comparability of Classification Systems and Quantities* (Copenhagen, Denmark; Luxembourg: European Environment Agency; Office for Official Publications of the European Communities, 2002), 10.

[14] Kate O'Neill, Waste Trading among Rich Nations : Building a New Theory of Environmental Regulation (Cambridge, Mass.: MIT Press, 2000), 44.

In America, the now well-known August 1977 Love Canal Incident sufficed to put the issue of hazardous waste on the national agenda and into public consciousness:

> […] reports of black sludge bleeding through basement walls in a suburban subdivision in Niagara Falls, New York. There were initial reports of benzene fumes in the kitchen, dead trees in the backyard, headaches, skin ailments, and respiratory discomfort; and later of dioxin and miscarriages and birth defects. The story struck a chord with the American public. It was featured on the *Today* Show, the *McNeil-Lehrer News Hour*, *Sixty Minutes*, and *Good Morning America.*[15]

Despite these encounters with the catastrophic effects of toxic substances, the profits generated by their production and use remained far too great for the chemical industry to agree to reduce its output. To blame were the tastes of consumers that remained relatively unchanged despite increasing awareness of the risks associated with hazardous waste. At last, with awareness and knowledge slowly accumulating in producing societies, the industry realized that some action would have to be taken. One solution to these problems was to migrate some of the production to less regulated economies where it would not fall prey to the continuous scrutiny of established controls. The economic case for such a move seemed favourable and was therefore an easy and convincing one to make to the decision makers. With little international liability laws, a minimum of local regulatory institutions as well as much cheaper labour available, the cost benefit problem clearly favoured such transitions. In a context of increased popularity of such practices, it would not be long before short-term negligence would yet again be source of great catastrophe.

On the night of December 2, 1984, a storage tank at a US-owned pesticide plant in Bhopal, India burst open, releasing a cloud of poisonous methyl isocyanate gas toward the town Jayaprakash Nagar that bordered the plant. A former *New York Times* correspondent, Sanjoy Hazarika, reported that the children and adults alike were "struck down, gasping for breath, clutching at burning, hurting eyes and chests, frothing at the mouth… and then choking on their own vomit and blood."[16] The accident would claim more than 6000 lives within a week and over 16,000 to date, going down in history as one of the world's worst environmental disasters.[17]

All these, it must be noted, are only select examples of an already limited area of public knowledge. Yet it has been plentiful for the public to draw lessons from it, albeit by means of tragic sounds and catastrophic images of the victims that have fallen every time so innocently from them. Countless other incidents however remain

[15] R.A. Freeze, *The Environmental Pendulum : A Quest for the Truth about Toxic Chemicals, Human Health, and Environmental Protection*, 10.
[16] Sanjoy Hazarika, *Gas leak in India kills at least 410 in city of Bhopal* , *The New York Times* , (New York, N.Y.: Dec 4, 1984), A1.
[17] Hilary F. French, Vanishing Borders: Protecting the Planet in the Age of Globalization. 1std ed. (New York: W.W. Norton, 2000), 71.

unknown or completely unaccounted for – at least, for the time being. This is true in the case of the voyage of the *Khian Sea*. Leaving from Philadelphia in August 1986, the ship was loaded with toxic ash from municipal incinerators in search of a location to dump the waste. The strategy backfired as the ship spent close to a year in a half in the Caribbean Sea looking unsuccessfully for a dump location. A partial release in Haiti provoked uproar and forced the ship to continue its journey to five continents, changing its name three times. According to its owners, it is reported to have eventually discharged its load at some undisclosed location in late 1988.[18]

Examples are plentiful and simply too many to list in full. Over time, the culmination effect of these events led to the tightening of laws concerning hazardous waste in their principal producing economies: namely the United States and the European industry. It was not long afterwards before cases of waste dumping were found in Africa. In 1988, in the small fishing village of Koko in Nigeria, were discovered 8000 drums of highly toxic waste, including methyl melamine, dimethyl formaldehyde, ethylacetate formaldehyde and about 150 tons of polychlorinated biphenyls (PCBs). Many of the Nigerian workers who helped remove the waste were hospitalized with severe chemical burns, nausea, vomiting of blood, and partial paralysis, and one person fell into a coma.[19] Behind it all was an Italian waste disposal firm that would later take responsibility. Meanwhile, in a symbolical yet deeply meaningful political gesture, Nigeria had recalled its ambassador from Rome.[20]

All of the above incidents have served as examples of the short-term effects resulting from exposure to toxic substances. In each case, local health systems likely received sudden unexpected increases in demand for services and treatments leading to the intensification of capital and labour investment needs. However, unlike other tragedies, the consequences arising from exposure to toxic chemicals or hazardous waste extend far into the future. In small and devastated communities, the labour force is drastically affected, arable land contaminated and the local economy often gravely ruined from the sum of these consequences. Yet, as will be explored later, movement of harmful substance to regions unprepared for its absorption is still, despite international controls, a persisting trend supported by contemporary economic reasoning.

3.2 International Controls

[18] Hilary F. French, Vanishing Borders: Protecting the Planet in the Age of Globalization. 1std ed. (New York: W.W. Norton, 2000), 72.
[19] Ibid, 73.
[20] Hiltzik, *West's Waste Dumping Stirs Africa Controversy*, L.A. Times, June 19, 1988, at 9, col. 1.

Once after the public was widely informed, it eventually became apparent to politicians also that the rich nations had been successfully mitigating many of their domestic toxic catastrophes by sending them elsewhere. At the same time, firms were lowering their costs of chemical production by establishing themselves in the developing world where many economic advantages existed for them. The African nations condemned the practice as "toxic terrorism" and "garbage imperialism"[21] leading them to a long and strenuous battle that would ultimately win them enough political traction to align the world's nations behind the *Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal*.

Their work was accelerated by the fact that by the late 1980's, environmental groups in the rich nations, had managed to build up enough publicity around the cause that public outcry was loud and clear to politicians. The Convention however, only limited the movement of transboundary hazardous waste – it did not the ban its production nor completely stop its migration. As such, parties without the proper disposal facilities were allowed to continue exporting.

Nevertheless, by the mid-1990's the movement of such waste from OECD to non-OECD countries was reported as *officially* slowing down. Some would quickly credit this success to the Convention, but in the end it was proved to be largely because of the increase in media attention. What is important to note in all of this, is that movement of hazardous waste never did stop completely. On the contrary, it managed to take on new forms allowing it to camouflage itself in other areas of waste disposition that were much less scrutinized by the public eye – such as "recycling". NGO's, uneasy with this Convention loophole from the very beginning lobbied for the addition to the Convention of control measures dealing with this "recycling" activity.

In 1994, parties agreed voluntarily to ban all exports of wastes, both for disposal and for recycling purposes from OECD members to non-members. Along with this ban came fresh new complications to replace the void created by the elimination of the exports debate. For one, at the 4th Meeting of the Parties, in Malaysia in February 1998, delegates made only limited progress on drawing up comprehensive lists of hazardous wastes for the purpose of the Convention.[22] They also disagreed on which countries should be allowed to belong to

[21] Christopher Hilz, *The International Toxic Waste Trade*, (New York: Van Nostrand Reinhold, 1992), 20.
[22] O'Neill, *Waste Trading among Rich Nations: Building a New Theory of Environmental Regulation*, 43.

Annex VII (the group allowed to continue importing wastes: until then OECD members and Liechtenstein).[23] What's more, this ban on exports also became an incentive to migrate entire hazardous waste producing industries abroad – a development arriving at a time when empirical data was beginning to show that such "pollution havens" were already in existence.[24] Also on the list of complications were the free trade restrictions imposed by the Convention. The problem existing here was that libertarians who argued against such barriers to free trade often did so neglecting the realities of the long term costs likely to result in regions ill-equipped for proper treatment and disposal.

Many of these disagreements have yet to be resolved and the Convention itself still awaits complete ratification from its signatory parties. Notable exceptions to treaty ratification include many less developed countries and the United States, which claims that its domestic regulations are adequate to ensure the proper control of hazardous waste movement.[25] Thus, caught inside these deep, complex and lasting political disputes, there is little hope that international law alone will ever succeed in giving the world a hazardous waste trade whose damages will be distributed fairly across all parties it involves.

4.0 CHARACTERISTICS AND CONSEQUENCES

All of the chemicals of concern to this study are highly toxic. Some however, hold characteristics and / or are dispersed in the environment in a way that makes them even more problematic than others. For instance, chemicals such as dioxins, PCBs and mercury are particularly notorious for bioaccumulation throughout every stage of the food chain. In particular, Dioxins, by-products of incineration of hazardous waste, and PCBs have become virtually impossible to avoid. Accumulating in body fats and oils, they originate mostly from dairy and meat products. Since they are highly persistent, they break down very little in human and animal tissue and thus get passed up the food chain from prey to predator increasing in concentration every turn. As a result, their presence has become so widespread that everyone on earth is now thought to carry dioxins in their body.[26]

Bioaccumulation is just one example of the ever-increasing list of consequences discovered by scientific research. It has been known for some time now that there exists a very large diversity of hazardous waste types originating from an equally substantial number of different sources. Since it would be impossible to undertake a

[23] O'Neill, *Waste Trading among Rich Nations: Building a New Theory of Environmental Regulation*, 43.
[24] See H. Jeffrey Leonard, *Pollution and the Struggle for the World Product* (Cambridge: Cambridge University Press, 1988)
[25] O'Neill, *Waste Trading among Rich Nations: Building a New Theory of Environmental Regulation*, 42.
[26] Global Anti-Incinerator Alliance, Neil Tangri (ed.), *Waste Incineration: A Dying Technology*, (Quezon City, Phillipines, July 2003), 14.

complete and thorough study of the subject matter and since that is certainly not the purpose of this study, general observations only will be offered on the subject in the following sections.

4.1 Types and Origins

With regards to the origins of hazardous waste, one can classify the sources into two groups of generators: large and small. For instance, in the United States there are tens of thousands of large generators (producing more than 1000 kg per month) with about 55 percent of them from the chemical industry, 20 percent from the metal industry, 5 percent from the petroleum industry and 2 percent each from the textile, plastics, electronics and transportation industries.[27] As for the small quantity generators, their aggregated production constitutes a sizeable proportion of most generating nations' total volume of hazardous waste. They are most often found active in the following industries: ceramics, distilleries, furniture works, laundries / dry cleaners, metal manufacturing, pesticide application services, photography, printing press, soap manufacture and vehicle maintenance.[28]

In terms of quantities of hazardous waste generated in proportion to the total volume of waste produced, the OECD reports that its member countries produced a total waste amount in 1990 of about 9 billion tonnes, of which 425 million tonnes was municipal wastes and 1.5 billion tonnes was industrial wastes, including more than 230 million tonnes of hazardous wastes.[29] The production and consumption culture actively encouraged in the OECD developed economies, is responsible for the largest share of the total movement and accumulation of toxic waste on the planet. Any hopes to ever sustain this currently uncontrolled time bomb will therefore require direct and intense attention towards the habits and tastes adapted since the sixties in OECD countries.

Types of hazardous waste being produced and traded are very wide-ranging. The Basel Secretariat, the UN agency tasked with the implementation and monitoring of Basel Convention related activities, offers a list of the substances generated in the largest amounts that are the most frequently reported. The results are presented in Table 1.

Table 1: 10 waste streams generated in the largest amounts and highest frequency of being reported

[27] R.A. Freeze, *The Environmental Pendulum : A Quest for the Truth about Toxic Chemicals, Human Health, and Environmental Protection*, 59.
[28] Asante-Duah, D. Kofi, and Imre V. Nagy. *International Trade in Hazardous Waste,* (London; New York: E & FN Spon, 1998) 42.
[29] Ibid., 23.

Name
Oil/water mixtures
Waste oil
Residues from industrial waste disposal
Clinical waste
Lead and lead compounds
Tars
Zinc compounds
Paints, dyes
Acids
Asbestos

Source: Adapted from Secretariat of the Basel Convention, *Global Trends in Generation and Transboundary Movements of Hazardous Wastes and Other Wastes*, Basel Convention series /SBC No. 02/14, (Chatelaine, Switzerland, November 2002), 15.

Some of these substances correspond directly with those commodities studied in the trade flow quantification component of this study also listed in Appendix B at the end of this document. As previously mentioned, it is not the purpose of this study to offer a great deal of details about the characteristics of each of the substances found in Table 1 or listed in Appendix B. However, it is important to offer some insights regarding some of the more commonly generated and traded toxic substances. Thus, brief notes are included below in order to provide some details about the source of some of these hazardous substances. This information is later supplemented with the corresponding relevant health information in a subsequent section. The information is for the most part adapted from the World Bank[30] and from the Basel Action Network.[31]

4.1.1 Acids and Alkalis

Although most acid wastes come from metal finishing and surfacing, acids and alkalis are generated by many industrial processes. Acids are also corrosive in nature.

4.1.2 Halogenated and Non-Halogenated Solvents

Halogenated solvents are generated primarily from dry cleaning operations, metal cleaning, degreasing, and de-oiling in the leather industry. These wastes are characterized by high toxicity, high mobility, and long persistence in the environment. There exist a large number of hydrocarbons and oxygenated hydrocarbons, including toluene, methanol, and isopropanol. These solvents are typically used in manufacture of paints, inks, adhesives, resins, solvent-based wood preservatives, toiletries, food flavorings, and cosmetics. Among the heaviest solvent users are the plants, contractors and service companies of the aerospace industry.[32]

[30] Batstone, Roger, Smith, James E., Jr., Wilson, David (ed.), World Bank. *The Safe Disposal of Hazardous Wastes: The Special Needs and Problems of Developing Countries*, Technical Paper Number 93, (April, 1989), 19.
[31] The Basel Action Network (BAN), Jim Puckett (ed.), *Exporting Harm: The High-Tech Trashing of Asia* (Seattle, 2002).
[32] R.A. Freeze, *The Environmental Pendulum: A Quest for the Truth about Toxic Chemicals, Human Health, and Environmental Protection*, 89.

Organic chemical residues including both halogenated and non-halogenated chemicals and are generated from the manufacture of primary, secondary, and tertiary chemical products. Industries that generate organic chemical residues also include petroleum refining, chemical, pharmaceutical, plastic, and rubber manufacturing. Putrescible organic wastes include byproducts of edible oil production, as well as leftovers from slaughterhouses, tanneries, and other animal-based industries.

4.1.3 PCBs

Polychlorinated Biphenyls (PCBs) are most often found in transformer fluid and in large electrical capacitors. When these transformers and capacitors are recycled, PCB residues are present and can release highly toxic and carcinogenic chlorinated dioxins and dibenzofurans.

4.1.4 Paints, Resins, and Biocides

Paints and resins are typically combinations of solvents and polymeric materials generated as byproducts of the application of paints and resins to finished products. Biocide wastes are wastes from herbicides, pesticides, and other chemicals used in agriculture, horticulture, and a variety of other industries.

4.1.5 Plastics including PVC[33]

Poly-Vinyl-Chloride (PVC) plastics make up the largest volume of plastics (26%) used in the electronics. PVC is mainly found in cabling and computer housings, although many computer moldings are now made with the somewhat more benign ABS plastics. PVC is used for its fire-retardant properties but as with many other chlorine-containing compounds, dioxin can be formed when PVC is burned within a certain temperature range.

4.1.6 Clinical Waste / Pharmaceutical Waste

Pharmaceutical / Clinical waste takes on two forms. First is the clinical waste derived from the industry itself either through research and development activity. Second, is the export to developing regions of pharmaceutical formulations that are either banned or severely restricted in the developed world. In both cases, the developed world reaps all benefits and only adds to the long list of problems in the developing world.

[33] The Basel Action Network (BAN), Jim Puckett (ed.), *Exporting Harm: The High-Tech Trashing of Asia* (Seattle, 2002), 9-10.

4.1.7 Various Heavy Metals[34]

Cadmium: Cadmium occurs in certain components such as certain types of chip resistors, infra-red detectors, and semiconductor chips. Cadmium is also a plastics stabilizer and found in some older cathode ray tubes.

Beryllium: Beryllium is a steel-grey metal that is extremely lightweight, hard, a good conductor of electricity and heat, and non-magnetic. These properties make beryllium suitable for many industrial uses, including, electronic applications such as computers commonly found on motherboards and "finger clips".

Hexavalent Chromium / Chromium VI: Chromium VI is still used as corrosion protection of untreated and galvanized steel plates and as a decorative or hardener for steel housings.

Mercury: It is estimated that 22 % of the yearly world consumption of mercury is used in electrical and electronic equipment. It is used in thermostats, sensors, relays, switches (e.g. on printed circuit boards and in measuring equipment), medical equipment, lamps, mobile phones and in batteries. Additionally, incinerators and medical waste incinerators in particular, are major sources of mercury pollution.[35]

Lead: The negative effects of lead are well established and recognized. It was first banned from gasoline in the 1970s. In computers it is found in glass panels and gasket in monitors (3-8 pounds per monitor), solder in printed circuit boards and other components.

4.2 <u>Human Health and the Environment</u>

The categorization and classification of hazardous waste, as already explained at length earlier, varies incredibly from one agency to another as well as from one jurisdiction to another. Risks arising from exposure to hazardous waste, as individually unique, diversified and debated as they may be, remain nonetheless very real and demonstrated empirically from effects to human health and the environment. The problem however is a very complex one and depends largely on interpretations as well as circumstances. For instance, not all hazardous wastes are toxic during their entire life cycle; some hazardous wastes are only toxic when considered in certain environments (i.e. in contact with water); what may be toxic to some is of vital importance to others (i.e. medical prescriptions).

[34] Ibid., 9.
[35] Global Anti-Incinerator Alliance, Neil Tangri (ed.), *Waste Incineration: A Dying Technology*, (Quezon City, Phillipines, July 2003), 16.

The health impacts that have been observed on animals or people from acute exposure to chemicals run the gruesome gamut from skin rashes and eye irritations to cancer and instant death.[36] However, given their variety and rate of creation, many new chemicals remain untested for potential hazardous effects and as such, knowledge about related risks is unavoidably very limited. Some health related details are included later as a follow up to the hazardous substances introduced in the previous section.

As for the environment, it is widely acknowledged that even at the most basic level, waste production is an environmental threat through sheer accumulation.[37] With no projection of slowed growth in production, planet earth's capacity to absorb these time-resistant toxic substances is source of great worries. Once released into the environment many of these substances are then easily spread and transported randomly and sporadically through soil, water and the by the atmosphere's wind currents. Very recently, researchers added to this list of natural contaminant transporters migratory animal species such as salmon and arctic seabirds, the latter responsible for transporting industrial and agricultural contaminant from ocean to land.[38]

It isn't long before these threats to local ecologies become major economic problems since for the most part, economies are intricately linked to the land and natural resources they contain. Once contamination occurs, local damages are often so expensive to remediate that the affected population has no choice but to re-establish themselves elsewhere. Prevention, in any form, is most of the time simply too expensive and usually omitted.

Globally, incessant growth in population coupled with the relatively stable and finite amount of arable land stretches the value of the increasingly scarce uncontaminated land. On the other hand, improvements in technology leading to more effective dissemination of information about, namely, the leaching or the contaminant transport phenomena (and the related consequences) along with revelations of nearby toxic sources could ultimately amount to the devaluation of properties host to farming or other activities that involve regular contact with the land. Following such events, property rights owners, in order to continue extracting the most value from their land, must reorganize its intended use. However, in cases where the property rights are poorly defined or improperly distributed such as in the developing world, the overall ineffectiveness of the

[36] R.A. Freeze, *The Environmental Pendulum : A Quest for the Truth about Toxic Chemicals, Human Health, and Environmental Protection*, 96.
[37] O'Neill, *Waste Trading among Rich Nations: Building a New Theory of Environmental Regulation*, 29.
[38] Jules M. Blais and ca., *Arctic Seabirds Transport Marine-Derived Contaminants*, Science, Vol 309, 15 July 2005.

economic system may be such that, overall, value is lost. What's more, if the total area of contaminated land in a country increases to unmanageable levels as a result of poor hazardous waste management, food production may drop and consequently bring increased cost to societies now forced to import their supply. While it may be too early for such problems to be taken very seriously, developing trends are pointing in their direction. Some anecdotal evidence demonstrates on a micro scale an instance of such increasing shortage of arable land:

> "In a Nigerian waste scheme, a dumpsite was connected to the Benin river, which irrigates the farmland of 30,000 farmers. As a result of this one waste dump, the government felt forced to request the local people to stop harvesting their farmland to prevent the intake of unsafe amounts of chemicals."[39]

Given the possibility that this contaminated farmland may not have an equally valuable replacement use, there exist the chance that this Nigerian community may have lost benefits as a direct consequence of this poorly managed waste dump. This represents only one short-term dimension of the potential economic costs associated with the negligent and illegal (although not always) disposal of hazardous waste. For this particular example, the future repercussions of the contaminated water source may easily result in increased health costs. Furthermore, knowledge about this environmental problem in other countries can alter perceptions and breed scepticism about the quality of goods produced in that region, thereby leading to adjustments in trade flows among nations. To take an exaggerated and perhaps crude example: Chernobyl no longer has many importers of its farm produce.

What is most alarming however is the discovery of these chemicals in very distant locations. In using the terms "very distant locations", I mean areas far away from any industrialization or contaminant sources such as in the Arctic and Antarctic regions. In a very discouraging discovery, researchers showed that the milk of Inuit women in the arctic has the highest PCB levels "ever found in any human population except those who had been exposed to industrial accidents".[40] Such findings go a long way in helping demonstrate that improper management of such waste will ultimately result in grave health, environmental and economic consequences not only where the wastes are transported and generated but also everywhere natural forces may be at play. Additional to the natural contaminant transporting forces already touched upon earlier, international commerce is yet another potent mechanism through which hazardous chemicals move about the world.[41] As will be explored in a later section of this study, that artificial source of contaminant transport has now reached levels of activity and frequency previously very difficult to fathom.

[39] S. Ogunseitan, *Nigeria: the drums are gone but the poison remains,* Panascope 9:15-16, (November 1988), 15.
[40] Hilary F. French, Vanishing Borders: Protecting the Planet in the Age of Globalization. 1std ed. (New York: W.W. Norton, 2000), 71.
[41] Ibid., 71.

These environmental problems, as been demonstrated in this section, have major economic consequences. This is true largely because of the interdependencies that exist not only between all forces found within an environment or between all economic agents within a closed economy but also between the two entire domains themselves. These interdependencies, underlying the thesis of this study, are explored in more detail in the next section. Meanwhile, in conclusion to this section and as a follow up to an earlier introduction of some major pollutants, more specific health and environmental information is offered below for some of the substances of concern to this study. Again, it should be noted that the list[42] is deliberately made brief, and in lieu of these limitations, should be considered with care.

4.2.1 Acids and Alkalis

Strong mineral acids, such as sulfuric acid, can cause burns and remove water from infected tissue. Other acids, such as perchloric acid, are highly flammable and cause wood to ignite. When improperly stored or exposed to too much heat, acids produce highly corrosive fumes that can cause permanent lung damage.

4.2.2 PCBs

During handling and treatment of PCBs, spillage can result in groundwater, aquifer, and land contamination. Environmental and human effects are then seen for long periods of time due the persistence of the chemical. Exposure to PCBs can result in reproductive dysfunction, immune suppression, and chloracne.

4.2.3 Heavy metals[43]

Cadmium: Cadmium compounds are toxic with a possible risk of irreversible effects on human health. They accumulate in the human body, particularly the kidneys, and are responsible for lung disorders and kidney disease. High exposures can severely damage the lungs and can cause death.

Beryllium: Beryllium has been classified as a human carcinogen and exposure to it can cause lung cancer. The primary health concern is inhalation of beryllium dust, fume or mist. Constant exposure to beryllium, even in small amounts, can lead to the development of Chronic Beryllium Disease (beryllicosis), a disease which primarily affects the lungs. Exposure to beryllium also causes a form of skin disease that is

[42] Batstone, Roger, Smith, James E., Jr., Wilson, David (ed.), World Bank. *The Safe Disposal of Hazardous Wastes: The Special Needs and Problems of Developing Countries* , Technical Paper Number 93, 19.
[43] Partially adapted from Global Anti-Incinerator Alliance, Neil Tangri (ed.), *Waste Incineration: A Dying Technology*, (Quezon City, Phillipines, July 2003), 16-17.

characterized by poor wound healing and wart-like bumps. Studies have shown that people can still develop beryllium disease even many years following the last exposure.

Hexavalent Chromium/Chromium VI: After Chromium VI easily passes through cell membranes it is then absorbed, producing various toxic effects in contaminated cells. Chromium VI can cause damage to DNA and is extremely toxic in the environment. It can also damage nose, lungs and stomach.

Mercury: Mercury can cause damage to various organs including the brain and kidneys. It is a potent neurotoxin, which means it attacks the body's central nervous system, resulting in disturbances in sensation (tingling and numbness), impaired vision, speech, and motor control, spasms, loss of memory, and even death. Mercury also attacks the heart, kidney and lungs. It is also particularly hazardous to developing fetuses, infants and young children, with effects including delayed development of motor functions (walking, talking and speaking), mental retardation, seizure disorders, cerebral palsy, blindness and deafness. When inorganic mercury spreads out in the water, it is transformed to methylated mercury in the bottom sediments. This methylated mercury easily accumulates in living organisms and concentrates through the food chain, particularly via fish.

Lead: The negative effects of lead are well established and recognized. Lead causes damage to the central and peripheral nervous systems, blood systems, kidney and reproductive system in humans. Effects on the endocrine system have been observed and its serious negative effects on children's brain development are well documented. Lead accumulates in the environment and has high acute and chronic effects on plants, animals and microorganisms.

5.0 INTERDEPENDENCIES

Future decisions, political or otherwise, must not only consider the biosphere for reasons of sustainability and race survival, but must also evolve in content so as to account for the environment as a finite, interconnected and closed system. The global economic system, incidentally, also happens to be a finite, interconnected and closed system. While the two systems may be studied in great depth individually, the strong inevitable connection between the two receives far less attention than would be expected given its importance to human survival. It is evident that as long as economic activity persists on earth, it will be impossible to sway these systems away from mutual dependence: humans must have nature and its resources for survival much like, as we have only recently acknowledged, nature needs discipline among humans to operate at full strength. From time to time, when humans think themselves too dominant, nature reminds them that they are relatively powerless. In the case of hazardous waste production, nature has tools such as bioaccumulation, natural spreading and well-developed interdependencies, to demonstrate that what is produced unsustainably today will plague everyone long into the future.

Economic activity requires raw resources in order to produce consumer goods. These resources are available only in nature and must eventually partially return to it in the form of residuals. Sometimes however, these residuals can be fed back into production activities by means of recycling. In all other cases, nature decomposes residuals at various rates and ultimately regenerates the raw resources necessary for the cycle to continue innocuously. Over time however, human economic activity has interrupted this cycle in three ways:

> "First, technology has created a wide range of substances that do not exist in nature. Human discards are thus increasingly comprised of plastics, metals, and natural materials laced with hazardous substances (for example, bleached and inked paper), which, in many cases, are difficult or impossible for natural ecosystems to break down. Second, industrial societies use and dispose of much more material per person than their predecessors, and than their counterparts in the less industrialized world. Third, rapid population growth increases the number of people and the total amount of waste generated. As a result, the global ecosystem is overwhelmed, both quantitatively and qualitatively, with what we discard."[44]

Thus, humankind is faced with a very difficult and alarming scenario in which an increase in the scarcity of resources happens to be synchronized with an increasingly contaminated planet. Adding to the mêlée, health and other social damages resulting from toxic wastes, triggers the emergence of a very sobering economic reality. Worse still, since many of these toxic wastes not only bioaccumulate but also only rarely decompose in reasonable time, what results is a slow but real "self-poisoning" activity unleashed within the limits of the closed biosphere system.

In the long run, macroeconomic issues such as growth or decline depend largely on the accumulation of capital – human, social, ecological and manufacturing. The production possibility frontier of market goods vs. environmental quality over time may, under unsustainable practices, regress towards the origin. It is conceivable that damaging the environment too much today will affect future possibilities – for example by depleting certain

[44] Global Anti-Incinerator Alliance, Neil Tangri (ed.), *Waste Incineration: A Dying Technology*, (Quezon City, Phillipines, July 2003), 7.

important resources, or by pollution that is so high it causes irreversible damages, or simply by the release of pollutants that are long-lived and that affect future generations.[45]

This hazardous waste, just like any other waste, is the visible side of inefficiency of our methods of production and patterns of consumption. Figure 1 below integrates waste as a component to the existing web of economic interdependencies. The figure shows a modern interpretation of some of the interactions existing between flows underlying an active economy. An intertemporal version of this scheme, modified to account for the increase over time in hazardous waste production, its health and ecological effects and making use of the size of the boxes to account for intensity variations in each variable, would show how hazardous waste generation and accumulation will negatively affect utility in later periods. The source of this utility reduction, as shown by the interdependencies, lies in damages affecting the ecological capital (i.e. agriculture), the human capital (i.e. health), the social and organizational capital and the manufactured capital. Slowing down the production component of the cycle reduces the generation of hazardous waste and positively contributes to the capital resources of the economy. In a subsequent time period however, the reinforced capital leads to increases in production activities that, in due course, elevate quantities of hazardous waste produced. As such, under ideal circumstances, the cycle would be expected to reach an equilibrium over time. What the interactions fail to show however, are the distortions arising from the resistive and bioaccumulative characteristics inherent to many of the chemicals. Doing so would illustrate a situation whereby production of hazardous waste would continue rising so as to satisfy the persistent market demand for certain goods. This production however would be expected to rise at a diminishing rate, eventually peak and then begin dropping, since the necessary input capital resources would diminish as their exposure to the ever-increasing accumulation of poisons became more frequent.

[45] Barry C. Field, and Nancy D. Olewiler, *Environmental Economics.* 1st Canadian ed. (Toronto: McGraw-Hill Ryerson, 1994), 39.

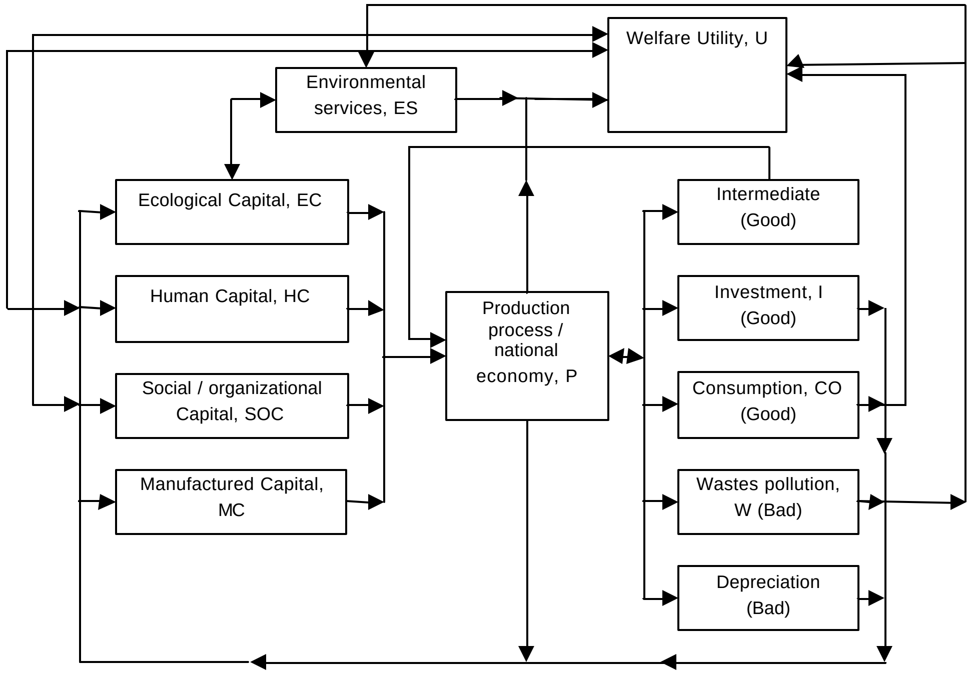

Figure 1: Stocks, flows and welfare in the process of production
Source: Adapted and modified from Paul Ekins, *Economic Growth and Environmental Sustainability: The Pros pects for Green Growth,* (London: New York: Routledge, 2000), 53.

Thankfully, various controls and safeguards limiting exposure to toxic chemicals released into the environment exist – at least, in the developed world. There is also a very large number of other known factors that make the previous interactions far more complex in reality than how they have been presented through this oversimplified analysis. Thus, while there may be no reason for great immediate panic, there exists enough empirical evidence supporting some of the trends discussed above. For instance, while controls and safeguards may exist to contain disposed hazardous waste, all are short-term solutions and all are expected to eventually perish and slowly release their content in nature (discussed later).

That said, there exist two immediate areas of concerns. First is the issue of intergenerational justice which, for the purposes of this work, revolves mostly around the idea that current generations are stockpiling chemical time bombs knowing very well that detonation is an unavoidable future certainty. This problem of intergenerational equity becomes problematic when it is understood literally, in a fashion that ascribes rights to future generations and obligations for present generations.[46] The second is the indifference of electorates

[46] Elli Louka, *Overcoming National Barriers to International Waste Trade : A New Perspective on the Transnational Movements of Hazardous and Radioactive Wastes,* (Dordrecht ; Boston; Norwell, MA, U.S.A.: Graham & Trotman/M. Nijhoff; Sold and distributed in the U.S.A. and Canada by Kluwer Academic Publishers, 1994), 10.

worldwide resulting from poor information and leading to insufficient political will to curb current levels of toxic releases and generation volumes.

In closing, a note must be made regarding the irony created by the existence of these natural and economic interdependencies. Fearing threats to their own well being, developed societies often force the movement of hazardous waste to some of the most vulnerable regions on the planet. Unfortunately in so doing, it is neither realized that the lifespan of most of these chemicals exceed that of humans, nor that nature always finds a way for the substances, often under poorer (if any) controls and regulations, to travel back to their sources. This time around however, while they may arrive in some other form or reduced in levels of toxicity, the chemicals will not be subjected the safeguards and controls initially effective in mitigating their dangerous effects.

Part 2: Scope and Quantifications

1.0 GENERATION

The generation of hazardous substances has generally been on the increase since its very beginning. At the source of this growth, and often a reason for its acceleration, are the consumer tastes adapted in the rich world. A notable example of this fact is the high technology sector which, in addition to integrating toxic elements such as PVC plastics in the manufacturing of the typical personal computer, also generates directly and indirectly via its subsidiary industries, a long list of hazardous wastes.[47] The end product itself, the personal computer, becomes at the end of its useful economic life a bundle of toxicity with little future use and in need of disposal. Given the pace at which technology is depreciated in this sector, rates of replacement and levels of production only add to this already burdensome disposal problem.

Cumulatively, about 500 million PCs reached the end of their service lives between 1994 and 2003. In terms of potentially toxic materials, this represents approximately 2,872,000 tonnes of plastics, 718,000 tonnes of lead, 1363 tonnes of cadmium and 287 tonnes of mercury.[48] The problem in this sector is obviously not limited to the personal computer and thus extends to cell phones and other electronics fuelling thereby a very fast-growing toxic waste stream. With the global market for these goods far from saturation and their average lifespan decreasing rapidly, the Basel Convention Secretariat has felt the need to include "e-waste" on its list of hazardous waste.

From a more general perspective, while extensive comparisons and analyses may be difficult to make given the generation data inconsistencies such as those arising from Table 2, there exist one trend that remains evident and sufficiently supported everywhere: generation of hazardous waste is on the rise. While it may differ in terms of absolute figures depending on the source, this trend is confirmed across all major available sources, including the OECD, the EEA and the Basel Convention Secretariat.[49] These increases in waste volume, while ideally would be avoided altogether, are not so problematic when they involve a substance with a high decay rate or with a potential for re-use and/or recycling. Such options however, are unavailable for most of the substances

[47] See Erica Johnson, *Tossing your computer? Read this first*, (CBC Broadcast: Oct 22, 2002)
[48] The Basel Action Network (BAN), Jim Puckett (ed.), *Exporting Harm: The High-Tech Trashing of Asia* (Seattle, 2002) as cited in Widmera, Rolf, Heidi Oswald-Krapf, Deepali Sinha-Khetriwalb, Max Schnellmann and Heinz Böni, *Global perspectives on e-waste*, Elsevier, April 26 2005.
[49] Secretariat of the Basel Convention, *Global Trends in Generation and Transboundary Movements of Hazardous Wastes and Other Wastes* , Basel Convention series /SBC No. 02/14, (Chatelaine, Switzerland, November 2002), 11.

considered by this study and consequently this lack of technology introduces management and disposal obstacles that have yet to be overcome.

In terms of volume, the United Nations Environmental Programme estimates that some 440 million tons of hazardous wastes are generated every year worldwide and that 10 percent are shipped across frontiers.[50] This estimated volume becomes much more meaningful when it is compared to the estimated generation levels from the same sources for the mid-eighties and 1950's which stood respectively at 250 and only 7 million metric tonnes.[51] What's more, some 95% of that waste is produced by just a handful of industrialized countries, the United States producing some 85% of it and the Europeans generating 5-7% of the world's total.[52]

However, even equipped with such estimates, it remains extremely difficult to quantify precisely the production and movement of hazardous waste on an ongoing basis. There are the problems of classification and definition of "hazardous waste" alluded to earlier in this study that are source of many comparative and analytical challenges. On this issue, the OECD report *Transfrontier Movement of Hazardous Wastes, 1992-1993 Statistics,*[53] one of only a handful of existing reliable compilations of generation data, warns that "figures have to be considered with great caution" and that "several inconsistencies or discrepancies between countries may occur and they principally result from difference in the definition of hazardous waste which still exists from country to country".[54] Additionally, there is inconsistency in reporting from year to year even by the same countries due to various ongoing definition changes as well as undocumented industry growth fluctuations.

As mentioned earlier, Table 2 is a good testament of these difficulties. It shows, for select countries, values reported for total generation of waste to two different reliable sources. While there exists some areas of consistency, the data is overall inadequate for comparisons. It is important to note that the data presented reflects only those activities that are monitored and reported.

[50] Christopher Hilz, *The International Toxic Waste Trade*, (New York: Van Nostrand Reinhold, 1992), 20.
[51] Katharina Kummer, *International Management of Hazardous Wastes: The Basel Convention and Related Legal Rules* (Oxford; New York: Clarendon Press; Oxford University Press, 1995), 4.
[52] Jennifer Clapp, *Toxic Exports: The Transfer of Hazardous Wastes from Rich to Poor Countries,* 22.
[53] OECD, *Transfrontier Movements of Hazardous Wastes, 1992-1993 Statistics* (Paris: OECD, 1997).
[54] Ibid., 10.

Table 2: Generation of Hazardous Wastes in select OECD and European Countries

Reporting Agency		(All values are in 000's of metric tonnes)																
EEA	**OECD**	**1985**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**Total**	**Difference**
	United Republic of Tanzania						159125		104987		172732		36901		36312		510057	
	United States				197500				258000								455500	
	Russian Federation								67520			82590	89390	107060	108070		454630	
	Germany					16010			10780			17421					44211	22039
Germany						13079			9093								22172	
	Mexico					5657					8000	2074	12700		3183	3706	35320	
	Czech Republic									1867	6005	6669	6436	3417	2393		26787	
	Poland							3444		3188	3866	5164	4007	1105	1134	1601	23509	
	Hungary					4691				3338		2585	3630	3915	3646		21805	
	Republic of Korea							7804			1622	1912	2217	1922	2733	2779	20989	
	Italy					3246	3387				2708		3401	4058			16800	7445
Italy						3246					2708		3401				9355	
	France					7000									9000		16000	9000
France						7000											7000	
	Japan									2297	2883	3158	2994	2653			13985	
	Netherlands					1040		1430	867			1015	1277	1600	1500		8729	4656
Netherlands						1040		1513	1520								4073	
	Sweden						730	826	829	853	831	888	969	1043	1016		7985	7485
Sweden		500															500	
	Singapore										1353	1441	1500	1400	1400		7094	
	Canada						5896										5896	
	Austria				215			423		513	595	607	629	918	972		4872	3359
Austria								423		513	577						1513	
	South Georgia and the South Sandwich Islands									3394							3394	
	Norway					200				636	641	616	619	608			3320	2155
Norway						520				645							1165	
	Portugal									1365	668		595				2628	1180
Portugal			1087			1365				1356							3808	
	Denmark					106				204	218	263	311	374	386		1862	1312
Denmark						106				194	250						550	
	Ireland			73		66		99			248	328		370			1184	837
Ireland								99			248						347	
	Finland		314					559					485				1358	685
Finland			314					359									673	
	Luxembourg								86		181	157	143	201			768	502
Luxembourg								86			180						266	
	Greece							450					280				730	280
Greece								450									450	
	New Zealand								110		479						589	
	Australia							426									426	
	Swaziland					154				139							293	
	Iceland									6	6	7	7	7	8		41	35
Iceland										6							6	
U.K.						2936		2299	1844								7079	
Spain			1708							3394							5102	
Belgium										776							776	
	OECD Total	0	3109	73	215	42471	169138	17859	187023	23326	203284	126895	168491	130651	171753	8086		
	EEA Total	500	314	0	0	24991	0	2831	10613	1352	3715	0	3401	0	0	0		

Source: OECD, *Transfrontier Movements of Hazardous Wastes*, 1992-93 Statistics (Paris: OECD, 1997) and Henrik Jacobsen, Matthew Crowe, Jens Brodersen, European Environment Agency, and European Topic Centre on Waste, *Hazardous Waste Generation in EEA Member Countries: Comparability of Classification Systems and Quantities* (Copenhagen, Denmark; Luxembourg: European Environment Agency; Office for Official Publications of the European Communities, 2002). Some footnotes have been omitted from original.

Another source of generation data is that assembled by the Basel Convention Secretariat as presented in Table 3 for OECD countries. Compared to the OECD and the EEA datasets shown in Table 2, it is limited since it lacks data for two very large generators of hazardous substances, namely the United States and Japan. However, it is attractive since its approach offers more consistency in definition and classification across import, export and generation datasets. It is used in this study therefore to analyse trends arising from production, trade and accumulation tendencies.

Table 3: Basel Secretariat Generation of Hazardous Substances for OECD countries

Country	Generation (metric tonnes)								
	1993	1994	1995	1996	1997	1998	1999	2000	Total
Australia									0
Austria	391680	384807	480690	510311	535555	886916	974181	980558	5144698
Belgium	653368	1032906	1113501	1726822	2016123	2016123	957192	2016123	11532158
Canada	5900000	5900000	5900000	5900000	5900000	5900000	5900000	5900000	47200000
Czech Republic	3132330	1866608	4403215	6669000	6440000	3917719	3917719	3917719	34264310
Denmark	194000	194000	194000	252000	269000	281000	318737	287491	1990228
Finland	500000	500000	485000	485000	485000	586000	638000	638000	4317000
France	9000000	9000000	9000000	9000000	9000000	9000000	9000000	9000000	72000000
Germany	9093000	9093000	9093000	9478584	18239000	18239000	18239000	18239000	109713584
Greece	450000	450000	350000	350000	283000	287000	287000	287000	2744000
Hungary	2719066	3500578	3471361	2588130	3225233	3914978	3392628	3392628	26204602
Iceland	4900	7220	6038	8000	9925	8557	9839	12596	67075
Ireland	243754	243754	243754	327862	370328	370328	370328	370328	2540436
Italy	3401141	3401141	3401141	3401141	3401141	3401141	3401141	3401141	27209128
Japan									0
Luxembourg	16845	16845	36837	76526	76526	76526	33878	35684	369667
Mexico	2074288	2074288	2074288	2074288	2074288	2074288	2074288	2074288	16594304
Netherlands	2209000	1806000	2247000	2501000	3098140	2951610	2595060	2722828	20130638
New Zealand									0
Norway	200000	200000	200000	650000	650000	650000	650000	650000	3850000
Poland	3239136	3239136	3928011	5246831	4071272	1122474	1152101	1627143	23626104
Portugal	272	1600000	27321	120000	37000	3200000	126183	126183	5236959
Republic of Korea	1351141	1351141	1622256	1912334	2217215	1921906	2733313	2756984	15866290
Slovakia	3315025	3315025	2500000	1500000	1500000	1400000	1300000	1600000	16430050
Spain	2000000	3394353	3394353	3394353	4279709	4279709	4279709	3117020	28139206
Sweden	500000	500000	500000	801300	801300	801300	801300	801300	5506500
Switzerland	836800	870100	855800	887500	968698	1042567	1042567	1042567	7546599
Turkey									0
United Kingdom of Great Britain and Northern Ireland	2452000	2186000	2160000	2677000	4878000	4846000	5819980	6296043	31315023
United States of America									0
Total	53877746	56126902	57687566	62537982	74826453	73175142	70014144	71292624	519538559

Source: Secretariat of the Basel Convention, *Global Trends in Generation and Transboundary Movements of Hazardous Wastes and Other Wastes* , Basel Convention series /SBC No. 02/14, (Chatelaine, Switzerland, November 2002).
Note: The remaining empty cells were filled by using the amount provided by the Party for the year closest to that empty cell.

Trends in volume changes arising from data found in Table 3 and as clearly shown by Figure 2, demonstrate that generation is indisputably on the rise. The actual linear relationship between generated volume and time (i.e. accounting for the United States and Japan) would be scaled up anywhere between 200 to 400 million metric tonnes for every year depending on choice of definition and classification. The Basel Secretariat attributes this growth to three factors: growth of economic activities, change in definitions and better monitoring.[55]

[55] Secretariat of the Basel Convention, *Global Trends in Generation and Transboundary Movements of Hazardous Wastes and Other Wastes* , Basel Convention series /SBC No. 02/14, (Chatelaine, Switzerland, November 2002), 11-12.

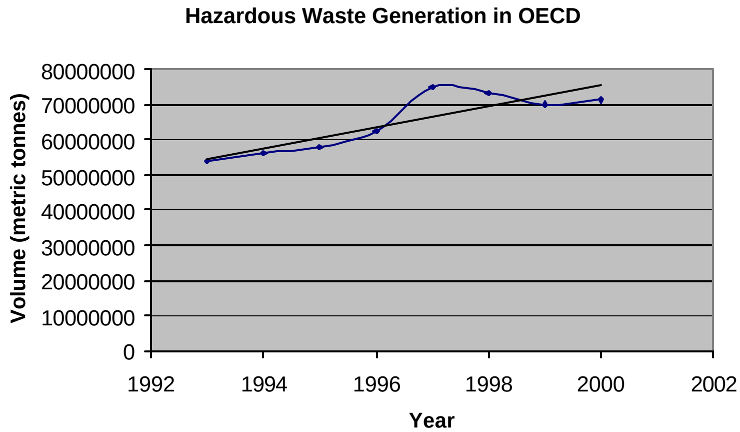

Figure 2: Basel Secretariat Hazardous Waste Generation in OECD countries

2.0 DISPOSAL

Faced with rising generation levels and controversial movements, the issues involved with hazardous waste disposal, namely the choice of location and disposal method, have been receiving much attention in recent years. Since disposal decisions stem from a rather complex interplay of political, economic, social and environmental forces, it is a difficult task to pinpoint the reasons underlying the choices that are made. Nevertheless, some existing data provides information about the destiny of the waste being transferred through trade as shown by Figure 3.

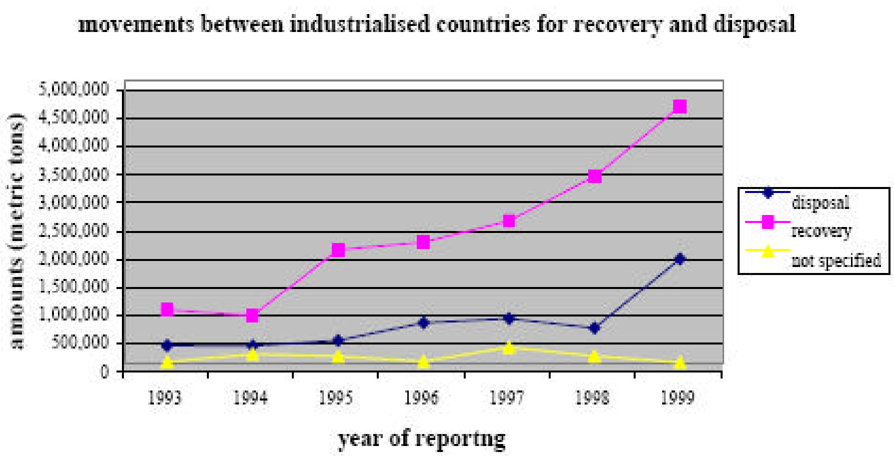

Figure 3: Movements between industrialised countries for recovery and disposal
Source: Secretariat of the Basel Convention, *Global Trends in Generation and Transboundary Movements of Hazardous Wastes and Other Wastes* , Basel Convention series /SBC No. 02/14, (Chatelaine, Switzerland, November 2002), 26.

Figure 3 shows that most of the waste movement between industrialized countries appears to be intended for recovery. However, one should not naively be mislead into thinking that the problem is less tragic than it has been depicted so far in this study. For one, as mentioned earlier, the recovery process itself (a.k.a. recycling) is a very problematic issue since, usually poorly managed and uncontrolled in developing economies, it is source of unprotected exposure and related severe damages. Example are numerous and include the case of the Guiyu region of China where a thriving recycling industry of e-waste has deteriorated the local drinking water supply, contaminated rice fields, directly exposed entire communities to toxic fumes generated by the dismantling of motherboards and overall forever destroyed countless communities as well as human, ecological and social capital.[56]

Table 4: Most popular traded waste and their treatment

Waste	Recovery	Of Which		Final Disposal	Of which	
Lead, lead compounds	75%	95%	Metal Recycling	10%	50%	Physico-chemical treatment
					25%	Incineration
					25%	Engineered landfill
Copper compounds	95%	50%	Recycling of inorganic material	3%	60%	Incineration
		40%	Metal Recycling		33%	Engineered landfill
Wastes from surface treatment of metals and plastic	95%	60%	Metal Recycling	5%	60%	Physico-chemical treatment
					20%	Permanent storage
Residues from industrial waste disposal	75%	45%	Metal Recycling	25%	55%	Incineration
		20%	Recycling of inorganic material		25%	Physico-chemical treatment
		10%	Use as fuel			
Zinc compounds	90%	95%	Metal Recycling	5%	50%	Permanent storage
Wastes from manufacture, formulation and use of organic solvents	80%	50%	Use as fuel	20%	90%	Incineration
		25%	Solvent reclamation			
Oil/water mixtures	55%	40%	Recycling of organic material	40%	40%	Incineration
		30%	Use as fuel		25%	Physico-chemical treatment
					20%	Biological treatment
Wastes from manufacture, formulation and use of paints	65%	50%	Use as fuel	35%	55%	Incineration
		20%	Accumulation		35%	Physico-chemical treatment
		15%	Metal Recycling			
Acids	80%	55%	Regeneration of acids	20%	70%	Physico-chemical treatment
		20%	Metal Recycling		10%	Deep injection
		20%	Recycling of inorganic material		10%	Incineration
Organic non-halogenated solvents	70%	45%	Use as fuel	30%	65%	Incineration
		20%	Solvent reclamation			
		20%	Metal Recycling			

Source: Secretariat of the Basel Convention, *Global Trends in Generation and Transboundary Movements of Hazardous Wastes and Other Wastes*, Basel Convention series /SBC No. 02/14, (Chatelaine, Switzerland, November 2002), 30.

Table 5: Final treatment and recovery operation receiving the largest amount of waste

	Description	Relative Importance
Disposal	Incineration on Land	7%
	Physico-chemical treatment	4%
	Deposit into or onto land (landfilling)	3%
	Specially engineered landfill	3%
Recycling	Recycling/reclamation of metals and metal compounds	31%
	Recycling/reclamation of other inorganic materials	14%
	Recycling/reclamation of organic substances which are not used as solvents	11%
	Use as a fuel (other than in direct incineration) or other means to generate energy	8%

Source: Secretariat of the Basel Convention, *Global Trends in Generation and Transboundary Movements of Hazardous Wastes and Other Wastes*, Basel Convention series /SBC No. 02/14, (Chatelaine, Switzerland, November 2002), 32.

The distribution of these treatment operations as detailed by Table 4 and summarized by Table 5 reflects that which would be expected. There are, however, problems with each of the final treatment and recovery

[56] The Basel Action Network (BAN), Jim Puckett (ed.), *Exporting Harm: The High-Tech Trashing of Asia* (Seattle, 2002), 15.

operations and the wastes destined for landfills are certainly no exception to them. In this case, it is only a matter of time before leachate contaminates local water supplies since even lined landfills are not likely to survive the test of time.[57] Also, under anaerobic conditions (without oxygen), the decomposition of some organic elements of the hazardous waste in landfills produces methane. Not only is methane problematic for its recognized contribution to climate change, it is also a cause of landfill fires which are notorious for engulfing other hazardous wastes and releasing very toxic gases soon after being ignited. Landfills also release strong unpleasant odours that attract animals and rodents, both easily capable of transmitting diseases and contaminants to their owners and / or to livestock.

The problem of definition becomes important again insofar as determining the waste's final resting location. What is toxic in one jurisdiction may sometimes be so as a result of direct experience or privileged knowledge, two pieces of information often concealed from the receiving jurisdiction. The design of landfills is also such an advanced and costly process that rare are those nations capable of meeting all of the recommended standards as well as carry out all of the pre-design tests:

> "Before constructing a landfill, laboratory and in situ evaluations of the site, including the climate, hydrology, geology, topography, soil, and impacts of the site on human health, environment, and life of the neighbouring communities is necessary."[58]

Not listed on Table 5 but a disposal practice nonetheless is marine disposal.[59] Here, although we are faced with two main different types of dumping, both are equally devastating to individuals, natural resources and ultimately to economies worldwide. First is the dumping of raw city sewage that contains hazardous waste generated by industry. The International Maritime Organization (IMO) estimates that English-speaking Africa generates about 2.23 million tonnes of hazardous wastes annually and that the wastes are mainly (with the partial exception of South Africa) discharged to sewers untreated, sent to municipal landfill or dumped on open land.[60] When released into a body of water, contaminants are typically first diluted in an estuary or in an ocean-bound water flow. Under the influence of natural ocean currents, they are then spread worldwide,

[57] The time estimates until rupture or deterioration occurs range between 50 -100 years.
[58] Elli Louka, *Overcoming National Barriers to International Waste Trade : A New Perspective on the Transnational Movements of Hazardous and Radioactive Wastes,* (Dordrecht ; Boston; Norwell, MA, U.S.A.: Graham & Trotman/M. Nijhoff; Sold and distributed in the U.S.A. and Canada by Kluwer Academic Publishers, 1994), 78.
[59] Marine disposal of the "disposal at sea type" w as officially banned by the *London Dumping Convention* (Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, December 29, 1972).
[60] O'Neill, *Waste Trading among Rich Nations: Building a New Theory of Environmental Regulation*, 209.

contaminating fish and other aquatic life in the process. The problem is certainly not unique to African countries:

> "Most of Africa, the Indian subcontinent and Latin America have no waste-water treatment facilities; raw human and industrial sewage is discharged directly into the same bodies of water used for drinking…. In China, an estimated 25 billion tons of unfiltered industrial pollutants went directly into the waterways in 1991, which means there was more toxic pollution in that one country than in the whole of the Western world."[61]

The second dumping scheme is that concerning permanent and intentional marine disposal. This practice relies primarily on the dilution capacity of the ocean and sources include: pesticide and fertilizer runoff, shipping accidents, offshore inputs, land-based and atmospheric inputs.[62] The intentional waste dumping from ships and offshore installations comprises only 10 percent of marine pollution.[63] It must be noted here that although the effects of isolated incidents is quite negligible and difficultly demonstrated, it is the resistive nature and incessant increases in concentration inside this constant reservoir that are worrisome.

As far as recovery and treatment operations are concerned, there are a number of costs to consider when performing the relevant cost benefit analysis. While recycling does indeed reduce the amount of raw materials needed for future production, it is faced with requirements for additional expensive energy. Moving on, incinerators also have their share of difficulties. For instance, incinerators have very high fixed costs – they are capital intensive – and are not without environmental troubles. A recently built 2000-ton-per-day municipal waste incinerator in the Netherlands cost approximately US $500 million.[64] With operating expenses, maintenance and part replacement costs also very high, incineration is the most expensive method of waste treatment and is therefore not very likely affordable to poorer countries. This result is equally applicable to all treatment types involving high initial setup costs and considerable maintenance expenditures. In the end, given the costs and benefits involved with each of the available options, the final decision for polluters can often rely entirely on the choice of social benefit valuation approach used.

3.0 EXPOSURE

In preparation for the discussion of the global movement of hazardous substances, it was deemed essential to investigate for the existence of relationships between imports, exports, accumulation, generation of hazardous

[61] Gregg Easterbrook, *Forget PCB's, Radon, Alar*, New York Times Magazine, September 11, 1994, 60-63 as cited in O'Neill, *Waste Trading among Rich Nations: Building a New Theory of Environmental Regulation*, 210.
[62] Elli Louka, *Overcoming National Barriers to International Waste Trade : A New Perspective on the Transnational Movements of Hazardous and Radioactive Wastes,* (Dordrecht ; Boston; Norwell, MA, U.S.A.: Graham & Trotman/M. Nijhoff; Sold and distributed in the U.S.A. and Canada by Kluwer Academic Publishers, 1994), 83.
[63] Ibid., 83.
[64] Global Anti-Incinerator Alliance, Neil Tangri (ed.), *Waste Incineration: A Dying Technology*, (Quezon City, Phillipines, July 2003), 27.

waste and health expenditures. This analysis is particularly useful in confirming or rejecting some of the hypotheses laid out throughout this work. The choice of health expenditures as the indicator variable is made for two reasons. First, is the fact that health expenditure data for OECD countries are relatively well documented and generally available in reliable dataset. Second is the obvious expected link between exposure to hazardous waste and demonstrated related health consequences. A disadvantage however, is the recognition that it is very difficult to determine causal factors influencing human health since so many possible factors may have an influence on it, including mobility, lifestyles, diet, genetics, age, etc.

3.1 Methodology

Constrained by data limitations but also since most hazardous waste is produced within rich economies, the following analysis uses data only from OECD countries in order to construct the sample group involved in this study. Independent variables tested include importing, exporting and production (generation) data for the 1999 fiscal year and the sole dependant variable is health expenditures. Derived from these three base variables is a measure of accumulation determined as follows:

Net Accumulation = Imports – Exports + Generation

Each of the four variables is then transformed into “per capita” and “per capita per land area” dimensions. Each derivation is made using the total population and the total land area of the country and then presented below when a significant relationship exists. More details on the indicator variables can be found in Appendix C.

3.2 Findings

As detailed in Table 6, there appears to be statistically significant relationship existing between the Health Expenditures per capita in OECD countries and some of their trading and / or generation tendencies of hazardous waste. More precisely, it is noted that exports per capita and imports per capita for 1999 are both statistically significant at the 90% level. Since generation per capita for that same year does not provide the same level of statistical significance, one can conclude that health expenditures per capita seem to be highest during the trading activity. There may be a number of reasons for this finding including the possibility that traded hazardous waste is exposed to more individuals than waste simply generated locally and not passed on from one jurisdiction to another. This is especially plausible since the two major pathways leading to damage are through accidental releases and through releases stemming from improper handling, either at the site of use or at waste disposal facilities.[65] When traded internationally, waste must be contained, transported, treated and / or disposed and is likely to take longer and pass through more operational steps reach its final destination. Important to note however is the fact that the vast majority of hazardous waste never leaves the premises of the firms where it is used.[66] Most hazardous waste is probably disposed of on-site; that is, at the site of the industrial plant where it was manufactured and / or used.[67] In Canada, Environment Canada estimates that in 1986, approximately 65 percent of hazardous wastes are managed on site.[68] This, in the context of OECD countries where safeguards exist, would explain why the net accumulation, accumulation and generation variables are shown to be insignificant in the health expenditure analysis.

None of the relationships for the "per capita per land area" measurements turned out to be statistically significant.

Table 6: Summary of results from multivariate models

Dependant	Independent	Intercept	Sig.	GDP / Capita	Sig.	Independent	Sig.	R^2-adj.
Health Expenditures / Capita	Exports / Capita 1999	278.162	.329	.067	<.001	18.524	.005	.680
Health Expenditures / Capita	Imports / Capita 1999	337.568	.374	.068	<.001	11.372	.089	.530
Health Expenditures / Capita	Generation / Capita 1999	322.984	.269	.065	<.001	.761	.146	.644
Health Expenditures / Capita	Accumulation / Capita 1999	200.205	.557	.076	<.001	.394	.530	.573
Health Expenditures / Capita	Net Accumulation / Capita 1999	322.984	.269	.065	<.001	.761	.146	.644

4.0 TRADE

Generally, there is little use for hazardous waste after it is produced. The un-recyclable residuals arising as a by-products of production processes, face only five possible disposal options: storage, astronomically expensive treatment, incineration, burial or stockpiling. For each of these five choices exists the possibility of executing them outside of the production zone, that is by trading. Thus, the increase in production in concert with the various economic and political forces involved, have resulted in continuous increases of hazardous trading activity within OECD countries. Since the reasons for this increase are discussed in the next section, this discussion will be limited to trend analysis only. As shown in Figure 4, the growth has not only been consistent for both exports and imports but it has also been quite substantial increasing almost 700% in only 7 years.

[65] Barry C. Field, and Nancy D. Olewiler, *Environmental Economics.* 1st Canadian ed. (Toronto: McGraw-Hill Ryerson, 1994), 365.
[66] Barry C. Field, and Nancy D. Olewiler, *Environmental Economics.* 1st Canadian ed. (Toronto: McGraw-Hill Ryerson, 1994), 363.
[67] Ibid., 363.
[68] Ibid., 365.

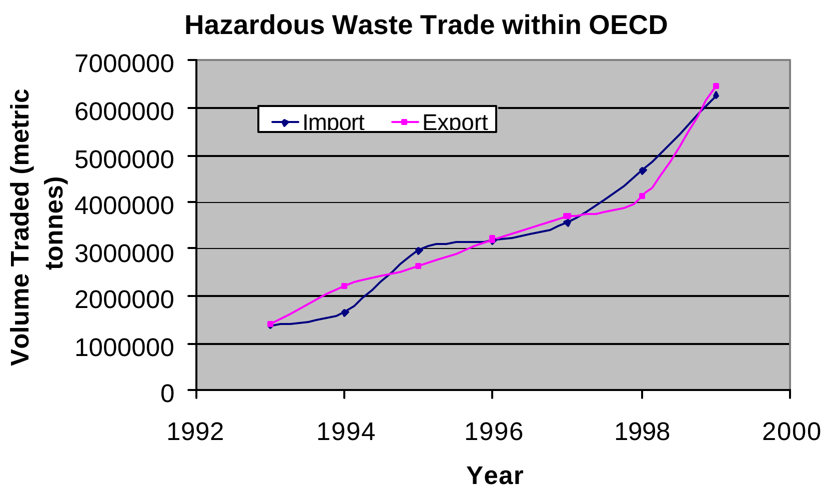

Figure 4: Export and Import trends within OECD countries 1992-2000
Source: Based on OECD countries data provided in Secretariat of the Basel Convention, *Global Trends in Generation and Transboundary Movements of Hazardous Wastes and Other Wastes*, Basel Convention series /SBC No. 02/14, (Chatelaine, Switzerland, November 2002), 85-90.

The trend is also reflected, although more generally, for all reporting countries. In this case, Figure 5 shows the reported movements of hazardous waste, offering a corrected relationship that accounts for instances of double-reporting. Here again, much like for the analysis of total volume traded, the number of movements has also grown somewhere in the area of 700% over the 7 years ranging between 1993 – 2000.

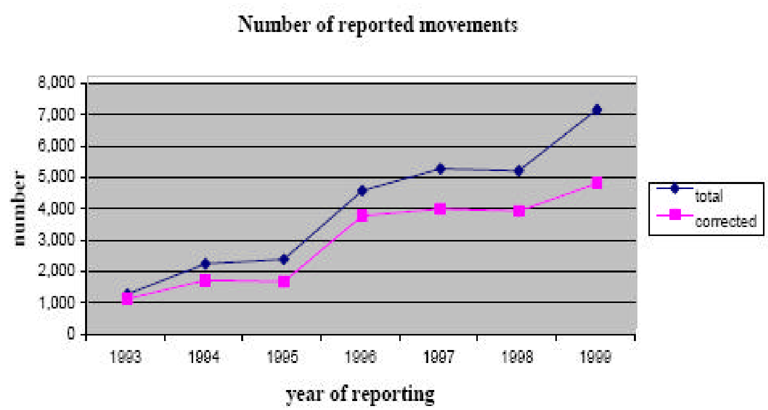

Figure 5: Reported movements (total and corrected for double counting) of hazardous waste
Source: Secretariat of the Basel Convention, *Global Trends in Generation and Transboundary Movements of Hazardous Wastes and Other Wastes*, Basel Convention series /SBC No. 02/14, (Chatelaine, Switzerland, November 2002), 21.

This trading activity is not a new phenomenon: already in the 1970's some wastes were exported from France and the United States to francophone Africa.[69] Today, the fluidity of the markets has accelerated this trade to a level so high that it has become increasingly difficult to monitor every single container of goods destined for trade. Thus, much illegal trade can and does take place while little is ever learned about the quantities involved. Much like for the monitoring of generation of wastes, keeping track of their movement is extremely difficult. Even

[69] Christopher Hilz, *The International Toxic Waste Trade* (New York: VanNostand Reinhold, 1992), 12.

if monitoring systems reach a good level of effectiveness, some trade takes the form of deals that are clandestine and therefore difficult to track.[70] These problems are only amplified in regions of rampant corruption as will be discussed later.

Despite these difficulties, some monitoring efforts do succeed in producing reasonably reliable data. For instance, included in the table below is a list of hazardous commodities presented with their corresponding reported number of tracked movements.

Table 7: Number of reported movements for some common Hazardous Wastes

Description	Amount reported (metric tonnes)	Number of movements
Lead, lead compounds	3,617,000	1550
Copper compounds	2,415,000	1092
Wastes from surface treatment of metals and plastic	2,233,000	1380
Residues from industrial waste disposal	2,645,000	764
Zinc compounds	2,236,000	908
Wastes from manufacture, formulation and use of organic solvents	863,000	1331
Oil/water mixtures	1,092,000	645
Wastes from manufacture, formulation and use of paints	827,000	1005
Acids	792,000	1054
Organic non-halogenated solvents	551,000	1079

Source: Secretariat of the Basel Convention, *Global Trends in Generation and Transboundary Movements of Hazardous Wastes and Other Wastes* , Basel Convention series /SBC No. 02/14, (Chatelaine, Switzerland, November 2002), 29.

While there are some insights to be gained from analyzing the data of Table 7 and / or the trends arising from Figure 4, the data does not provide the necessary information to analyze thoroughly the actual trade flows of hazardous wastes and / or toxic substances. Hence, to overcome this problem, I opted to do a sample study of the trade flows using commodity level data in order to establish the relative intensities between all combinations of country groups.

5.0 EMPIRICAL ANALYSIS: METHODOLOGY

5.1 Trade Dataset

The trade data used for the analysis originates from the UN Commodity Trade Statistics Database.[71] The data was organized into "distance charts" whereby both the reporter and receiver information could be retained throughout the analysis.

[70] Jennifer Clapp, *Toxic Exports: The Transfer of Hazardous Wastes from Rich to Poor Countries* (Ithaca: Cornell University Press, 2001), 24.
[71] The database is located at http://unstats.un.org/unsd/comtrade/. Consulted June/July 2005.

For some areas of the analysis, the dataset[72] was organized into three groups namely OECD, non-OECD and Territory. The detailed list of each group is included in Appendix A. In total, 175 countries make up the non-OECD category, 44 belong to the Territory category and 32 are treated as the developed OECD members. For the purpose of this analysis, a Territory is defined as an area that is not sovereign and typically not locally administered. Since such small and often uninhabited areas create opportunities for easy and relatively inexpensive hazardous waste disposal, it is was deemed essential to treat them separately.

For each country or territory, the reported trade data is aggregated for 3 reporting years namely 2002, 2003 and 2004. Given how hazardous waste often undergoes temporary accumulation (i.e. stockpiling) before exportation, such an approach allows for the analysis to capture a more representative sample of the actual activity.

For all analyses where the use of absolute values may be necessary, it is should be noted that the volume unit is the kilogram for all commodities. This choice allows for more uniform analyses to be made since it is not influenced by the constantly shifting monetary value associated with these transactions.

5.2 Commodities

To overcome the void arising from the scarcity of the data officially reported as "hazardous waste", the author opted to assemble from scratch a new dataset. The dataset consists of 28 commodities recognized as hazardous by the Basel Convention as well as by other classification systems. While it is uncertain what proportion (if any) of the traded volume will become an eventual source of hazard (this problem is inevitable), the study assumes as a basis that the very presence of any of the chosen commodities within any contained area increases at once the risk and the exposure levels of the substance to local individuals and environments.

The chosen commodities are, by definition, hazardous waste. One group consists of heavily toxic raw materials such as asbestos. The remainder includes dangerous heavy metals often found as part as traded incinerator ash or sent for "recycling" as scrap metals.

[72] The following changes and combinations were made to the states list to ease analysis: Palestinian Territory treated as Jordan; Bouvet Island, British Antarctic Territory and French Southern and Antarctic Territories grouped as Antarctic; Former Ethiopia and Ethiopia combined; Former Yemen division ignored; US Miscellaneous Pacific Islands and Marshall Island combined with Wake Island; Juan de Nova Island, Glorioso Islands, Bassas da India, Europa Island and Tromelin Island grouped together.

As previously discussed, given the fluctuations and evolutions undergone by the chemical industry, no list of toxic substances could ever be considered complete. Nevertheless, every effort was made to include as part of this list a representative selection of the obviously hazardous traded commodities for which data was available in the UN Comtrade database. The commodity list found in Appendix B includes the classification number of the commodity as found in the database and indicates across which sub-classification systems each commodity spans.

5.3 Dataset Statistics

As expected, the dataset was incomplete for the trade data. It is important to note here that that countries reporting 0 kg of trade (import or export) have been counted with those who had not reported anything at all. This adjustment was necessary for analytical purposes and except for the reporting statistics offered below (which may actually be generally slightly higher everywhere), it has had no other distorting influence on conclusions arising from this study. For purposes of comparison, the trade reporting statistics are presented in contrast with various UN social, economic and health indicators reporting statistics for the same countries.

5.3.1 Overall

Beginning with Table 8 below, it is clear that data on trade is limited. This is true for a number of reasons. Firstly, it could simply be a reflection of the ongoing reality, that is to say that trade of hazardous waste is concentrated among just a few countries. It could however result from a deliberate lack of reporting, intended by any given reporter as a means to circumvent any risk of receiving unwanted attention to existing unusual flows of toxic goods. It could also be a result of the intermittent nature of the movement of many of these commodities. Lastly, statistical analysis may be to blame for considering a sample group large enough to include a great number of inactive trading agents.

Table 8: Territory Reporting Statistics

Total	Trade	Indicators
Max	97.8%	100.0%
Min	0.0%	19.0%
Average	19.5%	78.1%
Median	4.4%	90.5%

This analysis is further dissected for each of the three separate subgroups in the following sections.

5.3.2 OECD

Reporting trends for OECD countries are generally the best among the three groups used in this study. With an average reporting for trade data of 67.2% and of 87.2% for indicator data, it is apparent that OECD countries have well-developed institutions allowing for ongoing monitoring of trends and trading activities. Moreover, in other ways it exemplifies the presence of transparency in reporting movement of toxic substances. Also, since most of the hazardous waste trade occurs between OECD countries, it is no great surprise to find this level of reporting.

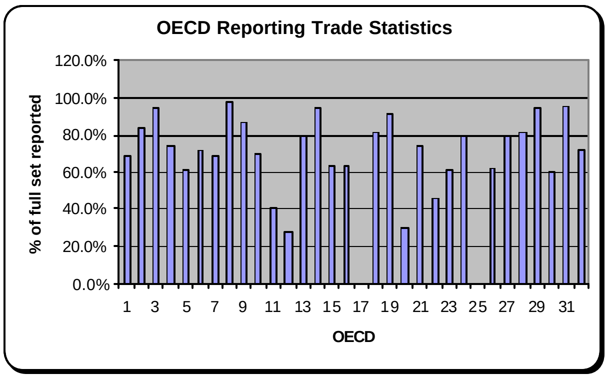

Figure 6: OECD Group Reporting Trade Statistics

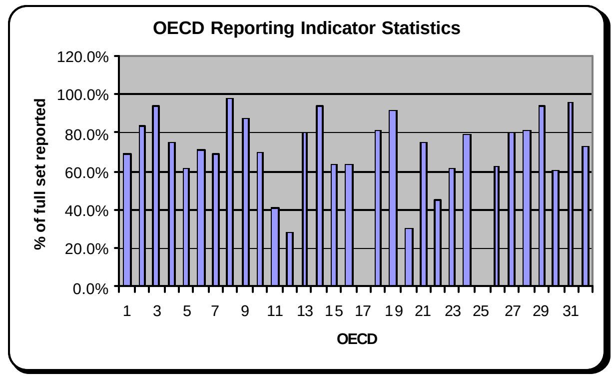

Figure 7: OECD Group Reporting Indicator Statistics

Table 9: OECD Reporting Statistics

OECD	Trade	Indicators
Max	97.8%	100.0%
Min	0.0%	19.0%
Average	67.2%	87.2%
Median	71.1%	90.5%

5.3.3 Non-OECD

Among non-OECD countries, indicator trends reporting are generally similar to those of the OECD countries. At first glance, trade data appears to be poorly reported but since non-OECD countries tend to produce less of the world's hazardous waste, this level seems plausible and may explain the significant difference between trade reporting and indicator reporting. Some of the difference however might be explained by deficiencies arising from reporting infrastructures in some of the countries.

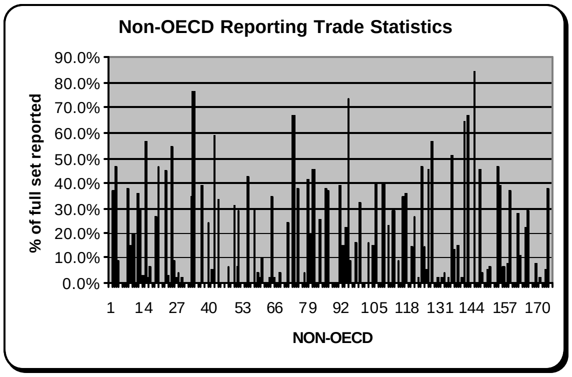

Figure 8: Non-OECD Group Reporting Trade Statistics

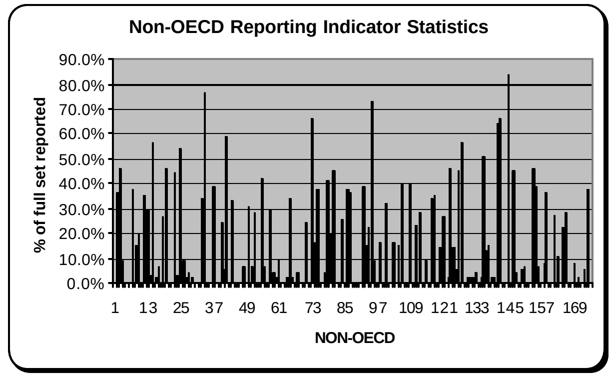

Figure 9: Non-OECD Group Reporting Indicator Statistics

Table 10: Non-OECD Reporting Statistics

Non-OECD	Trade	Indicators
Max	84.4%	100.0%
Min	0.0%	19.0%
Average	15.2%	84.1%
Median	4.4%	92.9%

5.3.4 Territory

In the case of territories data is slightly more difficult to interpret correctly. In some situations, the country administrating the territory may include any existing activity as part of its own reporting. There is also the fact that these areas are likely to be less active merely by vi rtue of to their isolation and non-diversified economies.

There are also those instances when the territory is completely uninhabited or only to temporary host to seasonal groups (i.e. scientific expeditions) rendering any attempt to measure things like education level, health condition, etc quite meaningless. When reports do exist, they can't help but raise suspicion. For the most part, these territories are not expected to be host to advanced industrialized activities requiring toxic inputs or generating hazardous outputs, so when their reporting shows otherwise, the movements which do surface deserve careful attention.

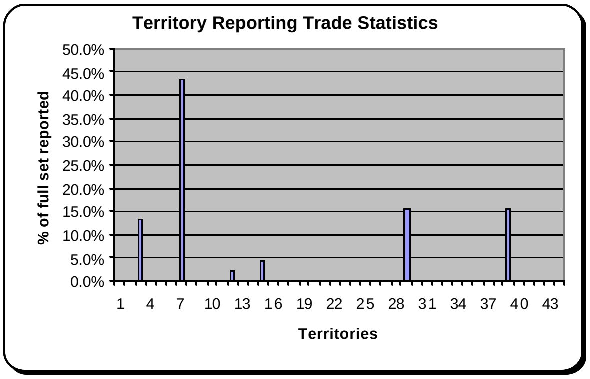

Figure 10: Territory Group Reporting Statistics

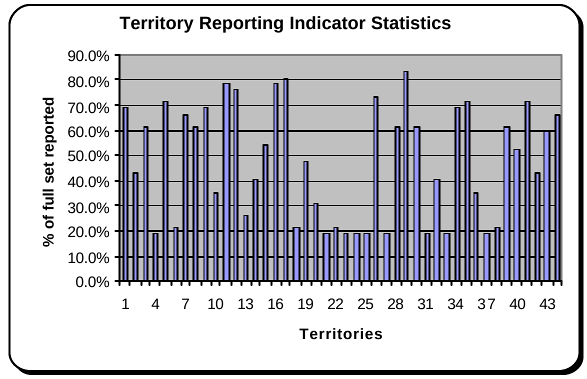

Figure 11: Territory Group Reporting Statistics

Table 11: Territory Reporting Statistics

Territory	Trade	Indicators
Max	43.3%	83.3%
Min	0.0%	19.0%
Average	2.1%	47.8%
Median	0.0%	50.0%

6.0 EMPIRICAL ANALYSIS: QUANTIFICATION OF FLOWS

Totals were calculated for each of the individual goods, across all countries and, in the case of the first analysis (Findings by Group), grouped by OECD, non-OECD and Territory. Since information about both the origin and the destination of the flow was retained by making use of the “distance chart” approach, it was possible to study the movements in detail for each of the goods as shown in Appendix D.

Since the volumes traded varied greatly depending on the commodity studied, some aspects of the analysis required that the data be normalized across importing or exporting groups. As such, one could determine a group’s propensity to import and export hazardous waste irrespective of absolute total volumes while also benefiting from information regarding the source of the imports or the destination of the exports.

Operating under the assumption that each of the commodities studied are equally hazardous, one could then proceed by summing across all commodities the share destined for each of the receivers for each of the possible 9 reporter-partner combinations. Lastly, one additional normalization using the totalled share for each of the 9 trading combinations produced the results offered in Table 12 for imports and in Table 13 for exports.

6.1 Findings by Group

6.1.1 Imports

Table 12 illustrates the import intensities among the various groups. As discovered, OECD countries are likely to attract 65% of total imports of hazardous waste compared to 33% for non-OECD countries and only 2% for Territories. Some comfort can be had in knowing that OECD countries, overall the most equipped to dispose of hazardous waste, welcome the largest share from 2 of the 3 contributing groups. In stark contrast is the small but significant 2% arriving in territories from non-OECD countries. While there exists the possibility that the receiving territory is well equipped and abides to international environmental regulations, there is also the risk that this importing activity represents an instance of a waste disposal haven at work. This suspicion is strengthened by the fact that the source of the import is a non-OECD country, a group that often does not itself have proper disposal technologies.

Table 12: Imports Intensities between all Group combinations

Sender (PARTNER)		Receiver (Normalized) (REPORTER)			
		OECD	Non-OECD	Territory	Total
	OECD	0.39	0.08	0.00	0.47
	Non-OECD	0.22	0.14	0.02	0.38
	Territory	0.04	0.11	0.00	0.15
	Total	0.65	0.33	0.02	1.00

Arising also from Table 12 and as clearly illustrated by Figure 12, the area showing the most activity occurs between OECD and OECD at 39% of the total followed by imports from non-OECD to OECD and then non-OECD to non-OECD. Given the often relatively very small economies found in territories, its relative contribution to imports of 15% is suspicious raises questions.

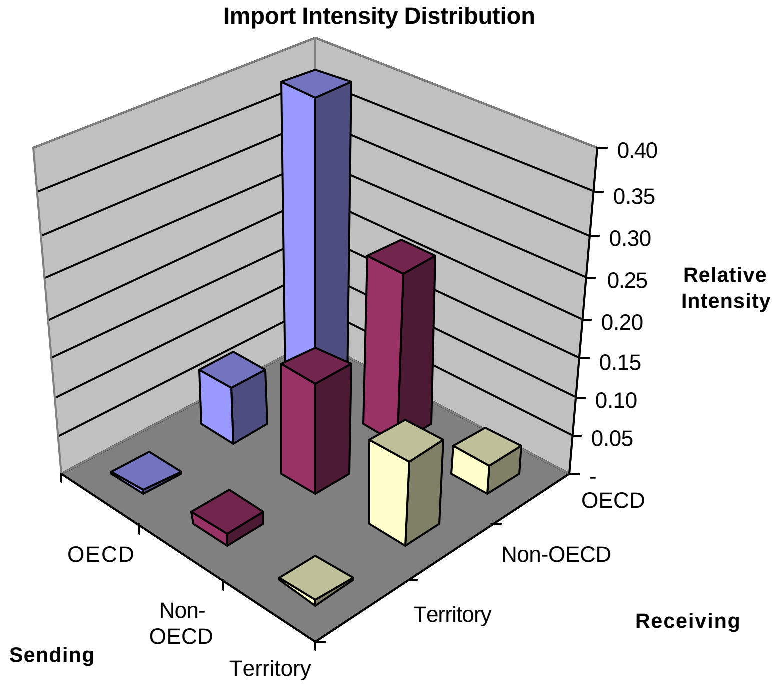

Figure 12: Graphical Representation of Importing Intensities of Table 12

Overall, in terms of volume the largest imported commodity among groups is Copper waste and scrap. Out of the 28 traded goods, 15 are imported only by / from OECD countries. Meanwhile, non-OECD countries reports account for almost all of the Cadmium importing movements and the entirety of pharmaceutical wastes imports which one would have expected to occur between OECD countries instead. No good appears to be traded only between two individual territories. What is traded the most between them however is sewage sludge. The one imports which stands out for territories is that of PVC plastics arriving to them from the non-OECD countries.

Despite this strong trade activity between OECD to OECD, some studies report that the exportation quantities of hazardous waste to OECD countries are decreasing while they are on the increase to non-OECD countries.[73]

6.1.2 Exports

In a similar fashion the export results are assembled in Table 13. The sender and receiver positions are now inversed and we discover here also some interesting findings.

[73] Hao-Jan Hsing, Fang-Kuo Wang, Pen-Chi Chiang and Wan-Fa Yang, *Hazardous wastes transboundary movement management: a case study in Taiwan*, from *Resources, Conservation and Recycling* (April 2004), 329-341.

Firstly, much like in the case of imports, there exist evidence suggesting that the OECD countries attract the largest share of the flow at 46% of the total. A similar pattern, although much more significant here, emerges between the non-OECD group and Territory at 11%. The 6% from OECD to Territory may be the result of flows exported by the administrative states (i.e. always OECD countries) towards their respective territory(ies). One however wonders about the 1% moving from Territory to Territory – given how most of these state-controlled areas are tiny islands often geographically distant from large centers of population and consumer markets. Looking at the data, one discovers that this particular movement is explained by exports of copper, asbestos, and furans.

Table 13: Export Intensities between all Group combinations

Receiver (PARTNER)		Sender (Normalized) (REPORTER)			
		OECD	Non-OECD	Territory	Total
	OECD	0.11	0.26	0.08	0.46
	Non-OECD	0.07	0.28	0.02	0.36
	Territory	0.06	0.11	0.01	0.18
	Total	0.24	0.65	0.11	1.00

While the greatest importer of hazardous waste was shown to be the OECD countries, the largest exporter appears to be the non-OECD countries at 65% of the total movement intensity. OECD countries meanwhile contribute 24% and territories, a suspicious 11%. The results are shown graphically in Figure 13.

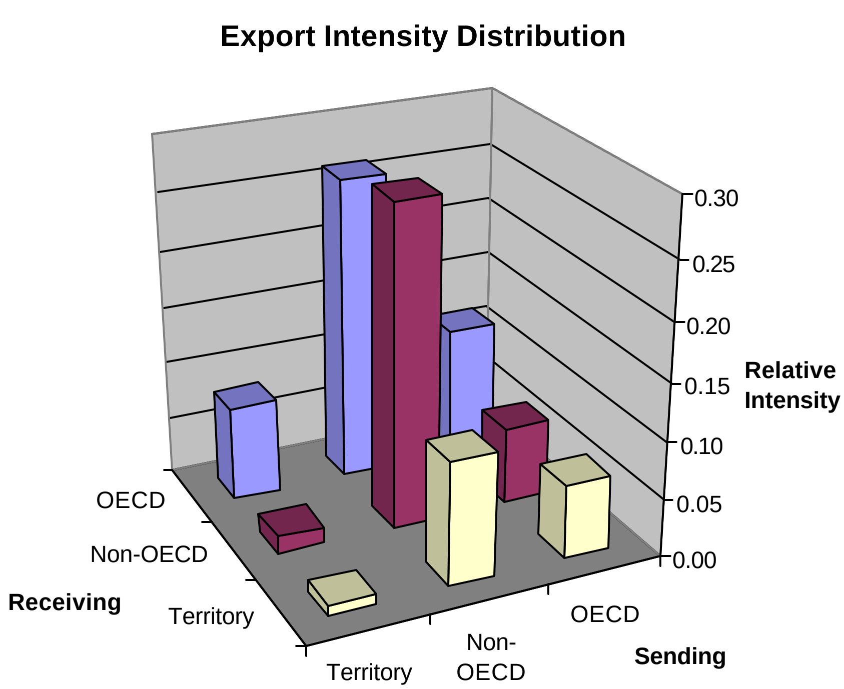

Figure 13: Graphical Representation of Exporting Intensities of Table 13

A more detailed analysis of the data reveals that non-OECD countries dominate the share of export flows to OECD countries for 20 out of the 28 commodities. This is true for only 3 commodities for the case of OECD to OECD. Similarly, non-OECD countries dominate the export flows towards other non-OECD countries which in some ways may be reasonable given how they make up the bulk of the countries studied. However, it must not be forgotten that non-developed countries are less likely to have the infrastructure necessary for proper disposal. Accounting for the majority of the shipments to territories are PVC plastics and Copper.

6.1.3 Net Imports: Accumulation Tendencies

Neglecting absolute volumes and using only relative propensities, Table 14 shows indices representing the tendencies of each the combinations of groups in accumulating hazardous waste from their trading activity. The values demonstrate a net importing intensity which again confirms the trend that OECD countries tend to attract and accumulate the most waste for final disposal or for production. Meanwhile, we note that aside for OECD receiving, no intensities are shown to be positive. Thus, it appears that while hazardous waste might sometimes originate from non-OECD countries or territories, most ultimately gravitates towards an OECD country perhaps for its final disposal. Overall, non-OECD countries and territories are shown to have negative net-import tendencies while OECD countries seem to absorb most of the flow.

Table 14: Accumulation Intensities arising from trade between all Group combinations

		Accumulation Tendencies arising from Trade (Receiver)			
		OECD	Non-OECD	Territory	Total
Sender	OECD	0.27	(0.19)	(0.08)	0.01
	Non-OECD	0.16	(0.14)	0.00	0.02
	Territory	(0.03)	0.00	(0.00)	(0.03)
	Total	0.40	(0.32)	(0.08)	(0.00)

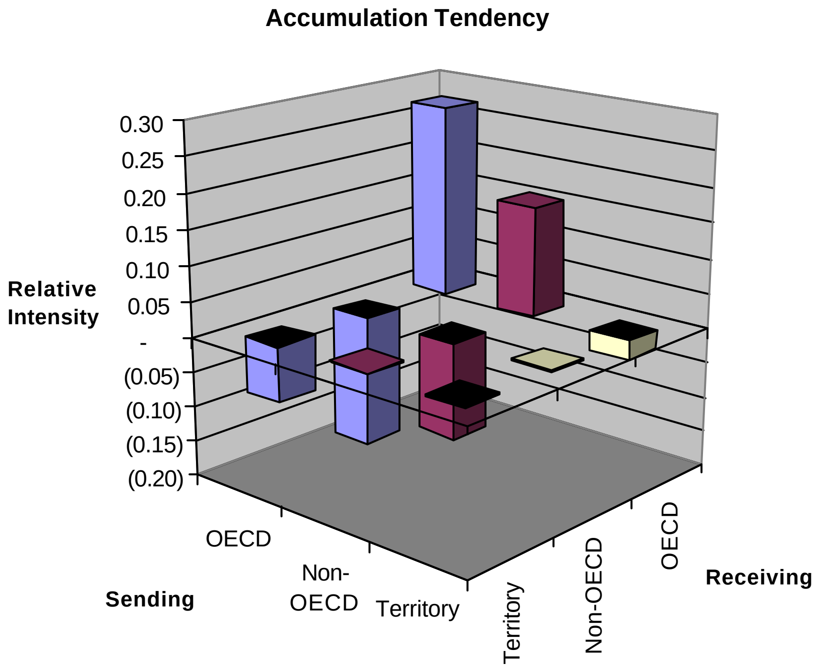

Figure 14: Graphical Representation of Accumulation Tendencies from Trade of Table 14

6.2 Findings By Individual Countries / Territory

6.2.1 Imports

Of all of the World's countries, Canada had the highest relative importing tendency of the sampled hazardous commodities. At the source of this result is the Canada – USA trade which accounts for most of the flow. Other large contributors to Canada's imports are in order: Japan, Belgium, China, France and the U.K. Other countries with a high tendency to import include France, Austria, Germany, USA and the UK. To note here is that the top importers, as established earlier in the group analysis, generally belong to the OECD group. Some exception however exist notably with South Africa and Singapore both making the top 15 importers.

Germany is the most active contributor overall to the imports of the world's countries and except for the case of Ireland, is the largest contributor to all top importing European countries. Itself, it imports the most from Belgium. The United Kingdom follows Germany as the second largest contributor in Europe of the studied imported commodities. Meanwhile, the United States is the second most important imports contributor overall and is responsible for the largest share of South Korea's imports.

Generally, geographic location seems to be reflected in trading patterns. Examples of this abound: Malaysia is the largest contributor to Singapore, Sweden the largest contributor to Norway, United Kingdom the largest contributor to Ireland, etc. This fact goes to show how the trading activity is successful at spreading waste and toxic substances both intra-continentally and inter-continentally.

In terms of total volume, China and Germany are the largest importers whereas Japan and the USA are the largest contributors to those imports.

6.2.2 Exports

Six out of the top 7 of the world's top exporters of the commodities studied are European. In order, they include France, Italy, USA, Germany, Austria, Switzerland, UK, etc. The receivers of these exports include in order Germany, China, India, Belgium, USA, Italy, UK, France, Japan, etc. Canada receives the largest share of the USA's exports whereas China and Japan are respectively second and third in volume in this category. In Europe, Belgium receives the most out of all countries when it comes to France and Germany's waste. In Asia, China, Japan and South Korea are all very active between one another when it comes to the trade of these hazardous commodities. Out of all the exporters, Switzerland is the most dependant exporter on a single receiving country (Germany). India welcomes most of its hazardous waste from Singapore, South Africa and the USA.

As a measure of the total share of the kilograms of hazardous commodities traded, the largest exporter is the USA and the top receivers of the volume are China and India.

6.3 Conclusions

These findings only confirm what had been established by the occasional findings scattered throughout the literature. Some major conclusions here include the confirmation that most hazardous waste tends to originate from – and gravitate towards – OECD countries. There is also the confirmation that the major players in the trade include the USA, Germany, the United Kingdom and many others. The analysis has also uncovered activity among non-OECD countries and Territories (various combinations of groups) which serves as preliminary evidence of potential damage-causing trading activity. There are also the cases of China and India, both heavily and densely populated, both undergoing economic growth, but both also underdeveloped and sometime insufficiently equipped to actively participate in this trade.

1.0 MARKET INNEFICIENCIES AND FACTORS OF TRADE

Increases in the generation of hazardous waste coupled with elevated awareness levels of its potential harm resulting from historical evidence and scientific research has created very difficult circumstances for generators of the waste. Among the solutions somewhat forcedly implemented is the increase in international trading of hazardous waste. Evidence confirming this trend shows correlations between the volume of hazardous waste generation and the tendency to export.[74] Such findings are particularly credible since they correspond in timing with a period during which generators of waste in OECD countries are beginning to appreciate the magnitude of the costs involved with the remediation of old contaminated dumping sites (the legacy of earlier decades). The trade of hazardous waste is also explained by a number of other interconnected factors. Included among them, are some market inefficiencies concurrently also responsible to some degree for other factors presented in this section.

Generally, while trade may be agreed to be the best policy, it does nonetheless have its share of problems. For instance, increases in trade may act against incentives for waste minimization and recycling locally. Also, trade may bring net gains to the populations involved with it but may not benefit all within those populations equally when more drastic vertical distributions of benefits occur. Since this is often more frequently found in regions of rampant corruption, it raises issues of equity and morality.

Controls such as the Basel Convention do help curtail problematic areas of trading activity but are far from being completely effective. For instance, not all countries are parties to the Basel Convention and among those who are, not all have succeeded in ratifying the text domestically. That said, several recent cases illustrate that hazardous waste transfers between countries in the OECD and non-OECD countries have continued to be a problem, even for countries that have ratified the Basel Convention.[75] What's more, even under the Convention, developing countries have little legal protection from hazard transfer from other developing countries and thus hard transfers continue between countries at different relative economic positions.[76] This claim is confirmed by the empirical analysis of the previous section and made especially clear from the findings summarized in Table

[74] Christopher Hilz, *The International Toxic Waste Trade*, (New York: Van Nostrand Reinhold, 1992), 39.
[75] Jennifer Clapp, *Toxic Exports: The Transfer of Hazardous Wastes from Rich to Poor Countries* (Ithaca: Cornell University Press, 2001), 152.
[76] Ibid., 152.

13. From a free trade point of view, the argument lies at the other end of the spectrum: the Convention hampers free trade.

These complications, along with other detailed in this section, individually and collectively, are key players in the domain of hazardous waste production and movement analysis.

1.1 Cost Differentials in Disposal and Treatment

Waste disposal is expensive. *Hazardous* waste disposal is often prohibitively expensive and generally rising in price over time. Today, the costs of an ordinary municipal solid waste landfill are usually less than a tenth the cost of a proper hazardous waste facility.[77] Since this cost of disposal is a key factor in the waste exporting decision-making process, it deserves careful attention. A potential danger with exports is that efficiency may overrule effectiveness and generators, because they view wastes as valueless materials, are likely to transfer them to the cheapest integrated facility and not to the most effective one.[78] As a matter a fact, since the disposal method used in developing nations is almost exclusively landfilling, trade does not mitigate risks but only transfers them to other countries.[79]

In the developed world, stricter environmental standards and regulations, tougher governmental enforcement programs, the liability potential for improperly managed hazardous waste, and the public rejection of hazardous waste facility siting proposals have all contributed to the high and rapidly growing cost of managing hazardous wastes.[80] Regionally, these various obstacles bring waste disposal facilities to the poorest neighbourhoods and areas. Globally, a similar pattern emerges with developing nations at the receiving end instead of neighbourhoods. Some calculations estimate that the total potential financial savings from the worldwide export of hazardous wastes to non-OECD countries, as compared to incineration in the country of generation, is in the range of US $900 million to US $1.05 billion per year.[81]

A review of the economic aspects of the transport and disposal of hazardous waste and also other available data on the disposal of hazardous wastes reveal that between 1976 and 1991 the average waste disposal costs

[77] Richard C. Porter, *The Economics of Waste,* (Washington, DC: Resources for the Future, 2002), 210.
[78] Elli Louka, *Overcoming National Barriers to International Waste Trade : A New Perspective on the Transnational Movements of Hazardous and Radioactive Wastes,* (Dordrecht ; Boston; Norwell, MA, U.S.A.: Graham & Trotman/M. Nijhoff; Sold and distributed in the U.S.A. and Canada by Kluwer Academic Publishers, 1994), 31.
[79] Christopher Hilz, *The International Toxic Waste Trade*, (New York: Van Nostrand Reinhold, 1992), 46.
[80] J. Andy Soesilo and Stephanie R. Wilson, *Hazardous Waste Planning* (Boca Raton: Lewis Publishers, 1995), 10.
[81] Christopher Hilz, *The International Toxic Waste Trade*, (New York: Van Nostrand Reinhold, 1992), 46.

in North America may have gone from less than $10 to more than $250 per tonne for landfilling and from about $50 to over $2600 per tonne for sludge incineration.[82] Meanwhile, some financially burdened poorer countries have been economically pressured to accept wastes from foreign countries for as little as $5 per tonne in some cases and no more than about $50 per tonne in most cases.[83]

As for alternative means of disposal of hazardous waste, incineration exists but at a much higher price and not without its share of problems. The price for incinerating 1 tonne of hazardous waste in 1994 was estimated in the United States at $2000.[84] Given the difference in costs between incineration and land disposal, one may wonder why some would lean towards the former in choosing how to dispose of their waste. However, in some cases when transportation costs are factored into the equation or when other costs such as that involved in the remedial activities – a responsibility often passed onto producers by law – then incineration sometimes becomes the more economical of all options (when excluding all related social costs from the calculation).

While these high disposal prices are often blamed for much of the illicit trading activity, there are some benefits also resulting from their increase. For instance, some economic study show that the elasticity of hazardous waste generation with respect to its disposal cost is 15: that is a 1% increase in the disposal cost of hazardous waste causes a 15% decrease in the volume of hazardous waste generated.[85]

Another important factor in the disposal / treatment cost analysis is that of transport costs which have been drastically lowered in recent years. The drop in cost has been possible thanks to lighter trucks and super-compaction as well as low fuel costs and low truck rates, but transport costs are still important to the disposal distance decision.[86] Also applicable here is the relative ease with which trade routes appear and disappear as highway networks develop and extend thanks in part to recent communication technology developments. As such, networks can accommodate more rapid and more frequent movement of goods, tow key factors for polluters when hastily attempting to transfer their waste to the area offering them the lowest costs overall.

[82] Asante-Duah, D. Kofi, and Imre V. Nagy. *International Trade in Hazardous Waste* (London; New York: E & FN Spon, 1998) 3.
[83] Ibid., 3.
[84] A.M. Ujihara and M. Gough, *Managing Ash from Municipal Waste Incinerators: A Report,* Center for Risk Management, (Washington, DC: Resources for the Future, 1989) as cited in Richard C. Porter, *The Economics of Waste,* (Washington, DC: Resources for the Future, 2002), 208.
[85] H. Sigman, *The Effects of Hazardous Waste Taxes on Waste Generation and Disposal,* Journal of Environmental Economics and Management, March 1996, as cited in Richard C. Porter, *The Economics of Waste,* (Washington, DC: Resources for the Future, 2002), 208.
[86] C.D. Bader, *Trucking Garbage to Ohio*, *MSW Management*, July-August, 1999, as cited in Richard C. Porter, *The Economics of Waste,* (Washington, DC: Resources for the Future, 2002), 103.

1.2 Domestic Legislation, Information Dissemination and Public Awareness

The domestic legislation found in a functioning democracy should reflect the will of the majority of the local public. Over the past decades, as the environmental movement gained popularity and information dissemination technologies became more effective, public awareness about environmental issues rose quite significantly. Early on, concerns were centered around pollution in general but then evolved to more specific areas such as the issues of climate change, threats to biodiversity, depletion of natural resources, the relationship between environment and development, etc. Assisted by heavy mass media attention the toxic catastrophes frightened the public in rich countries and led to what is now known as the "Not In My BackYard" (NIMBY) syndrome. NIMBY has been manifested time and time again in various pieces of legislation in both North America and Europe. This increase in awareness also led to an increase in public participation as been made evident by the flourishing of NGO's worldwide.

NIMBY is however viewed more as a problem than anything else since it makes waste disposal attempts in well-informed societies a very difficult task. This problem is sometimes encouraged by provisions in certain law systems whereby individuals who have been injured by the pollution of some other individual can sue for damages.[87] What's more, it is likely that increases in the restrictiveness of regulations and agreements governing the trade in hazardous waste generates additional incentives to dump toxic substances illegally.[88] Such seemingly innocuous precaution in legal systems therefore adds supplementary stress on waste producers and promotes exporting towards regions with lower awareness levels and most often ill equipped to receive waste.

A country's propensity to import hazardous wastes is however not necessarily related to the effectiveness or success of its environmental regulation.[89] Rather, it appears to be more about its willingness to take on environmental risks that others are not willing to absorb. As such, hazardous waste importing often becomes a problem of public awareness and widespread knowledge about the risks involved instead of one of legislation. Either way, both awareness fluctuations across countries and its resulting variance in legislation pieces create a problem partially reflected in price distortions across countries. These prices tend to be different from those

[87] Barry C. Field, and Nancy D. Olewiler, *Environmental Economics.* 1st Canadian ed. (Toronto: McGraw-Hill Ryerson, 1994), 415.
[88] Gèunther G. Schulze and Heinrich W. Ursprung, *International Environmental Economics: A Survey of the Issues,* (Oxford; New York: Oxford University Press, 2001), 165.
[89] O'Neill, *Waste Trading among Rich Nations: Building a New Theory of Environmental Regulation*, 52.

dictated by the local market. This problem is especially difficult to tackle since for instance, experience has shown that the scientific results of relative risks stemming from different sources may not agree very well with how people actually feel about different types of risk.[90]

There are also non-social factors involved here. For example, some local geological and hydrological conditions can also affect trade decisions and distort further tendencies otherwise guided by the market forces. This is the case with the Netherlands which bans landfills altogether because of its particularly high water table and hence, high economic damage risk level.[91] Other states such as Luxembourg, Denmark and Greece are so small that implementing economically efficient facilities proves to be more difficult than those high-volume producing countries like the United States. Thus, these countries revert to trade as a way to rid themselves of hazardous waste.

As for difference in awareness levels, in fairness, it must be acknowledged that while the many catastrophic environmental and health events involving toxic substances were unveiling, the world had not yet been stocked with the communication tools permitting today's fluid information dissemination. The past methods and techniques used by the rich countries are still very visible in the contemporary developing regions of the world. The problem exists in part since the means of communication and of information dissemination greatly differ according to the economic region as shown later empirically.

While it may initially have been inefficient in getting through to people, toxic waste awareness levels eventually became so important that they commonly became integrated in public policy pieces in the developed world. That success however did not happen overnight and is still an ongoing complicated process. At the beginning, it was necessary to determine what exactly was hazardous. In 1976 in the United States – the single largest generator of hazardous waste – Congress amended the *Solid Waste Disposal Act* and enacted the *Resource Conservation and Recovery Act* adding in it, guidelines detailing waste screening procedures:

> "When tested, is the material shown to be ignitable, corrosive, reactive, or toxic? Is the material known to contain anything that is designated as toxic in the United States? Has the material been shown to be acutely toxic in studies of humans or animals? If an entire mixture consists in part of hazardous waste, then the entire mixture becomes a hazardous waste."[92]

[90] Barry C. Field, and Nancy D. Olewiler, *Environmental Economics.* 1st Canadian ed. (Toronto: McGraw-Hill Ryerson, 1994), 127.
[91] Christopher Hilz, *The International Toxic Waste Trade*, (New York: Van Nostrand Reinhold, 1992), 41.
[92] J. Andy Soesilo and Stephanie R. Wilson *Hazardous Waste Planning* (Boca Raton: Lewis Publishers, 1995), 4.

With such changes in place, awareness rose further, momentum grew again and more changes occurred. A good testament of this evolution is presented below taking the form of disposal instructions for solvents. The instructions are from the Chemical Safety Data Sheets issued by the Manufacturing Chemist Association and other industry groups.[93]

1968 [Solvents] "may be poured on dry sand, earth, or ashes… and allowed to evaporate into the atmosphere."

1971 "Bury [the solvents] away from water supply or allow solvent to evaporate to atmosphere at a safe distance from inhabited buildings."

1973 "In some cases, small amounts [of the solvents] can be transported to an area where it can be placed on the ground and allowed to evaporate."

1979 "In some cases, small amounts [of the solvent] can be transported to an area where it can be placed on the ground and allowed to evaporate safely if local, state, and federal regulations permit."

1980 "Dumping [of solvents] into sewers, on the ground, or into any body of water is strongly discouraged, and may be illegal"

Documented historical disasters and increased quality of information detailing the problems associated with hazardous waste such as that found above are two major of the many factors ingrained in the NIMBY syndrome. Together, these factors are agents of price distortions often blamed for controversial exports of waste. A result of there work is seen in the form of price differentials that have resulted between different disposal regions. This force is far too strong to be ignored by the waste producers during their cost-benefit analysis.

It is acknowledged that in many ways the information factor is already integrated as part of the price-setting process explored in the previous section. Other factors such as the availability of information are also forces behind manifestations of the NIMBY syndrome. Assuming that the quantity – and to some extent also the quality – of the information disseminated in a society is directly related to the combined effect resulting from the amount of internet usage (per capita), the number televisions (per capita), the number of telephones (per

[93] J.F. Pankow, Stan Feenstra, John A. Cherry and M. Cathryn Ryan, *Dense Chlorinated Solvents in Groundwater: Background and history of the Problem*, (Waterloo, Ontario: Waterloo Press, 1996) as cited in Allan R. Freeze, *The Environmental Pendulum: A Quest for the Truth about Toxic Chemicals, Human Health, and Environmental Protection*, 151.

capita) and the number of newspaper and periodicals (per capita) found in that same society, the following investigation was carried out.

1.2.1 Methodology

To verify for differences in the information availability levels between OECD and non-OECD waste trading societies, the concentration of various media were compared. The analysis used as indicators the following variables: newspapers and periodicals in circulation (thousand) per 1000 inhabitants, television receivers (thousand) per 1000 inhabitants, telephone main lines in use per 1000 inhabitants and internet users per 100 population. The means of each indicator group for OECD and non-OECD subgroups were calculated and then compared to verify the hypothesis of statistical inequality at the 95% level.

1.2.2 Findings

With the exception of television receivers, all other indicators were shown to be significantly more concentrated in OECD countries than in non-OECD countries at the 95% significance level. This finding therefore supports the idea that information related to hazardous waste is more likely to propagate more effectively in OECD countries than in non-OECD countries. This evidence therefore supports the hypothesis that non-OECD countries tend to be less informed and perhaps therefore more susceptible to accepting hazardous waste as imports.

1.3 Inadequate Compensation

It is arguable that a more liberalized economic trade, even one dealing with hazardous waste, is a very beneficial activity for any economy. Through trade, economies mutually increase their wealth and cause the income of their constituents to rise. With higher incomes arrive increases in demand for cleaner environments as well as larger amounts of resources available to invest in the maintenance of those clean environments. From another perspective, it can be argued that the pollution is the price of progress.

Trade is therefore beneficial, but not without problems. For instance, the trading activity sometimes contributes to difficulties such as those arising from situations in which developing countries try to cope with thousands of hazardous chemicals they did not invent and that they have little capacity to regulate adequately.[94] Worse still, some of these same countries are absorbing waste derived from an industry that they do not control let alone

[94] Hilary F. French, Vanishing Borders: Protecting the Planet in the Age of Globalization. 1std ed. (New York: W.W. Norton, 2000), 72.

benefit from in amounts sufficient to justify the hardships and ensuing long run costs they incur from the imports. In the end, the compensation received is far less than the damages and the risks incurred by importing. Just one of many problems is that "short-term incentives in the form of monetary compensation can often prevent some countries from confronting, and dealing with, longer-term environmental problems associated with economic development policies."[95]

Furthermore, during the importing activity, there is never any guarantee that governments will use the funds earned from the imports toward improving the well being of their citizens. "It is apparent that most of the developing and less industrialized countries that have been receiving wastes from industrialised countries are generally not adequately compensated."[96] While it is true that each case is different and should be evaluated as such, it remains that, to be considered appropriate, compensation for waste imports must recognize the full costs of risks, remedial actions and other direct and indirect costs borne by the waste recipient country, as well as make insurance an integral part of the total compensation package.[97] Considering all of these costs in the long run may translate into arguments generally aligned against the participation in trade of hazardous waste altogether.

The practice of importing waste can appear to represent an additional very profitable source of income for developing countries. Here, it has often been a situation of "being trapped between a rock and a hard place", countries pressured into making certain economic decisions in lieu of their vulnerability and current economic situation. For instance, to the many debt-burdened developing nations, the import of wastes seems to constitute a tempting opportunity.[98] Unless some controls, laws and regulations are implemented and more strongly enforced to correspond with changing levels imports, the desperation for foreign exchange in developing countries and the reluctance of generating nations to dispose of their own waste locally may ultimately lead to an unsound equilibrium overriding that which would otherwise result from market forces.

1.4 The Perspective of the Cost-Benefit Analysis

Given the market distortions arising from NIMBY, variances in information concentration and other similar factors, it proves difficult to accurately study the issue of hazardous waste using a benefit cost analysis. This

[95] Asante-Duah, D. Kofi, and Imre V. Nagy. *International Trade in Hazardous Waste,* (London; New York: E & FN Spon, 1998) 128.
[96] Ibid., 128.
[97] Ibid., 129.
[98] Christopher Hilz, *The International Toxic Waste Trade*, (New York: Van Nostrand Reinhold, 1992), 47.

tool, despite its shortcomings in this case, is nevertheless the best available to help make public decisions from the standpoint of society in general in both trading and generating societies.

Starting with costs, it is important to first recognize that in economics the most fundamental concept of costs is the opportunity cost. In this case, the opportunity cost of using resources in a certain way is the highest valued alternative use to which those resources might have been put and which society has to forego when the resources are used in the specified fashion.[99] This notion of opportunity cost underlies the cost-benefit decisions that are made. For example, when firms knowingly acquire net benefits from their production of certain goods, even goods that generate hazardous waste as by-products, a cost benefit analysis reveals that it is in their interest to continue producing. This cost-benefit analysis approach is also manifested in importing and exporting decisions: once damages and benefits are considered in full, a decision is made reflecting what is the best of scenarios for the stakeholders involved.

In the accounting phase of the analysis, there are a number of costs that are sometimes not included or only partially considered. This challenge is sometimes simply the result of the fact that environmental quality is very difficult to price. One approach available in the case of damages caused by mismanagement or accidents, is to consider the costs involved with the follow-up cleanup operations until the benefit of additional cleanup exceeds the marginal cost of that cleanup. At that point, a price measure can capture the total willingness to pay and produce a cost that can be used in the analysis. While this approach is especially useful in cases of illegal dumping or improperly managed imports of hazardous waste, there is no guarantee that local authorities will use it properly. To consider also is the fact that the satisfactory level of cleanliness aimed for will vary greatly depending on a number of cultural, legal and regional factors. In addition to the cost of remediation already discussed, the cost benefit analysis must also account for the cost to neighbours who have been and may continue to be affected by the unremediated external damages (where applicable).

Other environmental and human damages resulting from the exposure to hazardous waste have economic costs. These costs represent the amount that society is willing to pay to prevent the occurrence of the damages. Since the damages are undesired to the extent that they remove potential benefits from society, it is

[99] Barry C. Field, and Nancy D. Olewiler, *Environmental Economics.* 1st Canadian ed. (Toronto: McGraw-Hill Ryerson, 1994), 158.

those benefits foregone that represent the cost. This can be applied rather crudely in the case of lost benefits resulting from a reduction in labour caused by decreases in health conditions of a community exposed to toxic waste. To consider also, are costs arising from expenditures such as disposal facilities, plant building, related equipment, labour and other such inputs necessary for emission reduction. In doing the benefit cost analysis, the manufacturing of equipment and the services integrated in these costs can affect other economic sectors not directly covered by environmental regulations and as such, macroeconomic interactions also need to be accounted for to get the complete picture.[100] For example, when circumstances are such that the employment level is affected in certain sectors due to rigid environmental controls (i.e. manufacturing), adjustments in other sectors (i.e. pollution control) can compensate for the loss. In sum, each of these costs can play a large role in determining whether the production and / or the trade of hazardous waste within a particular context will occur.

Additionally, there are also a number of indirect costs that come into play in the decision-making process. An example of these are the damages caused by the pollution interfering in some way with various production processes, in effect making it more costly to produce outputs of all sorts than it would be in a less polluted world.[101] These costs are obviously more difficult to quantify. From the perspective of the interdependencies detailed earlier however, it is clear that damages to the social, human, ecological and manufactured capital are expected to directly effect to some degree production activities and utility levels.

Turning to benefits, I begin by noting that the benefits associated with *anything*, are equal to what people are willing to pay for that *anything*, after taking into account differences in income distribution and in the information available to them. Like in the case of costs, measuring these benefits is not an easy task and proves to be even more difficult for *things* such as environmental quality. This is true since there are no markets where people can buy and sell units of environmental quality. It follows therefore that consumer benefits cannot be measured directly like products and services can when subjected they are subjected to market forces. As such, when certain environments are spared from the contamination resulting from the economic activity involving hazardous waste, it is afterwards very difficult to quantify into a price the value of the cleanliness retained. This challenge only adds to the already problematic price distortions involved with hazardous waste disposal and treatment. Since the benefits of uncontaminated land are measured by what people are willing to pay to keep it

[100] Barry C. Field, and Nancy D. Olewiler, *Environmental Economics.* 1st Canadian ed. (Toronto: McGraw-Hill Ryerson, 1994), 172.
[101] Ibid., 142.

uncontaminated, one can see how the slightest edge in information dissemination capabilities may lead to conditions such as those arising in OECD countries with NIMBY. There is also the case where, while people are not currently in a position to experience directly a particular environmental asset, they often want to preserve the option to do so in the future.[102] Value arising from this desire also needs to be accounted for in one way or another.

The problems of data availability explained earlier are particularly problematic during a cost-benefit analysis. In cases where data is so difficult to come by, isolating the real environmental impacts and determining the related costs (or benefits) proves to be a very difficult exercise.

Discount rates used in the analysis to account in the present for the value of future economic costs also have their share of problems. "A great deal of harm has been done to natural and environmental resources by using very low discount rates to evaluate development projects."[103] There is the problem that in discounting future benefits we tend to decrease the relative value of programs that produce benefits far in the future and increase those that produce benefits in the next few years.[104] In non-OECD countries, since the focus is on long-term development, it is often asserted that those with the lowest incomes often highly discount the future since they are more interested in the short-term gains available to them.[105] As such, a better approach may be to consider the concept of economic sustainability when setting the discounting rate.

Yet more complications arise with the presence of uncertainty and unpredictability during the analysis. These are due to the limited knowledge of potential costs to an industry, or perhaps to a region, of meeting environmental regulations or of adopting certain technologies. In complex fields of study such as those dealing with human health and environmental quality, it is always with some degree of uncertainty that research reveals causality among interdependencies. Uncertainty is also found in all aspects of societal decision-making processes, including legislation, politics, economics, etc affecting greatly valuation activities in the economy. In the cost-benefit analysis, things like how groups of polluting firms will respond to changes in laws on emissions

[102] Barry C. Field, and Nancy D. Olewiler, *Environmental Economics.* 1st Canadian ed. (Toronto: McGraw-Hill Ryerson, 1994), 153.
[103] Ibid., 122.
[104] Ibid., 151.
[105] Ibid., 439.

or how they will respond to changes in recycling regulations must be predicted with reasonable accuracy.[106] There is also the uncertainty about the types of disposal and treatment technologies that may be invented and used in the future and the uncertainty about how rapidly they may emerge. This affects current technologies by accelerating or decelerating their useful lifespan. The level of media attention given to events in the future as well as their effectiveness at affecting public opinion and the tastes of future generation also represents a tremendously important uncertainty that must be considered. Meteorological and geological events causing disasters leading to the release of wastes into the environment, often beyond remediation control, are yet more source of unpredictability.

In sum, many of these uncertainties may be accounted for to some extent by using probabilistic data in the cost benefit analysis. This solution is best for cases involving regular environmental damages, the type which tends to have been observed and measured for some time. Probabilities are more difficult to estimate for hazardous waste since, as a result of an only relatively recent acknowledgement of their problem, little has been able to be documented about mitigation measures.

Lastly, the cost benefit analysis must find a way to account for various costs arising from the risks involved with hazardous waste. Economics comes into risk assessment in determining how much people value alternative situations with differing risk levels.[107] As such, here again, a price can be obtained and included in the overall calculations and ultimately lead to the decision phase.

1.5 “Recycling”

A very controversial area of the trade in hazardous waste is the so-called recycling industry. On the one hand, there exists great economic opportunities in the trade of waste. For example, certain precious metals and minerals can be recuperated and used to help meet the demand for production materials. In terms of quantities, the OECD cites statistics showing that hazardous waste exports destined for recycling operations increased from 50.2 percent in 1992 to 58.4 percent in 1993.[108]

[106] Barry C. Field, and Nancy D. Olewiler, *Environmental Economics.* 1st Canadian ed. (Toronto: McGraw-Hill Ryerson, 1994), 157.
[107] Ibid., 127.
[108] OECD, *Transboundary Movements of Hazardous Wastes 1992 – 1993 Statistics,* (Paris: OECD, 1997).

On the other hand, the recovery of products from imported hazardous wastes in developing countries is in almost all cases carried out under very unhealthy and environmentally dangerous conditions.[109] Were social and health costs included in the cost benefit analysis, imports destined for poorly regulated regions would clearly not be supported economically. What's more, the recycling market is generally considered to be a failure. When recycling provides a net social benefit in comparison with landfilling or incineration, a working market should send a signal to the household to that effect. The basic market failure in recycling is that no such signal is sent.[110] There are other economic problems with recycling:

> "[…] markets work best when they are stable but do not allocate efficiently when they are subject to dramatic and regular changes. This is the case with recycling since it is subject to sharp changes in supply, demand, and prices."[111]

With hazardous waste, the problem of irregularity in patterns of production and shipments is far from uncommon and thus, as explained, becomes an efficiency problem even in the best of scenarios when all other factors of concern are reasonably effective.

1.6 Comparative Advantage

When exporting waste becomes problematic, polluters can simply revert to an easier solution: exporting entire industries. The practice, in its extreme form, has led to what is now known as "pollution havens". Debates about the extent or even the existence of these controversial havens are very much alive and thus the focus of this section will be restricted only to one of the underlying economic arguments for their existence: the comparative advantage concept.

International differences in endowments with factors of production are viewed as the reasons for specialization and trade. In this case, the comparative advantage offered nationally or regionally arises to some degree because of lower labour costs, various fiscal benefits, a misinformed public leading to lower prices and reduced environmental regulations, the presence of needed resources, etc or any combination of them. These "advantageous" attributes, it is argued by some, are often at the source of the economically attractive market conditions offered to hazardous waste generators worldwide. Others take the opposite view and maintain that

[109] Jennifer Clapp, *Toxic Exports: The Transfer of Hazardous Wastes from Rich to Poor Countries* (Ithaca: Cornell University Press, 2001), 61.
[110] Richard C. Porter, *The Economics of Waste,* (Washington, DC: Resources for the Future, 2002), 122.
[111] Ibid., 124.

whenever instances of such industry migration does occur, it is later discovered that the new industry is more environmentally responsible than its local counterparts.[112]

In the end, a short-term lowering of environmental regulations to attract foreign capital, or dirty industries, simply cannot be regarded as an intelligent strategy. This is so since in the long run time frame, when adequately accounting for human and ecological capital growth factors, the cost benefit analysis does not favour such practices. Nevertheless, despite this result, the thirst for short-term gains among corrupt political leaders can sometimes act against such reasoning. Under such circumstances pollution havens are free to flourish and risk causing long-term irreversible damage such as potentially reducing the diversity of the biological gene pool available to science for medical research. Considered in this context, such actions clearly not only jeopardize the local conditions and the future natural wealth of the local people but also that of every individual on earth in the long run.

1.7 Corruption and Enforcement

Corruption is a key factor in the trade activity. Rampant in many developing and developed countries, it is often responsible for reckless movements of hazardous waste. Moreover, corruption plagues third-party monitoring activities necessary for the safe management of the waste and in so doing renders useless quality controls, standards, checks and balances. Corruption is unpredictable in the form it chooses and in the degree of integration it requires to be effective. Always, it undermines regulatory authority every kind. Here is an example:

> "In the Philippines, corruption in waste projects is seen as endemic, with officials allegedly receiving up to 40 percent of the value of waste contracts as kickbacks. Since the amount of the contract is based upon the quantity of waste to be burned, this undermines waste prevention and recycling efforts."[113]

In a similar way, in small communities, threats of employment and revenue loss spread by transnational industry owners forces communities to put up with unhealthy levels of emissions and exposure. When such an approach fails in "movi ng" hazardous waste, generators can simply change to other strategies:

> "Unscrupulous waste traders from the generating states stand to make huge profits, and will induce uninformed individuals or corrupt government officials in the importing states to accept waste shipments by substantial financial offers."[114]

[112] Norman Bailey, *Foreign Direct Investment and Environmental Protection in the Third World,* in *Trade and the Environment,* ed. Durwood Zaelke et al. (Washington, D.C.: Island Press, 1993), 136, as cited in Jennifer Clapp, *Toxic Exports: The Transfer of Hazardous Wastes from Rich to Poor Countries* (Ithaca: Cornell University Press, 2001), 7.
[113] Global Anti-Incinerator Alliance, Neil Tangri (ed.), *Waste Incineration: A Dying Technology*, (Quezon City, Phillipines, July 2003), 30.
[114] Katharina Kummer International Management of Hazardous Wastes : The Basel Convention and Related Legal Rules (Oxford; New York: Clarendon Press; Oxford University Press, 1995) 7.

The problem is however not restricted to the importing country. For instance, there is wide acknowledgement, even in the international business community, that in the past transnational corporations in hazardous waste industries have at times engaged in environmentally unsound activities in less developed host countries.[115] These activities are made possible through bribery or other corrupt act not typically allowed in the home-base country of the transnational.

Corruption is present in one way or another and in varying degrees in all economic societies. It sometimes leads to biases in laws and administrative practices to benefit certain groups within society for political reasons.[116] This is often cause of an economically inefficient usage of resources and / or of unfair benefit distribution among stakeholders.

Corruption also makes local environmental enforcement activities drastically more problematic. As such, resources typically devoted to monitoring the behaviour of firms, agencies and individuals subject to the regulations are wasted because of bribes and other corrupt evasion. When sanctioning takes place, large risks already exist in good judicial systems let alone in corrupt ones. For instance, large fines risk being successfully evaded in court – when they are fortunate enough to reach that phase of the legal process in the first place (i.e. authorities tend to be more reluctant in applying larger fines). Moreover, the legal costs alone of collecting fines are likely to be excessive and there is always the risk that the convicted firms will escape through bankruptcy. Thus the economic problem of this enforcement involves a trade-off, here between the resources used for this activity, which have opportunity costs, and benefits in the form of greater compliance.[117] What's encouraging however, in both corrupt and not-so-corrupt economies, is that empirical data has generally found that tighter enforcement does indeed lead to greater compliance with disposal regulations.[118] This finding brings attention to the fact that when damages occur from exposure to hazardous waste, regulatory institutions, local governance and the judicial system along with their shortcomings must all carefully be considered in establishing causes.

[115] Jennifer Clapp, *Toxic Exports: The Transfer of Hazardous Wastes from Rich to Poor Countries* (Ithaca: Cornell University Press, 2001), 126.
[116] Barry C. Field, and Nancy D. Olewiler, *Environmental Economics*. 1st Canadian ed. (Toronto: McGraw-Hill Ryerson, 1994), 159.
[117] Richard C. Porter, *The Economics of Waste,* (Washington, DC: Resources for the Future, 2002), 219.
[118] Ibid., 211.

Hence, even under the best of circumstances, the presence of corruption makes it near impossible for international bans and agreements to truly be effective. Producing countries with more rigid laws and enforcement will forever remain tempted by illegal disposal to less regulated countries. While corruption levels may only change slowly in a society, there is hope that tools such as technology transfers coupled with improvements in international monitoring and information dissemination may help overcome this notorious form of comparative advantage.

The following section seeks to identify ordinal correlation between corruption levels and trading activity in OECD and non-OECD countries.

1.7.1 Methodology

To verify for the existence of a relationship between corruption and export and import patterns, I opted to do a statistical analysis using Spearman's rank correlation. The correlation, capture by the Spearman's Rho statistic, is a measure of the strength of the association between two variables.

The corruption dataset consisted of Transparency International's *Corruption Perception Index 1999*[119] (CPI) rankings for 30 OECD and 114 non-OECD countries. The corruption perception ranked data was then analyzed against ranked import data, ranked export data, ranked net imports data and ranked net accumulation data for various years for the same OECD and non-OECD countries. The ranking order for the corruption data was from least corrupt (first) to most corrupt (last). For all other variables, largest absolute volume would be last whereas the smallest absolute volume would be first. Ties were recorded by sharing the position among tied parties ("x" in quantity) and then by skipping "x" positions to reach the next position. The hypothesis of existing association was then verified and all significant results are included along with their individual significance in Table 15.

1.7.2 Findings

The results of Table 15 all illustrate with a probability of 95% that all variable 1 and variable 2 combinations shown have a strong rank correlation. The closer to 1 Spearman's Rho statistic approaches, the stronger is the association between the rankings.

[119] From the *Transparency International* website. http://www.transparency.org. Consulted July 2005.

Table 15: Measure of the strength of association between selected trade and corruption variable

	Variable 1	Variable 2	Spearman's Rho	Significance
OECD	CPI 1999	Exports 1999	0.42	0.02100
Non-OECD	CPI 1999	Net Imports 1993-1999	0.20	0.03058
		Net Accumulation 1998	0.27	0.00321
		Net Accumulation 1997	0.26	0.00508
		Net Accumulation 1996	0.28	0.00215
		Net Accumulation 1995	0.33	0.00030
		Net Accumulation 1994	0.29	0.00368
		Net Accumulation 1993	0.27	0.00173
		Imports 1993	0.42	4.38E-06

The findings show that those OECD countries perceived to be corrupt tend to export their hazardous waste more than those countries not perceived corrupt. For non-OECD countries, while no significant results were found for export activities, a number of them were discovered for the net imports total for the 1993-1999 range, for the net accumulation for every year between 1993 and 1998 and for the imports of 1993. In other words, those countries perceived to be most corrupt in 1999 tended to be the largest net accumulators every year between 1993 to 1999 as well as the largest importers during the year preceding the implementation of the Basel Convention in 1993.

Thus, it is apparent from the findings that corruption is a key determinant in the trade of hazardous waste. This discovery also supports the historical anecdotes covered earlier in which corrupt governments were documented as having welcomed bribes in exchange for the disposal of hazardous wastes. In such cases, it is important to recognize that both of the parties involved are guilty of corruption: one for offering the bribe and the other for welcoming it. When trade decisions emerge from such corrupt transactions, only rarely do they reflect those that the market would have produced alone. What also seems to be evident from the data is a confirmation that corruption in producing countries of hazardous waste (i.e. OECD exporters) matched with corruption in receiving countries (i.e. non-OECD accumulators / importers) results in instances trade.

1.8 Receiver's Vulnerability

Since most of the countries at the receiving end of the waste trade are not producers of waste themselves, most lack the technology and related infrastructure to appropriately and safely dispose and/or treat such shipments. Economically vulnerable to start with, they are pressured towards accepting the waste. In the end, the fees paid to them for doing so do not reflect the long-term health and environmental risks they ultimately also welcome.[120] Their vulnerability extends to many other areas, a few of which are explored below.

[120] Asante-Duah, D. Kofi, and Imre V. Nagy. *International Trade in Hazardous Waste,* (London; New York: E & FN Spon, 1998) 144.

1.8.1 Displaced Technology

Under extraordinarily good conditions, a developing country may own some of the advanced hazardous waste disposal and treatment technologies typically found in rich countries. Since developing nations often lack the expertise and specialized labour force to develop such advanced facilities themselves, most countries that have them would have had to import them from outside. Given how the conditions existing where the technology is implemented are often significantly different from those of where the technology was initially designed and developed, importing nations often end up with inadequate and sometimes ineffective systems. For example, in the case of incinerators, the energy content of the waste directed to it varies greatly from region to region. A European-designed incinerator prepared for a waste source full of combustibles (i.e. paper, plastic) would not be as effective if implemented in India where the waste source contains more inert material (i.e. ash, grit).[121] This type of problem also applies to differing weather patterns responsible for different moisture levels in the waste. As will be explored later, it is for such reasons that regulations such as technology standards have to be individually tailored in order to suit every context in which they are implemented.

What's more, the reliability of specialized technology often depends on the stability and presence of a supporting infrastructure. It also tends to be extremely limited in its range of input parameters and can become more of a nuisance than anything else if it cannot be properly managed. It goes without saying that such supporting infrastructure and proper management are not always up to par in developing nations.

1.8.2 Lack of monitoring

Environmental regulations, when and if they do exist, require some degree of active monitoring and sanctioning if they are to be effective. This monitoring activity takes two forms. First is the need for an ongoing reasonably frequent and accurate verification of quality indices to ensure that they meet those prescribed by legislation. This activity should usually be administered by an independent unbiased third-party. Another form of monitoring is that carried out by the polluters themselves on their equipment to gage the adjustments necessary to lead to increased levels of efficiency.

[121] Global Anti-Incinerator Alliance, Neil Tangri (ed.), *Waste Incineration: A Dying Technology*, (Quezon City, Phillipines, July 2003), 36.

The monitoring however is as complex as the specialized disposal / treatment operations themselves and often requires very expensive laboratory equipment and highly skilled personnel. Shortage in both of these areas undermines the accuracy, frequency and ultimately the usefulness of the operation in general. Other problems such as long processing delays and poor quality of testing equipment add their share of complications. Worse still, all of these are based on the assumption that a receiving country has been given all of the necessary information about the waste imported (i.e. monitoring needed, risks involved) – a ideal situation far from actual practices.

1.8.3 Lack of secure landfills

In disposing hazardous waste, there are not many options. Incineration has its share of problems but so does landfilling. Even the most advanced of countries are struggling with the management of hazardous waste, let alone those that are underdeveloped and ill equipped to begin with.

Without question, waste management facilities and technologies have come a long way in recent decades to stay in sync with the variety and volumes of toxic waste sent for disposal. Unlike some of the more-widely time tested engineered technologies, waste management technologies are quite unconventional, and there is little precedent by which to judge their likely performance.[122] Unlike, for instance, the collapse of a bridge, lining and other landfill technologies are much more difficult to monitor and their failures can only rarely be confirmed unequivocally. When failure does occur, it may be so small and so slow that even the most advanced system will not spot it immediately. Under the best of circumstances when a leak is detected in advance, new and even larger challenges arrive: how does one patch a faulty liner hundreds of meters under the surface without risking further contamination during the displacement of the layers above? The high risks of greater damage often lead to a solution of do-nothing.

Cynicism aside, suppose a perfectly designed landfill with leading-edge technology and developed using the very best basal-lining material available. To recognize here is that the most defensible estimates for how long a landfill liner can be expected to function probably lie in the range of 50 to 100 years.[123] With environmental contamination likely after such a period has elapsed and the fact that remediation at that stage

[122] Freeze, *The Environmental Pendulum : A Quest for the Truth about Toxic Chemicals, Human Health, and Environmental Protection*, 62.
[123] Ibid., 163.

is almost unimaginable given the costs involved, it is clear that current generation patterns are leaving behind a very heavy burden for future generations to handle.

All this is for the developed world. In most countries, hazardous waste is dumped, at best, in an unlined pit usually widely open to animals and human. This practice easily contaminates groundwater supplies, the surrounding land and poisons animals and humans alike. Uncontrolled landfills are also often home to populations of scavengers trying to make a living by extracting and reselling metals from the waste greatly endangering their health in the process. That is often the case of the "recycling industry" where recuperated metals can bring revenue to local scavengers.

There is also the problem that poor developing countries are often incapable of distinguishing between waste whose importing would be beneficial and not beneficial.[124] The institutions and methods necessary to carry full cost benefit analyses about proposed waste shipments are often non-existent. Decisions are made based on other factors and often tainted by corrupt choices. When the choice is made to import, poor countries recognize that their own governments are incapable of guaranteeing appropriate safeguards to the treatment or disposal of any imported waste.[125] This may be the temporary price to pay to bolster rates of economic growth and to boost income per capita locally, two factors known to increase the willingness to sacrifice for improved environmental quality.

1.8.4 Shortages of trained personnel

Specialized equipment requires very skilled staff to be operated and maintained. This expertise, sometimes rarely found locally, must be imported from developed countries where it is available in surplus quantities. This creates two problems. First, is the very high price of the expertise that must be borne by an already stretched budget perhaps not able to afford it for very long. Second, is the idea that nations are sometimes economically pressured into importing waste only to be pressured again shortly after to import the expertise necessary for its handling.

1.8.5 Political and Economic Context

[124] Richard C. Porter, *The Economics of Waste,* (Washington, DC: Resources for the Future, 2002), 113.
[125] Ibid., 113.

Local politics are often source of economic uncertainty as well as civic unrest leading to strikes and various interruptions of basic services such as electricity and water. Highly complex treatment systems are problematic under such conditions for they require both consistency and predictability in operational inputs. What's more, political unrest in certain regions is directly responsible for fluctuations in budgetary allocations and thus to unpredictable equipment maintenance routines. The uncontrollable nature of these limitations greatly increases the risk of accidents and reduces the efficiency of the equipment.

There are other difficulties. Factors such as the lacking supporting infrastructure in importing economies can be source of many additional problems. This includes deficiencies in the necessary hospitals, emergency response programmes, reliable communication technology, and well-funded environmental regulatory programmes.[126]

2.0 ENVIRONMENTAL ECONOMIC POLICIES

In addition to the factors of trade established above, some economic controls and approaches can further influence market forces to determine trade flows, generation levels, disposal and treatment methods of hazardous waste. These controls are generally helpful in mitigating risks and / or alleviating pollution in certain regions thus leading them to increased benefits and / or lowered costs. Most of these policies require good governance and reliable judiciaries to take full effect since they are efficient only with the presence of strong authority.

2.1 Economic Incentives for Cleaner Production

At its most extreme level, cleaner production means no production of toxic wastes whatsoever. In this case, trade irrespective of economic forces, would obviously stop spreading hazardous waste. This is however an unlikely scenario and for the time being, generally not aligned with the demands and desires of consumers worldwide.

At a less extreme level, clean production is more efficient and reduces the amount of residuals generated partially or entirely. This means technologies make less intensive use of natural resources, are energy efficient, eliminate the use of toxic raw materials, and / or eliminate or at least reduce the quantities and toxicity of

[126] Asante-Duah, D. Kofi, and Imre V. Nagy. *International Trade in Hazardous Waste,* (London; New York: E & FN Spon, 1998) 144.

wastes at all stages of the product's life cycle.[127] Internationally, the United Nations Environmental Programme launched a "Cleaner Production Programme" in 1990 to promote cleaner production among firms and governments and to facilitate the transfer of cleaner technologies globally.[128] Economic policies leading to such cleaner production can take the form of standards, pollution taxes, subsidies and permits and lead to incentives for greater investment in research and development.

Cleaner production strategies have economically been devastating for pollution intense industries but at the same time very beneficial for environmental products production and services. A remaining challenge however, is that in the cost-benefit analysis, it is difficult to demonstrate the potentially large benefits of cleaner production when at present it is so little practiced.[129] There are also other economic problems with cleaner technologies. For instance, these problems include the greater profitability of cleanup as opposed to clean technologies and the capture by industry players of the process for developing industry guidelines for cleaner production with the result that they do not provide solid enough incentives for industry to abandon hazardous production processes.[130]

2.2 Taxes and Subsidies

Taxes and subsidies to control hazardous waste management locally both have their advantages and disadvantages. To begin with, any tax placed on units produced of hazardous waste in an attempt to reduce their generation may create an incentive for generators to conceal the real amounts they produce. However, they could also create an incentive for generators to invest in the research and development for new, less pollution-intensive technologies.

As for subsidizing the legal disposal of hazardous waste, it can help remove the temptation for illegal disposal but at a cost. This cost is that there is a deadweight loss arising from the added taxation needed to finance the subsidies. What's more, subsidies in reducing the private costs of hazardous waste disposal may encourage the production of more.[131] Those subsidies aimed at decreasing generation work in a way such that all reduced emissions are rewarded by a payment. They act therefore as an opportunity cost: when a polluter chooses to

[127] Jennifer Clapp, *Toxic Exports: The Transfer of Hazardous Wastes from Rich to Poor Countries* (Ithaca: Cornell University Press, 2001), 128.
[128] UNEP, *Cleaner Production, UNEP Industry and Environment* 17, no. 4 (October – December 1994), 4, as cited in Jennifer Clapp, *Toxic Exports: The Transfer of Hazardous Wastes from Rich to Poor Countries* (Ithaca: Cornell University Press, 2001), 128.
[129] Jennifer Clapp, *Toxic Exports: The Transfer of Hazardous Wastes from Rich to Poor Countries* (Ithaca: Cornell University Press, 2001), 170.
[130] Ibid., 155.
[131] Richard C. Porter, *The Economics of Waste,* (Washington, DC: Resources for the Future, 2002), 210.

emit a unit of hazardous waste, it is in effect foregoing the subsidy payment they could have had if they had chosen to withhold that unit instead.[132]

All in all, if carefully used, taxes and subsidies on hazardous wastes, can be a feasible way of providing the incentive for reducing the quantities produced and for authorities to better control its movement and final disposal location. Improper use of such tools can bring contrary results that would preferably be avoided.

2.3 Transferable Discharge Permits

Transferable Discharge Permit (TDP) policies represent another centralized approach to using the economy to obtain some control over the generation and the trade of hazardous wastes. For TDP's to be effective however, they require a single market where suppliers and demanders may interact openly and where knowledge of transaction prices is publicly available to all participants.[133] For this market to function efficiently, the resource (in this case the permits), must be scarce or limited in quantity to have value. When dealing with hazardous waste, given their characteristics, some problems arise with using TDP policies. For one, given the variances in the quality of treatment and disposal facilities found from country to another, regulators must go against market forces in order to fairly distribute these permits. What's more, it is very unlikely that information will be shared and made available equally to all participants because of corruption and differences in media concentration. There may also be environmental, social and / or political conditions found in certain areas that warrant increases or decreases in permit allocation. Not to forget also are the costs and the challenges involved with the monitoring activities intended to verify whether generators exceed the number of permits are allocated to them.

2.4 Standards

A very practical problem in standard setting is whether it should be applied uniformly to all situations or varied according to circumstances.[134] Standards will be cost effective only if all generators of hazardous waste have the same marginal costs for abating their pollution – a situation not likely to found in practice. Thus, when they differ, individual standards tend to be more cost effective. The problem however is more complex. In many cases, for example, removing uniform standards leaves countries with no set minimum objective to use as a

[132] Barry C. Field, and Nancy D. Olewiler, *Environmental Economics.* 1st Canadian ed. (Toronto: McGraw-Hill Ryerson, 1994), 241.
[133] Ibid., 250.
[134] Ibid., 211.

benchmark. This may be the case where institutions are not well developed or not present at all. Thus, while uniform standards may not be ideal under all circumstances, they are sometimes the best of controls to limit instances of mismanagement and / or tragic accidents.

To lower costs in the long term, producers of hazardous waste are often encouraged, if not forced by legal technology standards, to invest in research and development. When firms are subjected to generation reduction requirements, they are given incentive to engage in research and development to find better generation reduction technology.[135] This activity may draw resources away from output production activities but will be beneficial in the long run since it will reduce the marginal costs of abatement uniformly across emission levels. The idea behind such an approach is to help stimulate ingenuity and hopefully develop more efficient methods and technologies for generation, disposal and treatment of waste.

Paradoxically, at times even the research, development or implementation of new waste minimization technology lead to even greater harm. A good example of this is sediment runoff from construction sites for new treatment plants or sewer lines.[136] Another example is the recent growth in the high tech sector that has brought new levels of computer power capable of automating a number of monitoring, enforcement and remediation activities previously too complex, lengthy or costly to carry out. Accompanying this progress is the unsurpassed technological growth and manufacturing responsible for the generation of large amounts of hazardous waste.

Technology standards can also prescribe practices generators must adopt, voluntarily or otherwise. These sometime take the form of voluntary codes of conduct such as the ISO 14000, the International Standards Organisation's environmental management standards:

> "Industry has argued that voluntary measures are preferable to command and control regulations set by government because they bring not just environmental benefits but also economic benefits through improved efficiency as well as enhanced public image."[137]

[135] Barry C. Field, and Nancy D. Olewiler, *Environmental Economics.* 1st Canadian ed. (Toronto: McGraw-Hill Ryerson, 1994), 171.
[136] Ibid., 159.
[137] Schmidheiny and WBCSD 1992, as cited in Jennifer Clapp, *Toxic Exports: The Transfer of Hazardous Wastes from Rich to Poor Countries* (Ithaca: Cornell University Press, 2001), 136.

Such codes therefore can sometimes lead to outcomes similar to that arising from market-based initiatives. ISO codes in particular are rapidly gaining wide recognition and acceptance among businesses and states in rich and poor countries alike with their firms trying to learn more about how to adhere to such standards.[138] These codes are beneficial in part since they can help spread the know-how about disposal and treatment technologies and alleviate in the process many uninformed and dangerous practices. Safer import conditions and more homogenous practices from one jurisdiction to another can facilitate and add fluidity to the trading activities. On the other hand, while amendable, the successful spreading of such uniform standards may discourage the search for improvements and may reduce the diversity of known practices.

2.4.1 Methodology

In an attempt to verify how widely and heavily implemented the ISO codes were in both of the OECD and non-OECD trade groups studied in this study, I performed a statistical analysis on of the number of ISO 14000 registrations. The number of registration per capita was calculated for each country and then nations were separated into their OECD and non-OECD groups. The means were compared to verify for a statistically significant result at the 95% level.

2.4.2 Findings

The results arising from the mean comparison analysis provided evidence that a difference in the number of registered ISO 14000 per capita between OECD and non-OECD countries exists at the 95% significance level. This finding goes to show that the countries best suited for the disposal of hazardous waste (as measured by ISO standards) tend to be those who are the generators of such wastes.

[138] Jennifer Clapp, *Toxic Exports: The Transfer of Hazardous Wastes from Rich to Poor Countries* (Ithaca: Cornell University Press, 2001), 137.

Conclusion

It is apparent from the findings delivered by this study that the issue of hazardous waste, even following the implementation of controls and regulation such as the Basel Convention, is still very much of valid concern. While some evidence demonstrates that the bulk of hazardous waste is circulating among nations capable of managing and treating it safely, other results raise suspicion about why Territories and non-OECD countries are still receiving such shipments. Of concern also are demonstrations that the more corrupt non-OECD countries tend to be, the more likely they are to be importers of hazardous waste. As for OECD countries, higher corruption levels matches higher exporting tendencies.

Disparities in the quality, availability and quantity of information available from one economic region to another is at the source of distortions found in both prices and in public perceptions of the risks involved with hazardous waste (NIMBY). These problems make it very difficult for economic policies and other controls to function properly and as a result allow for the spreading of the waste to continue. Thus, it can be concluded that while economic forces may appear responsible for some of the damages caused by the generation and movement of hazardous waste, all are ultimately nothing but the flawed product of deficient institutions and judiciaries. Under perfect market conditions and accounting methods, cost benefit analyses would be expected to always sway decisions towards the more beneficial of available options. It is therefore perhaps only a question of time and persuasive political work before such objectives can be approached and hence, hope remains that one day, markets alone will safely handle this issue of hazardous waste.

Appendix A: Country Groupings

NON-OECD	NON-OECD (Cont'd)	NON-OECD (Cont'd)	NON-OECD (Cont'd)	Territory	OECD
Afghanistan	Egypt	Mayotte	Tajikistan	American Samoa	Australia
Albania	El Salvador	Micronesia (Federated States of)	Thailand	Anguilla	Austria
Algeria	Equatorial Guinea	Moldova, Republic of	The former Yugoslav Republic of Macedonia	Aruba	Belgium
Andorra	Eritrea	Monaco	Timor-Este	Baker Island	Belgium-Luxembourg
Angola	Estonia	Mongolia	Togo	Bermuda	Canada
Antarctic	Ethiopia	Morocco	Tokelau	British Indian Ocean Territory	Czech Republic
Antigua and Barbuda	Falkland Islands (Malvinas)	Mozambique	Tonga	British Virgin Islands	Denmark
Argentina	Fiji	Myanmar	Trinidad and Tobago	Cayman Islands	Finland
Armenia	Fmr Fed. Rep. of Germany	Namibia	Tunisia	China, Hong Kong SAR	Fmr Dem. Rep. of Germany
Azerbaijan	Fmr USSR	Nauru	Turkmenistan	China, Macao SAR	France
Bahamas	Fmr Yugoslavia	Nepal	Tuvalu	Cook Islands	Germany
Bahrain	Gabon	Nicaragua	Uganda	Faroe Islands	Greece
Bangladesh	Gambia	Niger	Ukraine	French Guiana	Hungary
Barbados	Georgia	Nigeria	United Arab Emirates	French Polynesia	Iceland
Belarus	Ghana	Oman	United Republic of Tanzania	Gibraltar	Ireland
Belize	Grenada	Pakistan	Uruguay	Greenland	Italy
Benin	Guatemala	Palau	Uzbekistan	Guadeloupe	Japan
Bhutan	Guinea	Panama	Vanuatu	Guam	Luxembourg
Bolivia	Guinea-Bissau	Papua New Guinea	Venezuela	Guernsey	Mexico
Bosnia and Herzegovina	Guyana	Paracel Islands	Viet Nam	Isle of Man	Netherlands
Botswana	Haiti	Paraguay	Wallis and Futuna	Jarvis Island	New Zealand
Brazil	Honduras	Peru	Western Sahara	Jersey	Norway
Brunei Darussalam	India	Philippines	Yemen	Johnston Atoll	Poland
Bulgaria	Indonesia	Qatar	Zambia	Juan De Nova Island	Portugal
Burkina Faso	Iran (Islamic Republic of)	Romania	Zimbabwe	Macau, China	Republic of Korea
Burundi	Iraq	Russian Federation		Martinique	Slovakia
Cambodia	Israel	Rwanda		Mayotte	Spain
Cameroon	Jamaica	Saint Kitts and Nevis		Midway Islands	Sweden
Cape Verde	Jordan	Saint Lucia		Montserrat	Switzerland
Central African Republic	Kazakhstan	Saint Vincent and the Grenadines		Netherland Antilles	Turkey
Chad	Kenya	Samoa		New Caledonia	United Kingdom of Great Britain and Northern Ireland
Chile	Kiribati	San Marino		Niue	United States of America
China	Kuwait	Sao Tome and Principe		Norfolk Island	
Christmas Island	Kyrgyzstan	Saudi Arabia		Northern Mariana Islands	
Cocos (Keeling) Islands	Lao People's Democratic Republic	Senegal		Pitcairn Island	
Colombia	Latvia	Serbia and Montenegro		Puerto Rico	
Comoros	Lebanon	Seychelles		Reunion	
Congo	Lesotho	Sierra Leone		Saint Pierre and Miquelon	
Costa Rica	Liberia	Singapore		Saint-Helena	
Cote d'Ivoire	Libyan Arab Jamahiriya	Slovenia		South Georgia and the South Sandwich Islands	
Croatia	Liechtenstein	Solomon Islands		Svalbard and Jan Mayen Islands	
Cuba	Lithuania	Somalia		Turks and Caicos Islands	
Cyprus	Madagascar	South Africa		USA Virgin Islands	
Czechoslovakia	Malawi	Spratly Islands		Wake Island	
Dem. People's Rep. of Korea	Malaysia	Sri Lanka			
Democratic Republic of the Congo	Maldives	Sudan			
Djibouti	Mali	Suriname			
Dominica	Malta	Swaziland			
Dominican Republic	Mauritania	Syrian Arab Republic			
Ecuador	Mauritius	Taiwan			

Appendix B: Commodities

<table>
<tr><th rowspan="2">Selection of Hazardous Pollutant</th><th colspan="6">ComTRADE Classification</th></tr>
<tr><th>Rev 1</th><th>Rev 2</th><th>Rev 3</th><th>HS1992</th><th>HS1996</th><th>HS2002</th></tr>
<tr><td>Fabricated / Manufacture Asbestos, Mixtures with Asbestos</td><td colspan="3">66381</td><td></td><td></td><td></td></tr>
<tr><td>Fabricated asbestos fibres</td><td></td><td></td><td></td><td colspan="3">681290</td></tr>
<tr><td>Halogenated Organic Solvent (Halogenated waste organic solvents)</td><td></td><td></td><td></td><td></td><td></td><td>382541</td></tr>
<tr><td>Organic Solvents (Waste organic solvents other than halogenated waste organic solvents)</td><td></td><td></td><td></td><td></td><td></td><td>382549</td></tr>
<tr><td>Zinc (Zinc waste or scrap)</td><td></td><td></td><td></td><td colspan="3">790200</td></tr>
<tr><td>Zinc (Ash or residues containing hard zinc spelter)</td><td></td><td></td><td></td><td colspan="3">262011</td></tr>
<tr><td>Zinc (Ash or residues containing mainly zinc (not spelter))</td><td></td><td></td><td></td><td colspan="3">262019</td></tr>
<tr><td>Lead (Ash or residues containing mainly lead)</td><td></td><td></td><td></td><td>262020</td><td colspan="2">262029</td></tr>
<tr><td>Lead (Lead waste and scrap)</td><td></td><td></td><td></td><td colspan="3">780200</td></tr>
<tr><td>Copper (Ash or residues containing mainly copper)</td><td></td><td></td><td></td><td colspan="3">262030</td></tr>
<tr><td>Copper (Copper waste and scrap)</td><td></td><td></td><td></td><td colspan="3">740400</td></tr>
<tr><td>Arsenic and Mercury (Ash & residues cont. mainly arsenic/mercury)</td><td></td><td></td><td></td><td></td><td></td><td>262060</td></tr>
<tr><td>Beryllium (Beryllium Waste and Scrap)</td><td></td><td></td><td></td><td colspan="3">811211</td></tr>
<tr><td>Chromium (Beryllium Waste and Scrap)</td><td></td><td></td><td></td><td>811220</td><td colspan="2">811222</td></tr>
<tr><td>Cadmium (Cadmium, unwrought, waste or scrap, powders)</td><td></td><td></td><td></td><td colspan="3">810710</td></tr>
<tr><td>Antimony, Chromium, Cadmium, Beryllium (Ash & residues containing antimony/beryllium)</td><td></td><td></td><td></td><td></td><td></td><td>262091</td></tr>
<tr><td>Antimony (Antimony waste & scrap)</td><td></td><td></td><td></td><td colspan="3">811020</td></tr>
<tr><td>Waste Oils with Polychlorinated biphenyls (PCBs) (Waste oils cont. polychlorinated biphenyls (PCBs)/polychlorinated terphenyl OR Heavy Oils)</td><td></td><td></td><td></td><td colspan="3">271091</td></tr>
<tr><td>Waste oils without PCBs (Waste oils other than those cont. polychlorinated biphenyls (PCBs)/polychlo…)</td><td></td><td></td><td></td><td colspan="3">271099</td></tr>
<tr><td>DDT (Hexachlorobenzene and DDT)</td><td></td><td></td><td></td><td colspan="3">290362</td></tr>
<tr><td>Hexachlorobenzene (HCB) (Hexachlorobenzene and DDT)</td><td></td><td></td><td></td><td colspan="3">290362</td></tr>
<tr><td>Furans (Tetrahydrofuran)</td><td></td><td></td><td></td><td colspan="3">293211</td></tr>
<tr><td>Furans (Heterocyclic compounds with unfused furan ring, nes)</td><td></td><td></td><td></td><td colspan="3">293219</td></tr>
<tr><td>Clinical Waste</td><td></td><td></td><td></td><td></td><td></td><td>382530</td></tr>
<tr><td>PVC Plastics (Fabric impregnated, coated, covered with pvc plastic)</td><td></td><td></td><td></td><td colspan="3">590310</td></tr>
<tr><td>Waste Pharmaceutical</td><td></td><td></td><td></td><td></td><td></td><td>300680</td></tr>
<tr><td>Municipal Incinerator Waste (Ash & residues from the incineration of municipal waste)</td><td></td><td></td><td></td><td></td><td></td><td>262110</td></tr>
<tr><td>Sewage sludge</td><td></td><td></td><td></td><td></td><td></td><td>382520</td></tr>
<tr><td>Wastes of metal pickling liquors, hydraulic fluids, brake fluids & anti-freeze fluids</td><td></td><td></td><td></td><td></td><td></td><td>382550</td></tr>
</table>

Appendix C: Indicators

Category	Description	Source	Note	Year
POPULATION	Population, total rural (thousands)	UN Population Division estimates and projections [code 13730]	Original footnotes omitted	2000
	Population urban	[code 14910]		based on most recent reported census data
	Population rural	[code 14910]		based on most recent reported census data
	Population total	[code 14910]		based on most recent reported census data
	Slum population in urban areas	UN-HABITAT [code 30018]		2001
LIFE EXPECTANCY	Infant mortality rate (0-1 year) per 1,000 live births	UNICEF estimates [code 1230]		2003
	Life expectancy by sex	UN estimates and projections [code 13630]	Original footnotes omitted	2000
GOVERNMENT EXPANDITURE	Government final consumption expenditure for defence, % of total ,	SNA, national data [code 21480]	Original footnotes omitted	for 1997 or latest year reported
	Government final consumption expenditure for education, % of total ,	SNA, national data [code 21480]	Original footnotes omitted	for 1997 or latest year reported
	Government final consumption expenditure for health, % of total ,	SNA, national data [code 21480]	Original footnotes omitted	for 1997 or latest year reported
GDP	GDP in current international dollar (PPPs)	WB estimates [code 29923]		for 2002 or latest year reported
	GDP growth rate, US$ (in %)	UN DPPO/Link estimates [code 29939]		2004
COMMUNICATION	Telephone main lines in use	ITU [code 13120]		for 2002 or latest year reported
	Newspapers and periodicals, circulation (thousand)	[code 25640]		for latest year reported
	Television receivers (thousand)	[code 25710]		for 1999 or latest year reported
	Internet users per 100 population	ITU estimates [code 29969]		for 2003 or latest year reported
AGRICULTURE	Agricultural production index, 1999-2001=100	[code 3510]		for 2003 or latest year reported
	Fertilizer consumption, metric tons, Nitrogenous Fertilizers	[code 3520]		for 2002 or latest year reported
	Fertilizer consumption, metric tons, Phosphate Fertilizers	[code 3520]		for 2002 or latest year reported
	Fertilizer consumption, metric tons, Potash Fertilizers	[code 3520]		for 2002 or latest year reported
HEALTH EXPENDITURES	Per capita total expenditure on health at international dollar rate	WHO		
	General government expenditure on health as percentage of total general government expenditure	WHO		
	Total expenditure on health as percentage of GDP	WHO		
SURFACE AREA	Forests and woodland area, 1000 hectares	FAO estimates [code 3710]	Original footnotes omitted	for 1994 or latest year reported
	Land area, 1000 hectares	FAO [code 3730]	Original footnotes omitted	for 2002 or latest year reported
	Area of arable and permanent crops, 1000 hectares	FAO estimates [code 3720]	Original footnotes omitted	for 2002 or latest year reported
	Protected areas, sq. km.	UNEP-WCMC [code 29980]		for 2004 or latest year reported

Appendix D: Group Trade Flows

IMPORT SOURCE (PARTNER)

OECD

Good	Class.	IMPORT RECEIVER (REPORTER)							Good Share of Total
		OECD		NON-OECD		TERRITORY		TOTAL	
		Volume	Share	Volume	Share	Volume	Share	Volume	
Antimony (Antimony waste & scrap)	811020	223305	1.00	0	-	0	-	223305	0.0%
Antimony, Chromium, Cadmium, Beryllium (Ash & residues containing antimony/beryllium)	262091	28361712	1.00	0	-	0	-	28361712	0.2%
Arsenic and Mercury (Ash & residues cont. mainly arsenic/mercury)	262060	25149089	1.00	0	-	0	-	25149089	0.2%
Beryllium (Beryllium Waste and Scrap)	811211	140009	1.00	0	-	0	-	140009	0.0%
Cadmium (Cadmium, unwrought, waste or scrap, powders)	810710	2797664	0.21	10355620	0.79	0	-	13153284	0.1%
Chromium (Beryllium Waste and Scrap)	811220	38983401	0.92	3318452	0.08	0	-	42301853	0.3%
Chromium (Beryllium Waste and Scrap)	811222	7318941	0.99	76698	0.01	0	-	7395639	0.0%
Clinical Waste	382530	9773	1.00	0	-	0	-	9773	0.0%
Copper (Ash or residues containing mainly copper)	262030	201338177	0.29	500466120	0.71	0	-	701804297	4.7%
Copper (Copper waste and scrap)	740400	2553950594	0.22	8857737999	0.77	115094706	0.01	11526783299	76.4%
Fabricated / Manufacture Asbestos, Mixtures with Asbestos	66381	6935124	0.45	8528911	0.55	12084	0.00	15476119	0.1%
Fabricated asbestos fibres	681290	3979310	0.47	4465371	0.53	1725	0.00	8446406	0.1%
Furans (Heterocyclic compounds with unfused furan ring, nes)	293219	5146061	0.89	609906	0.11	1661	0.00	5757628	0.0%
Furans (Tetrahydrofuran)	293211	140311593	0.89	17886813	0.11	90345	0.00	158288751	1.0%
Halogenated Organic Solvent (Halogenated waste organic solvents)	382541	268260	1.00	0	-	0	-	268260	0.0%
Hexachlorobenzene (HCB) (Hexachlorobenzene and DDT)	290362	14210	1.00	0	-	0	-	14210	0.0%
Lead (Ash or residues containing mainly lead)	262020	25272542	1.00	0	-	0	-	25272542	0.2%
Lead (Ash or residues containing mainly lead)	262029	8356213	1.00	0	-	0	-	8356213	0.1%
Lead (Lead waste and scrap)	780200	330216056	1.00	836	0.00	334873	0.00	330551765	2.2%
Organic Solvents (Waste organic solvents other than halogenated waste organic solvents)	382549	34826	1.00	0	-	0	-	34826	0.0%
PVC Plastics (Fabric impregnated, coated, covered with pvc plastic)	590310	167881624	0.52	107548800	0.33	48320297	0.15	323750721	2.1%
Sewage sludge	382520	1108687	1.00	0	-	0	-	1108687	0.0%
Waste Oils with Polychlorinated biphenyls (PCBs) (Waste oils cont. polychlorinated biphenyls (PCBs)/polychlorinated terphenyl OR Heavy Oils)	271091	16409197	1.00	0	-	0	-	16409197	0.1%
Waste oils without PCBs (Waste oils other than those cont. polychlorinated biphenyls (PCBs)/polychlo…)	271099	797708046	0.84	147903946	0.16	0	-	945611992	6.3%
Waste Pharmaceutical	300680	771007	1.00	6	0.00	0	-	771013	0.0%
Zinc (Ash or residues containing hard zinc spelter)	262011	128865654	1.00	132000	0.00	0	-	128997654	0.9%
Zinc (Ash or residues containing mainly zinc (not spelter))	262019	386057729	1.00	648706	0.00	0	-	386706435	2.6%
Zinc (Zinc waste or scrap)	790200	207071718	0.53	182141109	0.47	2108871	0.01	391321698	2.6%
Total		**5084680522**	**82.9%**	**9841821293**	**16.5%**	**165964562**	**0.6%**	**15092466377**	**100.0%**

IMPORT SOURCE (PARTNER)

NON-OECD

Good	Class.	IMPORT RECEIVER (REPORTER) OECD Volume	OECD Share	NON-OECD Volume	NON-OECD Share	TERRITORY Volume	TERRITORY Share	TOTAL Volume	Good Share of Total
Antimony (Antimony waste & scrap)	811020	1080750	1.00	0	-	0	-	1080750	0.0%
Antimony, Chromium, Cadmium, Beryllium (Ash & residues containing antimony/beryllium)	262091	0	-	0	-	0	-	0	0.0%
Arsenic and Mercury (Ash & residues cont. mainly arsenic/mercury)	262060	0	-	0	-	0	-	0	0.0%
Beryllium (Beryllium Waste and Scrap)	811211	1687	1.00	0	-	0	-	1687	0.0%
Cadmium (Cadmium, unwrought, waste or scrap, powders)	810710	32187	0.00	6467569	1.00	0	-	6499756	0.2%
Chromium (Beryllium Waste and Scrap)	811220	20873046	0.97	542453	0.03	0	-	21415499	0.8%
Chromium (Beryllium Waste and Scrap)	811222	0	-	0	-	0	-	0	0.0%
Clinical Waste	382530	0	-	0	-	0	-	0	0.0%
Copper (Ash or residues containing mainly copper)	262030	27975360	0.41	27265044	0.40	13205194	0.19	68445598	2.6%
Copper (Copper waste and scrap)	740400	668408615	0.40	842363461	0.50	166135511	0.10	1676907587	63.6%
Fabricated / Manufacture Asbestos, Mixtures with Asbestos	66381	7758551	0.27	20404579	0.72	271218	0.01	28434348	1.1%
Fabricated asbestos fibres	681290	3467751	0.39	5462714	0.61	15428	0.00	8945893	0.3%
Furans (Heterocyclic compounds with unfused furan ring, nes)	293219	3865711	0.74	1330886	0.26	4144	0.00	5200741	0.2%
Furans (Tetrahydrofuran)	293211	43309	0.54	36163	0.46	0	-	79472	0.0%
Halogenated Organic Solvent (Halogenated waste organic solvents)	382541	3201572	1.00	0	-	0	-	3201572	0.1%
Hexachlorobenzene (HCB) (Hexachlorobenzene and DDT)	290362	0	-	0	-	0	-	0	0.0%
Lead (Ash or residues containing mainly lead)	262020	4040249	0.99	56104	0.01	0	-	4096353	0.2%
Lead (Ash or residues containing mainly lead)	262029	4040249	0.99	56104	0.01	0	-	4096353	0.2%
Lead (Lead waste and scrap)	780200	40753323	0.55	33620334	0.45	0	-	74373657	2.8%
Organic Solvents (Waste organic solvents other than halogenated waste organic solvents)	382549	9123010	1.00	0	-	0	-	9123010	0.3%
PVC Plastics (Fabric impregnated, coated, covered with pvc plastic)	590310	18300928	0.08	43865607	0.20	159664688	0.72	221831223	8.4%
Sewage sludge	382520	224400232	1.00	256768	0.00	0	-	224657000	8.5%
Waste Oils with Polychlorinated biphenyls (PCBs) (Waste oils cont. polychlorinated biphenyls (PCBs)/polychlorinated terphenyl OR Heavy Oils)	271091	2418237	0.20	9962780	0.80	0	-	12381017	0.5%
Waste oils without PCBs (Waste oils other than those cont. polychlorinated biphenyls (PCBs)/polychlo…)	271099	14017479	0.07	172947173	0.93	0	-	186964652	7.1%
Waste Pharmaceutical	300680	0	-	2542	1.00	0	-	2542	0.0%
Zinc (Ash or residues containing hard zinc spelter)	262011	13385248	0.98	206866	0.02	0	-	13592114	0.5%
Zinc (Ash or residues containing mainly zinc (not spelter))	262019	9744124	0.57	7218928	0.43	0	-	16963052	0.6%
Zinc (Zinc waste or scrap)	790200	10431512	0.22	35453152	0.74	1953249	0.04	47837913	1.8%
Total		**1087363130**	**47.8%**	**1207519227**	**30.5%**	**341249432**	**3.8%**	**2636131789**	**100.0%**

IMPORT SOURCE (PARTNER)

TERRITORY

Good	Class.	IMPORT RECEIVER (REPORTER) OECD Volume	OECD Share	NON-OECD Volume	NON-OECD Share	TERRITORY Volume	TERRITORY Share	TOTAL Volume	Good Share of Total
Antimony (Antimony waste & scrap)	811020	0	-	0	-	0	-	0	0.0%
Antimony, Chromium, Cadmium, Beryllium (Ash & residues containing antimony/beryllium)	262091	0	-	0	-	0	-	0	0.0%
Arsenic and Mercury (Ash & residues cont. mainly arsenic/mercury)	262060	0	-	0	-	0	-	0	0.0%
Beryllium (Beryllium Waste and Scrap)	811211	0	-	0	-	0	-	0	0.0%
Cadmium (Cadmium, unwrought, waste or scrap, powders)	810710	0	-	0	-	0	-	0	0.0%
Chromium (Beryllium Waste and Scrap)	811220	8210	0.38	13187	0.62	0	-	21397	0.0%
Chromium (Beryllium Waste and Scrap)	811222	0	-	0	-	0	-	0	0.0%
Clinical Waste	382530	0	-	0	-	0	-	0	0.0%
Copper (Ash or residues containing mainly copper)	262030	0	-	0	-	0	-	0	0.0%
Copper (Copper waste and scrap)	740400	40862413	0.04	950400559	0.96	67222	0.00	991330194	92.1%
Fabricated / Manufacture Asbestos, Mixtures with Asbestos	66381	0	-	88379	1.00	0	-	88379	0.0%
Fabricated asbestos fibres	681290	0	-	93455	1.00	0	-	93455	0.0%
Furans (Heterocyclic compounds with unfused furan ring, nes)	293219	0	-	0	-	0	-	0	0.0%
Furans (Tetrahydrofuran)	293211	0	-	612	1.00	0	-	612	0.0%
Halogenated Organic Solvent (Halogenated waste organic solvents)	382541	0	-	0	-	0	-	0	0.0%
Hexachlorobenzene (HCB) (Hexachlorobenzene and DDT)	290362	0	-	0	-	0	-	0	0.0%
Lead (Ash or residues containing mainly lead)	262020	0	-	0	-	0	-	0	0.0%
Lead (Ash or residues containing mainly lead)	262029	0	-	0	-	0	-	0	0.0%
Lead (Lead waste and scrap)	780200	0	-	0	-	0	-	0	0.0%
Organic Solvents (Waste organic solvents other than halogenated waste organic solvents)	382549	0	-	0	-	0	-	0	0.0%
PVC Plastics (Fabric impregnated, coated, covered with pvc plastic)	590310	317499	0.00	66916944	0.98	947002	0.01	68181445	6.3%
Sewage sludge	382520	10674312	0.76	0	-	3450000	0.24	14124312	1.3%
Waste Oils with Polychlorinated biphenyls (PCBs) (Waste oils cont. polychlorinated biphenyls (PCBs)/polychlorinated terphenyl OR Heavy Oils)	271091	2868874	1.00	0	-	0	-	2868874	0.3%
Waste oils without PCBs (Waste oils other than those cont. polychlorinated biphenyls (PCBs)/polychlo…)	271099	0	-	16513	1.00	0	-	16513	0.0%
Waste Pharmaceutical	300680	0	-	0	-	0	-	0	0.0%
Zinc (Ash or residues containing hard zinc spelter)	262011	0	-	0	-	0	-	0	0.0%
Zinc (Ash or residues containing mainly zinc (not spelter))	262019	0	-	0	-	0	-	0	0.0%
Zinc (Zinc waste or scrap)	790200	0	-	0	-	0	-	0	0.0%
Total		**54731308**	**7.8%**	**1017529649**	**23.4%**	**4464224**	**0.9%**	**1076725181**	**100.0%**

IMPORT SOURCE (PARTNER)

TOTAL

		IMPORT RECEIVER (REPORTER)							
		OECD		NON-OECD		TERRITORY		TOTAL	Good Share of Total
Good	Class.	Volume	Share	Volume	Share	Volume	Share	Volume	
Antimony (Antimony waste & scrap)	811020	1304055	1.00	0	-	0	-	1304055	0.0%
Antimony, Chromium, Cadmium, Beryllium (Ash & residues containing antimony/beryllium)	262091	28361712	1.00	0	-	0	-	28361712	0.2%
Arsenic and Mercury (Ash & residues cont. mainly arsenic/mercury)	262060	25149089	1.00	0	-	0	-	25149089	0.1%
Beryllium (Beryllium Waste and Scrap)	811211	141696	1.00	0	-	0	-	141696	0.0%
Cadmium (Cadmium, unwrought, waste or scrap, powders)	810710	2829851	0.14	16823189	0.86	0	-	19653040	0.1%
Chromium (Beryllium Waste and Scrap)	811220	59864657	0.94	3874092	0.06	0	-	63738749	0.3%
Chromium (Beryllium Waste and Scrap)	811222	7318941	0.99	76698	0.01	0	-	7395639	0.0%
Clinical Waste	382530	9773	1.00	0	-	0	-	9773	0.0%
Copper (Ash or residues containing mainly copper)	262030	229313537	0.30	527731164	0.69	13205194	0.02	770249895	4.1%
Copper (Copper waste and scrap)	740400	3263221622	0.23	10650502019	0.75	281297439	0.02	14195021080	75.5%
Fabricated / Manufacture Asbestos, Mixtures with Asbestos	66381	14693675	0.33	29021869	0.66	283302	0.01	43998846	0.2%
Fabricated asbestos fibres	681290	7447061	0.43	10021540	0.57	17153	0.00	17485754	0.1%
Furans (Heterocyclic compounds with unfused furan ring, nes)	293219	9011772	0.82	1940792	0.18	5805	0.00	10958369	0.1%
Furans (Tetrahydrofuran)	293211	140354902	0.89	17923588	0.11	90345	0.00	158368835	0.8%
Halogenated Organic Solvent (Halogenated waste organic solvents)	382541	3469832	1.00	0	-	0	-	3469832	0.0%
Hexachlorobenzene (HCB) (Hexachlorobenzene and DDT)	290362	14210	1.00	0	-	0	-	14210	0.0%
Lead (Ash or residues containing mainly lead)	262020	29312791	1.00	56104	0.00	0	-	29368895	0.2%
Lead (Ash or residues containing mainly lead)	262029	12396462	1.00	56104	0.00	0	-	12452566	0.1%
Lead (Lead waste and scrap)	780200	370969379	0.92	33621170	0.08	334873	0.00	404925422	2.2%
Organic Solvents (Waste organic solvents other than halogenated waste organic solvents)	382549	9157836	1.00	0	-	0	-	9157836	0.0%
PVC Plastics (Fabric impregnated, coated, covered with pvc plastic)	590310	186500051	0.30	218331351	0.36	208931987	0.34	613763389	3.3%
Sewage sludge	382520	236183231	0.98	256768	0.00	3450000	0.01	239889999	1.3%
Waste Oils with Polychlorinated biphenyls (PCBs) (Waste oils cont. polychlorinated biphenyls (PCBs)/polychlorinated terphenyl OR Heavy Oils)	271091	21696308	0.69	9962780	0.31	0	-	31659088	0.2%
Waste oils without PCBs (Waste oils other than those cont. polychlorinated biphenyls (PCBs)/polychlo…)	271099	811725525	0.72	320867632	0.28	0	-	1132593157	6.0%
Waste Pharmaceutical	300680	771007	1.00	2548	0.00	0	-	773555	0.0%
Zinc (Ash or residues containing hard zinc spelter)	262011	142250902	1.00	338866	0.00	0	-	142589768	0.8%
Zinc (Ash or residues containing mainly zinc (not spelter))	262019	395801853	0.98	7867634	0.02	0	-	403669487	2.1%
Zinc (Zinc waste or scrap)	790200	217503230	0.50	217594261	0.50	4062120	0.01	439159611	2.3%
Total		**6226774960**	**79.1%**	**12066870169**	**19.5%**	**511678218**	**1.5%**	**18805323347**	**100.0%**

EXPORT SENDER (REPORTER)										EXPORT RECEIVER (PARTNER): OECD
OECD		NON-OECD		TERRITORY		TOTAL	Good Share of Total			
Volume	Share	Volume	Share	Volume	Share	Volume		Class.	Good	
0	-	91241	1.00	0	-	91241	0.0%	811020	Antimony (Antimony waste & scrap)	
93149024	1.00	154241	0.00	0	-	93303265	1.6%	262091	Antimony, Chromium, Cadmium, Beryllium (Ash & residues containing antimony/beryllium)	
0	-	0	-	25149089	1.00	25149089	0.4%	262060	Arsenic and Mercury (Ash & residues cont. mainly arsenic/mercury)	
0	-	353043	1.00	0	-	353043	0.0%	811211	Beryllium (Beryllium Waste and Scrap)	
2602355	0.19	6990462	0.51	4008286	0.29	13601103	0.2%	810710	Cadmium (Cadmium, unwrought, waste or scrap, powders)	
29818227	0.29	54251470	0.54	17253377	0.17	101323074	1.7%	811220	Chromium (Beryllium Waste and Scrap)	
0	-	7824244	0.31	17070573	0.69	24894817	0.4%	811222	Chromium (Beryllium Waste and Scrap)	
5779	0.59	3897	0.40	97	0.01	9773	0.0%	382530	Clinical Waste	
59463424	0.29	136068984	0.67	6113060	0.03	201645468	3.4%	262030	Copper (Ash or residues containing mainly copper)	
1164575963	0.31	2204988097	0.59	351358588	0.09	3720922648	62.5%	740400	Copper (Copper waste and scrap)	
6023830	0.19	24225284	0.77	1139244	0.04	31388358	0.5%	66381	Fabricated / Manufacture Asbestos, Mixtures with Asbestos	
5003526	0.20	19378047	0.79	64553	0.00	24446126	0.4%	681290	Fabricated asbestos fibres	
3296942	0.47	3509072	0.50	170856	0.02	6976870	0.1%	293219	Furans (Heterocyclic compounds with unfused furan ring, nes)	
2620263	0.02	137204842	0.98	438533	0.00	140263638	2.4%	293211	Furans (Tetrahydrofuran)	
2080	1.00	0	-	0	-	2080	0.0%	382541	Halogenated Organic Solvent (Halogenated waste organic solvents)	
0	-	65	1.00	0	-	65	0.0%	290362	Hexachlorobenzene (HCB) (Hexachlorobenzene and DDT)	
22312100	0.34	42365258	0.66	0	-	64677358	1.1%	262020	Lead (Ash or residues containing mainly lead)	
0	-	0	-	8356213	1.00	8356213	0.1%	262029	Lead (Ash or residues containing mainly lead)	
79109336	0.26	217165777	0.72	4301986	0.01	300577099	5.1%	780200	Lead (Lead waste and scrap)	
551678	0.40	811263	0.60	0	-	1362941	0.0%	382549	Organic Solvents (Waste organic solvents other than halogenated waste organic solvents)	
101827134	0.30	176986100	0.52	59237279	0.18	338050513	5.7%	590310	PVC Plastics (Fabric impregnated, coated, covered with pvc plastic)	
9813674	0.05	190000612	0.95	46550	0.00	199860836	3.4%	382520	Sewage sludge	
0	-	7937	0.56	6241	0.44	14178	0.0%	271091	Waste Oils with Polychlorinated biphenyls (PCBs) (Waste oils cont. polychlorinated biphenyls (PCBs)/polychlorinated terphenyl OR Heavy Oils)	
2944432	0.04	24812634	0.37	39321688	0.59	67078754	1.1%	271099	Waste oils without PCBs (Waste oils other than those cont. polychlorinated biphenyls (PCBs)/polychlo…)	
0	-	486594	1.00	0	-	486594	0.0%	300680	Waste Pharmaceutical	
12201611	0.20	49089364	0.80	0	-	61290975	1.0%	262011	Zinc (Ash or residues containing hard zinc spelter)	
103434123	0.39	108273010	0.41	51076179	0.19	262783312	4.4%	262019	Zinc (Ash or residues containing mainly zinc (not spelter))	
92689200	0.36	111435052	0.43	56670503	0.22	260794755	4.4%	790200	Zinc (Zinc waste or scrap)	
1791444701	**24.7%**	**3516476590**	**57.5%**	**641782895**	**17.8%**	**5949704186**	**100.0%**		**Total**	

EXPORT SENDER (REPORTER)											NON-OECD EXPORT RECEIVER (PARTNER)
OECD		NON-OECD		TERRITORY		TOTAL	Good Share of Total				
Volume	Share	Volume	Share	Volume	Share	Volume		Class.	Good		
0	-	0	-	0	-	0	0.0%	811020	Antimony (Antimony waste & scrap)		
0	-	0	-	0	-	0	0.0%	262091	Antimony, Chromium, Cadmium, Beryllium (Ash & residues containing antimony/beryllium)		
0	-	0	-	0	-	0	0.0%	262060	Arsenic and Mercury (Ash & residues cont. mainly arsenic/mercury)		
0	-	1479	1.00	0	-	1479	0.0%	811211	Beryllium (Beryllium Waste and Scrap)		
35187	0.01	2486500	0.98	4311	0.00	2525998	0.0%	810710	Cadmium (Cadmium, unwrought, waste or scrap, powders)		
182479	0.10	1627409	0.89	28329	0.02	1838217	0.0%	811220	Chromium (Beryllium Waste and Scrap)		
0	-	2108	1.00	0	-	2108	0.0%	811222	Chromium (Beryllium Waste and Scrap)		
0	-	0	-	0	-	0	0.0%	382530	Clinical Waste		
132017849	0.69	58533790	0.31	0	-	190551639	2.6%	262030	Copper (Ash or residues containing mainly copper)		
1633629198	0.29	2979388157	0.54	935192105	0.17	5548209460	75.1%	740400	Copper (Copper waste and scrap)		
7616205	0.06	115815572	0.92	2370992	0.02	125802769	1.7%	66381	Fabricated / Manufacture Asbestos, Mixtures with Asbestos		
5375331	0.05	95105636	0.94	542034	0.01	101023001	1.4%	681290	Fabricated asbestos fibres		
854636	0.39	1356593	0.61	1049	0.00	2212278	0.0%	293219	Furans (Heterocyclic compounds with unfused furan ring, nes)		
50331	0.01	3705036	0.97	53264	0.01	3808631	0.1%	293211	Furans (Tetrahydrofuran)		
0	-	0	-	0	-	0	0.0%	382541	Halogenated Organic Solvent (Halogenated waste organic solvents)		
1573750	1.00	0	-	0	-	1573750	0.0%	290362	Hexachlorobenzene (HCB) (Hexachlorobenzene and DDT)		
0	-	147167066	0.98	2331312	0.02	149498378	2.0%	262020	Lead (Ash or residues containing mainly lead)		
0	-	4096353	1.00	0	-	4096353	0.1%	262029	Lead (Ash or residues containing mainly lead)		
6255347	0.04	155354389	0.92	8100494	0.05	169710230	2.3%	780200	Lead (Lead waste and scrap)		
0	-	0	-	0	-	0	0.0%	382549	Organic Solvents (Waste organic solvents other than halogenated waste organic solvents)		
252567474	0.36	113697710	0.16	326464349	0.47	692729533	9.4%	590310	PVC Plastics (Fabric impregnated, coated, covered with pvc plastic)		
12020250	0.85	2039875	0.15	0	-	14060125	0.2%	382520	Sewage sludge		
0	-	8646178	1.00	2386	0.00	8648564	0.1%	271091	Waste Oils with Polychlorinated biphenyls (PCBs) (Waste oils cont. polychlorinated biphenyls (PCBs)/polychlorinated terphenyl OR Heavy Oils)		
678186	0.05	13795713	0.94	165005	0.01	14638904	0.2%	271099	Waste oils without PCBs (Waste oils other than those cont. polychlorinated biphenyls (PCBs)/polychlo…)		
0	-	18106	1.00	0	-	18106	0.0%	300680	Waste Pharmaceutical		
4812	0.00	2481002	0.94	141795	0.05	2627609	0.0%	262011	Zinc (Ash or residues containing hard zinc spelter)		
61218	0.00	34228279	0.99	388608	0.01	34678105	0.5%	262019	Zinc (Ash or residues containing mainly zinc (not spelter))		
49001904	0.15	235489954	0.74	33393916	0.11	317885774	4.3%	790200	Zinc (Zinc waste or scrap)		
2101924157	**14.6%**	**3975036905**	**60.7%**	**1309179949**	**3.4%**	**7386141011**	**100.0%**		**Total**		

EXPORT RECEIVER (PARTNER)

TERRITORY

EXPORT SENDER (REPORTER)							Good Share of Total	Class.	Good
OECD		NON-OECD		TERRITORY		TOTAL			
Volume	Share	Volume	Share	Volume	Share	Volume			
0	-	27437	1.00	0	-	27437	0.0%	811020	Antimony (Antimony waste & scrap)
0	-	0	-	0	-	0	0.0%	262091	Antimony, Chromium, Cadmium, Beryllium (Ash & residues containing antimony/beryllium)
0	-	0	-	0	-	0	0.0%	262060	Arsenic and Mercury (Ash & residues cont. mainly arsenic/mercury)
0	-	0	-	0	-	0	0.0%	811211	Beryllium (Beryllium Waste and Scrap)
0	-	0	-	0	-	0	0.0%	810710	Cadmium (Cadmium, unwrought, waste or scrap, powders)
0	-	1393	1.00	0	-	1393	0.0%	811220	Chromium (Beryllium Waste and Scrap)
0	-	0	-	0	-	0	0.0%	811222	Chromium (Beryllium Waste and Scrap)
0	-	0	-	0	-	0	0.0%	382530	Clinical Waste
39904280	0.99	331000	0.01	0	-	40235280	9.4%	262030	Copper (Ash or residues containing mainly copper)
71815936	0.37	112001036	0.58	10344436	0.05	194161408	45.4%	740400	Copper (Copper waste and scrap)
202086	0.30	448988	0.68	13989	0.02	665063	0.2%	66381	Fabricated / Manufacture Asbestos, Mixtures with Asbestos
74163	0.69	31328	0.29	2382	0.02	107873	0.0%	681290	Fabricated asbestos fibres
24237	0.91	2462	0.09	0	-	26699	0.0%	293219	Furans (Heterocyclic compounds with unfused furan ring, nes)
0	-	0	-	0	-	0	0.0%	293211	Furans (Tetrahydrofuran)
0	-	0	-	0	-	0	0.0%	382541	Halogenated Organic Solvent (Halogenated waste organic solvents)
0	-	0	-	0	-	0	0.0%	290362	Hexachlorobenzene (HCB) (Hexachlorobenzene and DDT)
0	-	0	-	0	-	0	0.0%	262020	Lead (Ash or residues containing mainly lead)
0	-	0	-	0	-	0	0.0%	262029	Lead (Ash or residues containing mainly lead)
0	-	0	-	0	-	0	0.0%	780200	Lead (Lead waste and scrap)
0	-	0	-	0	-	0	0.0%	382549	Organic Solvents (Waste organic solvents other than halogenated waste organic solvents)
121923857	0.66	62775796	0.34	162788	0.00	184862441	43.2%	590310	PVC Plastics (Fabric impregnated, coated, covered with pvc plastic)
0	-	0	-	0	-	0	0.0%	382520	Sewage sludge
0	-	0	-	0	-	0	0.0%	271091	Waste Oils with Polychlorinated biphenyls (PCBs) (Waste oils cont. polychlorinated biphenyls (PCBs)/polychlorinated terphenyl OR Heavy Oils)
0	-	17062	1.00	0	-	17062	0.0%	271099	Waste oils without PCBs (Waste oils other than those cont. polychlorinated biphenyls (PCBs)/polychlo…)
0	-	32358	1.00	0	-	32358	0.0%	300680	Waste Pharmaceutical
0	-	0	-	0	-	0	0.0%	262011	Zinc (Ash or residues containing hard zinc spelter)
0	-	0	-	0	-	0	0.0%	262019	Zinc (Ash or residues containing mainly zinc (not spelter))
0	-	4325088	0.54	3659250	0.46	7984338	1.9%	790200	Zinc (Zinc waste or scrap)
233944559	**14.0%**	**179993948**	**23.3%**	**14182845**	**2.0%**	**428121352**	**100.0%**		**Total**

EXPORT SENDER (REPORTER)							Good Share of Total	Class.	Good
OECD		NON-OECD		TERRITORY		TOTAL			
Volume	Share	Volume	Share	Volume	Share	Volume			
0	-	118678	1.00	0	-	118678	0.0%	811020	Antimony (Antimony waste & scrap)
93149024	1.00	154241	0.00	0	-	93303265	0.7%	262091	Antimony, Chromium, Cadmium, Beryllium (Ash & residues containing antimony/beryllium)
0	-	0	-	25149089	1.00	25149089	0.2%	262060	Arsenic and Mercury (Ash & residues cont. mainly arsenic/mercury)
0	-	354522	1.00	0	-	354522	0.0%	811211	Beryllium (Beryllium Waste and Scrap)
2637542	0.16	9476962	0.59	4012597	0.25	16127101	0.1%	810710	Cadmium (Cadmium, unwrought, waste or scrap, powders)
30000706	0.29	55880272	0.54	17281706	0.17	103162684	0.7%	811220	Chromium (Beryllium Waste and Scrap)
0	-	7826352	0.31	17070573	0.69	24896925	0.2%	811222	Chromium (Beryllium Waste and Scrap)
5779	0.59	3897	0.40	97	0.01	9773	0.0%	382530	Clinical Waste
231385553	0.54	194933774	0.45	6113060	0.01	432432387	3.1%	262030	Copper (Ash or residues containing mainly copper)
2870021097	0.30	5296377290	0.56	1296895129	0.14	9463293516	68.8%	740400	Copper (Copper waste and scrap)
13842121	0.09	140489844	0.89	3524225	0.02	157856190	1.1%	66381	Fabricated / Manufacture Asbestos, Mixtures with Asbestos
10453020	0.08	114515011	0.91	608969	0.00	125577000	0.9%	681290	Fabricated asbestos fibres
4175815	0.45	4868127	0.53	171905	0.02	9215847	0.1%	293219	Furans (Heterocyclic compounds with unfused furan ring, nes)
2670594	0.02	140909878	0.98	491797	0.00	144072269	1.0%	293211	Furans (Tetrahydrofuran)
2080	1.00	0	-	0	-	2080	0.0%	382541	Halogenated Organic Solvent (Halogenated waste organic solvents)
1573750	1.00	65	0.00	0	-	1573815	0.0%	290362	Hexachlorobenzene (HCB) (Hexachlorobenzene and DDT)
22312100	0.10	189532324	0.88	2331312	0.01	214175736	1.6%	262020	Lead (Ash or residues containing mainly lead)
0	-	4096353	0.33	8356213	0.67	12452566	0.1%	262029	Lead (Ash or residues containing mainly lead)
85364683	0.18	372520166	0.79	12402480	0.03	470287329	3.4%	780200	Lead (Lead waste and scrap)
551678	0.40	811263	0.60	0	-	1362941	0.0%	382549	Organic Solvents (Waste organic solvents other than halogenated waste organic solvents)
476318465	0.39	353459606	0.29	385864416	0.32	1215642487	8.8%	590310	PVC Plastics (Fabric impregnated, coated, covered with pvc plastic)
21833924	0.10	192040487	0.90	46550	0.00	213920961	1.6%	382520	Sewage sludge
0	-	8654115	1.00	8627	0.00	8662742	0.1%	271091	Waste Oils with Polychlorinated biphenyls (PCBs) (Waste oils cont. polychlorinated biphenyls (PCBs)/polychlorinated terphenyl OR Heavy Oils)
3622618	0.04	38625409	0.47	39486693	0.48	81734720	0.6%	271099	Waste oils without PCBs (Waste oils other than those cont. polychlorinated biphenyls (PCBs)/polychlo…)
0	-	537058	1.00	0	-	537058	0.0%	300680	Waste Pharmaceutical
12206423	0.19	51570366	0.81	141795	0.00	63918584	0.5%	262011	Zinc (Ash or residues containing hard zinc spelter)
103495341	0.35	142501289	0.48	51464787	0.17	297461417	2.2%	262019	Zinc (Ash or residues containing mainly zinc (not spelter))
141691104	0.24	351250094	0.60	93723669	0.16	586664867	4.3%	790200	Zinc (Zinc waste or scrap)
4127313417	**26.9%**	**7671507443**	**58.2%**	**1965145689**	**14.8%**	**13763966549**	**100.0%**		**Total**

EXPORT RECEIVER (PARTNER)

TOTAL

NET IMPORT (REPORTER IMPORTS - REPORTER EXPORTS)							
OECD		NON-OECD		TERRITORY			
Net Volume	Total Volume	Net Volume	Total Volume	Net Volume	Total Volume	Class.	Good
223305	223,305.00	-91241	91,241.00	0	-	811020	Antimony (Antimony waste & scrap)
-64787312	121,510,736.00	-154241	154,241.00	0	-	262091	Antimony, Chromium, Cadmium, Beryllium (Ash & residues containing antimony/beryllium)
25149089	25,149,089.00	0	-	-25149089	25,149,089.00	262060	Arsenic and Mercury (Ash & residues cont. mainly arsenic/mercury)
140009	140,009.00	-353043	353,043.00	0	-	811211	Beryllium (Beryllium Waste and Scrap)
195309	5,400,019.00	3365158	17,346,082.00	-4008286	4,008,286.00	810710	Cadmium (Cadmium, unwrought, waste or scrap, powders)
9165174	68,801,628.00	-50933018	57,569,922.00	-17253377	17,253,377.00	811220	Chromium (Beryllium Waste and Scrap)
7318941	7,318,941.00	-7747546	7,900,942.00	-17070573	17,070,573.00	811222	Chromium (Beryllium Waste and Scrap)
3994	15,552.00	-3897	3,897.00	-97	97.00	382530	Clinical Waste
141874753	260,801,601.00	364397136	636,535,104.00	-6113060	6,113,060.00	262030	Copper (Ash or residues containing mainly copper)
1389374631	3,718,526,557.00	6652749902	11,062,726,096.00	-236263882	466,453,294.00	740400	Copper (Copper waste and scrap)
911294	12,958,954.00	-15696373	32,754,195.00	-1127160	1,151,328.00	66381	Fabricated / Manufacture Asbestos, Mixtures with Asbestos
-1024216	8,982,836.00	-14912676	23,843,418.00	-62828	66,278.00	681290	Fabricated asbestos fibres
1849119	8,443,003.00	-2899166	4,118,978.00	-169195	172,517.00	293219	Furans (Heterocyclic compounds with unfused furan ring, nes)
137691330	142,931,856.00	-119318029	155,091,655.00	-348188	528,878.00	293211	Furans (Tetrahydrofuran)
266180	270,340.00	0	-	0	-	382541	Halogenated Organic Solvent (Halogenated waste organic solvents)
14210	14,210.00	-65	65.00	0	-	290362	Hexachlorobenzene (HCB) (Hexachlorobenzene and DDT)
2960442	47,584,642.00	-42365258	42,365,258.00	0	-	262020	Lead (Ash or residues containing mainly lead)
8356213	8,356,213.00	0	-	-8356213	8,356,213.00	262029	Lead (Ash or residues containing mainly lead)
251106720	409,325,392.00	-217164941	217,166,613.00	-3967113	4,636,859.00	780200	Lead (Lead waste and scrap)
-516852	586,504.00	-811263	811,263.00	0	-	382549	Organic Solvents (Waste organic solvents other than halogenated waste organic solvents)
66054490	269,708,758.00	-69437300	284,534,900.00	-10916982	107,557,576.00	590310	PVC Plastics (Fabric impregnated, coated, covered with pvc plastic)
-8704987	10,922,361.00	-190000612	190,000,612.00	-46550	46,550.00	382520	Sewage sludge
16409197	16,409,197.00	-7937	7,937.00	-6241	6,241.00	271091	Waste Oils with Polychlorinated biphenyls (PCBs) (Waste oils cont. polychlorinated biphenyls (PCBs)/polychlorinated terphenyl OR Heavy Oils)
794763614	800,652,478.00	123091312	172,716,580.00	-39321688	39,321,688.00	271099	Waste oils without PCBs (Waste oils other than those cont. polychlorinated biphenyls (PCBs)/polychlo…)
771007	771,007.00	-486588	486,600.00	0	-	300680	Waste Pharmaceutical
116664043	141,067,265.00	-48957364	49,221,364.00	0	-	262011	Zinc (Ash or residues containing hard zinc spelter)
282623606	489,491,852.00	-107624304	108,921,716.00	-51076179	51,076,179.00	262019	Zinc (Ash or residues containing mainly zinc (not spelter))
114382518	299,760,918.00	70706057	293,576,161.00	-54561632	58,779,374.00	790200	Zinc (Zinc waste or scrap)
3293235821	**6876125223**	**6325344703**	**13358297883**	**-475818333**	**807747457**		**Total**

OECD

NET IMPORT (REPORTER IMPORTS - REPORTER EXPORTS)							
OECD		NON-OECD		TERRITORY			
Net Volume	Total Volume	Net Volume	Total Volume	Net Volume	Total Volume	Class.	Good
1080750	1,080,750.00	0	-	0	-	811020	Antimony (Antimony waste & scrap)
0	-	0	-	0	-	262091	Antimony, Chromium, Cadmium, Beryllium (Ash & residues containing antimony/beryllium)
0	-	0	-	0	-	262060	Arsenic and Mercury (Ash & residues cont. mainly arsenic/mercury)
1687	1,687.00	-1479	1,479.00	0	-	811211	Beryllium (Beryllium Waste and Scrap)
-3000	67,374.00	3981069	8,954,069.00	-4311	4,311.00	810710	Cadmium(Cadmium, unwrought, waste or scrap, powders)
20690567	21,055,525.00	-1084956	2,169,862.00	-28329	28,329.00	811220	Chromium (Beryllium Waste and Scrap)
0	-	-2108	2,108.00	0	-	811222	Chromium (Beryllium Waste and Scrap)
0	-	0	-	0	-	382530	Clinical Waste
-104042489	159,993,209.00	-31268746	85,798,834.00	13205194	13,205,194.00	262030	Copper (Ash or residues containing mainly copper)
-965220583	2,302,037,813.00	-2137024696	3,821,751,618.00	-769056594	1,101,327,616.00	740400	Copper (Copper waste and scrap)
142346	15,374,756.00	-95410993	136,220,151.00	-2099774	2,642,210.00	66381	Fabricated / Manufacture Asbestos, Mixtures with Asbestos
-1907580	8,843,082.00	-89642922	100,568,350.00	-526606	557,462.00	681290	Fabricated asbestos fibres
3011075	4,720,347.00	-25707	2,687,479.00	3095	5,193.00	293219	Furans (Heterocyclic compounds with unfused furan ring, nes)
-7022	93,640.00	-3668873	3,741,199.00	-53264	53,264.00	293211	Furans (Tetrahydrofuran)
3201572	3,201,572.00	0	-	0	-	382541	Halogenated Organic Solvent (Halogenated waste organic solvents)
-1573750	1,573,750.00	0	-	0	-	290362	Hexachlorobenzene (HCB) (Hexachlorobenzene and DDT)
4040249	4,040,249.00	-147110962	147,223,170.00	-2331312	2,331,312.00	262020	Lead (Ash or residues containing mainly lead)
4040249	4,040,249.00	-4040249	4,152,457.00	0	-	262029	Lead (Ash or residues containing mainly Pb
34497976	47,008,670.00	-121734055	188,974,723.00	-8100494	8,100,494.00	780200	Lead (Lead waste and scrap)
9123010	9,123,010.00	0	-	0	-	382549	Organic Solvents (Waste organic solvents other than halogenated waste organic solvents)
-234266546	270,868,402.00	-69832103	157,563,317.00	-166799661	486,129,037.00	590310	PVC Plastics (Fabric impregnated, coated, covered with pvc plastic)
212379982	236,420,482.00	-1783107	2,296,643.00	0	-	382520	Sewage sludge
2418237	2,418,237.00	1316602	18,608,958.00	-2386	2,386.00	271091	Waste Oils with Polychlorinated biphenyls (PCBs) (Waste oils cont. polychlorinated biphenyls (PCBs)/polychlorinated terphenyl OR Heavy Oils)
13339293	14,695,665.00	159151460	186,742,886.00	-165005	165,005.00	271099	Waste oils without PCBs (Waste oils other than those cont. polychlorinated biphenyls (PCBs)/polychlo…)
0	-	-15564	20,648.00	0	-	300680	Waste Pharmaceutical
13380436	13,390,060.00	-2274136	2,687,868.00	-141795	141,795.00	262011	Zinc (Ash or residues containing hard zinc spelter)
9682906	9,805,342.00	-27009351	41,447,207.00	-388608	388,608.00	262019	Zinc (Ash or residues containing mainly zinc
-38570392	59,433,416.00	-200036802	270,943,106.00	-31440667	35,347,165.00	790200	Zinc (Zinc waste or scrap)
-1014561027	**3189287287**	**-2767517678**	**5182556132**	**-967930517**	**1650429381**		**Total**

NON-OECD

NET IMPORT (REPORTER IMPORTS - REPORTER EXPORTS)								
OECD		NON-OECD		TERRITORY				
Net Volume	Total Volume	Net Volume	Total Volume	Net Volume	Total Volume	Class.	Good	TERRITORY
0	-	-27437	27,437.00	0	-	811020	Antimony (Antimony waste & scrap)	
0	-	0	-	0	-	262091	Antimony, Chromium, Cadmium, Beryllium (Ash & residues containing antimony/beryllium)	
0	-	0	-	0	-	262060	Arsenic and Mercury (Ash & residues cont. mainly arsenic/mercury)	
0	-	0	-	0	-	811211	Beryllium (Beryllium Waste and Scrap)	
0	-	0	-	0	-	810710	Cadmium (Cadmium, unwrought, waste or scrap, powders)	
8210	8,210.00	11794	14,580.00	0	-	811220	Chromium (Beryllium Waste and Scrap)	
0	-	0	-	0	-	811222	Chromium (Beryllium Waste and Scrap)	
0	-	0	-	0	-	382530	Clinical Waste	
-39904280	39,904,280.00	-331000	331,000.00	0	-	262030	Copper (Ash or residues containing mainly copper)	
-30953523	112,678,349.00	838399523	1,062,401,595.00	-10277214	10,411,658.00	740400	Copper (Copper waste and scrap)	
-202086	202,086.00	-360609	537,367.00	-13989	13,989.00	66381	Fabricated / Manufacture Asbestos, Mixtures with Asbestos	
-74163	74,163.00	62127	124,783.00	-2382	2,382.00	681290	Fabricated asbestos fibres	
-24237	24,237.00	-2462	2,462.00	0	-	293219	Furans (Heterocyclic compounds with unfused furan ring, nes)	
0	-	612	612.00	0	-	293211	Furans (Tetrahydrofuran)	
0	-	0	-	0	-	382541	Halogenated Organic Solvent (Halogenated waste organic solvents)	
0	-	0	-	0	-	290362	Hexachlorobenzene (HCB) (Hexachlorobenzene and DDT)	
0	-	0	-	0	-	262020	Lead (Ash or residues containing mainly lead)	
0	-	0	-	0	-	262029	Lead (Ash or residues containing mainly lead)	
0	-	0	-	0	-	780200	Lead (Lead waste and scrap)	
0	-	0	-	0	-	382549	Organic Solvents (Waste organic solvents other than halogenated waste organic solvents)	
-121606358	122,241,356.00	4141148	129,692,740.00	784214	1,109,790.00	590310	PVC Plastics (Fabric impregnated, coated, covered with pvc plastic)	
10674312	10,674,312.00	0	-	3450000	3,450,000.00	382520	Sewage sludge	
2868874	2,868,874.00	0	-	0	-	271091	Waste Oils with Polychlorinated biphenyls (PCBs) (Waste oils cont. polychlorinated biphenyls (PCBs)/polychlorinated terphenyl OR Heavy Oils)	
0	-	-549	33,575.00	0	-	271099	Waste oils without PCBs (Waste oils other than those cont. polychlorinated biphenyls (PCBs)/polychlo…)	
0	-	-32358	32,358.00	0	-	300680	Waste Pharmaceutical	
0	-	0	-	0	-	262011	Zinc (Ash or residues containing hard zinc spelter)	
0	-	0	-	0	-	262019	Zinc (Ash or residues containing mainly zinc (not spelter))	
0	-	-4325088	4,325,088.00	-3659250	3,659,250.00	790200	Zinc (Zinc waste or scrap)	
-179213251	**288675867**	**837535701**	**1197523597**	**-9718621**	**18647069**		**Total**	

NET IMPORT (REPORTER IMPORTS - REPORTER EXPORTS)								TOTAL
OECD		NON-OECD		TERRITORY				
Net Volume	**Total Volume**	**Net Volume**	**Total Volume**	**Net Volume**	**Total Volume**	**Class.**	**Good**	
1304055	1,304,055.00	-118678	118,678.00	0	-	811020	Antimony (Antimony waste & scrap)	
-64787312	121,510,736.00	-154241	154,241.00	0	-	262091	Antimony, Chromium, Cadmium, Beryllium (Ash & residues containing antimony/beryllium)	
25149089	25,149,089.00	0	-	-25149089	25,149,089.00	262060	Arsenic and Mercury (Ash & residues cont. mainly arsenic/mercury)	
141696	141,696.00	-354522	354,522.00	0	-	811211	Beryllium (Beryllium Waste and Scrap)	
192309	5,467,393.00	7346227	26,300,151.00	-4012597	4,012,597.00	810710	Cadmium (Cadmium, unw rought, waste or scrap, powders)	
29863951	89,865,363.00	-52006180	59,754,364.00	-17281706	17,281,706.00	811220	Chromium (Beryllium Waste and Scrap)	
7318941	7,318,941.00	-7749654	7,903,050.00	-17070573	17,070,573.00	811222	Chromium (Beryllium Waste and Scrap)	
3994	15,552.00	-3897	3,897.00	-97	97.00	382530	Clinical Waste	
-2072016	460,699,090.00	332797390	722,664,938.00	7092134	19,318,254.00	262030	Copper (Ash or residues containing mainly copper)	
393200525	6,133,242,719.00	5354124729	15,946,879,309.00	-1.016E+09	1,578,192,568.00	740400	Copper (Copper waste and scrap)	
851554	28,535,796.00	-111467975	169,511,713.00	-3240923	3,807,527.00	66381	Fabricated / Manufacture Asbestos, Mixtures with Asbestos	
-3005959	17,900,081.00	-104493471	124,536,551.00	-591816	626,122.00	681290	Fabricated asbestos fibres	
4835957	13,187,587.00	-2927335	6,808,919.00	-166100	177,710.00	293219	Furans (Heterocyclic compounds with unfused furan ring, nes)	
137684308	143,025,496.00	-122986290	158,833,466.00	-401452	582,142.00	293211	Furans (Tetrahydrofuran)	
3467752	3,471,912.00	0	-	0	-	382541	Halogenated Organic Solvent (Halogenated waste organic solvents)	
-1559540	1,587,960.00	-65	65.00	0	-	290362	Hexachlorobenzene (HCB) (Hexachlorobenzene and DDT)	
7000691	51,624,891.00	-189476220	189,588,428.00	-2331312	2,331,312.00	262020	Lead (Ash or residues containing mainly lead)	
12396462	12,396,462.00	-4040249	4,152,457.00	-8356213	8,356,213.00	262029	Lead (Ash or residues containing mainly lead)	
285604696	456,334,062.00	-338898996	406,141,336.00	-12067607	12,737,353.00	780200	Lead (Lead waste and scrap)	
8606158	9,709,514.00	-811263	811,263.00	0	-	382549	Organic Solvents (Waste organic solvents other than halogenated waste organic solvents)	
-289818414	662,818,516.00	-135128255	571,790,957.00	-176932429	594,796,403.00	590310	PVC Plastics (Fabric impregnated, coated, covered with pvc plastic)	
214349307	258,017,155.00	-191783719	192,297,255.00	3403450	3,496,550.00	382520	Sewage sludge	
21696308	21,696,308.00	1308665	18,616,895.00	-8627	8,627.00	271091	Waste Oils with Polychlorinated biphenyls (PCBs) (Waste oils cont. polychlorinated biphenyls (PCBs)/polychlorinated terphenyl OR Heavy Oils)	
808102907	815,348,143.00	282242223	359,493,041.00	-39486693	39,486,693.00	271099	Waste oils without PCBs (Waste oils other than those cont. polychlorinated biphenyls (PCBs)/polychlo…)	
771007	771,007.00	-534510	539,606.00	0	-	300680	Waste Pharmaceutical	
130044479	154,457,325.00	-51231500	51,909,232.00	-141795	141,795.00	262011	Zinc (Ash or residues containing hard zinc spelter)	
292306512	499,297,194.00	-134633655	150,368,923.00	-51464787	51,464,787.00	262019	Zinc (Ash or residues containing mainly zinc (not spelter))	
75812126	359,194,334.00	-133655833	568,844,355.00	-89661549	97,785,789.00	790200	Zinc (Zinc waste or scrap)	
2099461543	**10354088377**	**4395362726**	**19738377612**	**-1.453E+09**	**2476823907**		**Total**	

Appendix E: Country Trade Flows

Table A: Imports normalized against total volume

1.0000	Total	0.5479	0.1010	0.0340	0.0339	0.0326	0.0311	0.0304	0.0285	0.0269	0.0265	0.0235	0.0151
Total		China	Germany	Italy	France	Republic of Korea	Singapore	United States of America	Canada	Mexico	China, Hong Kong SAR	Malaysia	Austria
0.2394799	Japan	0.2081	0.0000	0.0000	0.0000	0.0016	0.0262	0.0004	0.0001	-	0.0018	0.0011	0.0000
0.1877973	United States of America	0.1079	0.0038	0.0000	0.0002	0.0110	0.0002	-	0.0270	0.0269	0.0023	0.0002	0.0003
0.0531231	China, Hong Kong SAR	0.0467	0.0000	0.0000	-	0.0021	0.0001	0.0000	-	-	-	0.0040	-
0.0524523	Belgium	0.0281	0.0108	0.0005	0.0096	0.0001	0.0000	0.0000	0.0002	-	0.0002	0.0000	0.0004
0.0484497	Germany	0.0207	-	0.0090	0.0054	0.0009	0.0001	0.0010	0.0000	-	0.0003	0.0000	0.0060
0.0336776	France	0.0121	0.0113	0.0072	-	0.0000	0.0000	0.0003	0.0001	-	0.0000	0.0000	0.0003
0.0324242	United Kingdom of Great Britain and Northern Ireland	0.0137	0.0078	0.0017	0.0019	0.0017	0.0000	0.0006	0.0001	-	0.0002	0.0000	0.0000
0.030759	Netherlands	0.0121	0.0121	0.0003	0.0040	0.0002	0.0000	0.0003	0.0000	-	0.0001	0.0000	0.0001
0.0296526	Canada	0.0109	0.0009	-	0.0000	0.0002	0.0000	0.0173	-	-	0.0003	0.0000	-
0.0262046	Spain	0.0132	0.0038	0.0031	0.0044	0.0004	0.0000	0.0001	0.0004	-	0.0000	-	0.0003
0.0236636	Republic of Korea	0.0199	0.0000	0.0000	0.0000	-	0.0002	0.0002	0.0000	-	0.0030	0.0000	0.0000
0.0226601	Italy	0.0091	0.0064	-	0.0036	0.0000	0.0000	0.0001	0.0000	-	0.0002	0.0001	0.0019
0.0197593	Philippines	0.0004	-	-	-	0.0021	0.0014	0.0000	-	-	0.0004	0.0154	-
0.0191475	China	-	0.0003	0.0001	0.0000	0.0015	0.0002	0.0007	0.0000	-	0.0142	0.0001	0.0000
0.0150446	Australia	0.0136	0.0000	-	-	0.0005	0.0000	0.0000	-	-	0.0003	0.0001	-
0.0120584	Switzerland	0.0000	0.0069	0.0023	0.0008	0.0000	0.0000	0.0000	0.0000	-	0.0000	0.0000	0.0019
0.0111342	Mexico	0.0046	0.0001	-	-	0.0003	-	0.0061	0.0000	-	-	-	-
0.0106101	Sweden	0.0018	0.0016	0.0000	0.0000	0.0000	0.0000	0.0000	0.0002	-	-	-	0.0000
0.0097014	United Arab Emirates	0.0003	0.0001	-	-	0.0007	-	0.0000	-	-	-	0.0003	-
0.0091744	Russian Federation	0.0011	0.0035	0.0001	0.0000	0.0000	-	0.0004	-	-	0.0001	-	0.0002

(Reporters are in the horizontal row, Partner are in the ve rtical column)

Table B: Exports normalized against total volume

1.000	Total	0.194	0.148	0.112	0.088	0.076	0.053	0.050	0.039	0.037	0.033	0.032	0.027
Total		United States of America	Cyprus	Germany	France	China, Hong Kong SAR	United Kingdom of Great Britain and Northern Ireland	China	Italy	Canada	Republic of Korea	Malaysia	Russian Federation
0.337	China	0.112	0.041	0.027	0.005	0.072	0.016	-	0.006	0.007	0.022	0.005	0.002
0.096	India	0.015	0.043	0.006	0.003	0.000	0.008	0.007	0.002	0.000	0.000	0.003	0.000
0.070	Belgium	0.004	-	0.021	0.033	-	0.005	0.000	0.003	0.000	0.000	0.000	-
0.065	Germany	0.005	0.006	-	0.015	0.000	0.009	0.000	0.007	0.000	0.000	0.000	0.002
0.048	Republic of Korea	0.012	0.025	0.001	0.000	0.002	0.001	0.002	0.000	0.000	-	0.001	0.000
0.034	United States of America	-	-	0.001	0.000	0.000	0.001	0.001	0.000	0.028	0.001	0.000	0.000
0.033	Netherlands	0.006	-	0.018	0.004	-	0.001	0.000	0.000	-	0.000	-	0.002
0.030	China, Hong Kong SAR	0.003	0.004	0.001	0.000	-	0.001	0.012	0.000	0.001	0.005	0.000	-
0.030	Italy	0.000	-	0.010	0.009	0.000	0.001	0.001	-	-	0.000	-	-
0.027	Japan	0.005	-	0.000	0.000	0.001	0.000	0.002	0.000	0.000	0.002	0.012	0.000
0.022	Canada	0.022	-	0.000	0.000	0.000	0.000	0.000	0.000	-	0.000	-	0.000
0.017	Spain	0.000	-	0.001	0.012	0.000	0.001	0.000	0.002	0.000	0.000	-	-
0.017	Sri Lanka	0.000	0.015	-	-	0.000	0.000	0.000	-	-	0.000	0.000	-
0.016	France	0.001	-	0.005	-	0.000	0.002	0.000	0.005	0.000	0.000	-	-
0.015	Austria	0.000	-	0.007	0.000	0.000	0.000	0.000	0.004	-	0.000	-	0.000
0.012	Pakistan	0.000	0.009	0.000	0.000	0.000	0.002	0.000	0.000	-	0.000	0.000	-
0.011	Viet Nam	0.000	-	-	0.000	0.000	-	0.000	0.000	-	0.000	0.000	0.010
0.009	United Kingdom of Great Britain and Northern Ireland	0.001	0.001	0.001	0.001	0.000	-	0.001	0.000	0.000	0.000	-	0.000
0.009	Kazakhstan	-	-	0.000	-	-	-	-	-	-	-	-	0.009
0.008	Malaysia	0.001	-	0.000	-	0.000	0.000	0.002	-	-	0.000	-	-

(Reporters are in the horizontal row, Partner are in the vertical column)

Table C: Exports normalized by country in column

363.0000	Total	21.000	19.000	19.000	18.000	18.000	18.000	17.000	15.000	14.000	13.000	13.000	12.000
Total		France	Italy	United States of America	Germany	Austria	Switzerland	United Kingdom of Great Britain and Northern Ireland	South Africa	Canada	Singapore	China	Republic of Korea
35.32352042	Germany	3.955	2.572	0.382	-	7.256	8.208	0.869	0.350	0.012	0.018	0.045	0.001
33.48081849	China	0.426	1.516	3.563	1.369	0.046	0.102	2.373	0.289	1.339	0.372	-	4.733
26.29900893	India	0.297	0.501	2.159	0.282	-	0.199	1.252	2.236	0.050	3.198	0.397	0.009
22.04449312	Belgium	7.758	1.429	0.493	4.787	1.098	1.499	0.695	0.272	0.426	-	0.029	0.001
20.75360207	United States of America	0.567	0.267	-	1.283	0.010	0.475	3.009	0.317	10.703	0.234	0.892	0.120
14.29002015	Italy	1.471	-	0.011	0.889	1.981	2.663	0.335	0.002	-	0.056	0.164	0.000
13.75997885	United Kingdom of Great Britain and Northern Ireland	0.607	1.321	0.342	0.147	0.027	0.073	-	0.334	0.084	0.022	0.240	0.002
11.83131328	France	-	2.379	0.075	1.687	0.002	2.621	1.415	-	0.001	0.108	0.018	0.001
11.77685964	Japan	0.093	0.031	2.496	0.046	0.011	0.005	0.212	0.009	0.476	0.525	2.102	3.969
8.720571852	Netherlands	0.458	1.197	0.731	1.968	0.210	0.373	0.404	0.015	-	-	0.181	0.108
8.503560477	Spain	1.495	1.427	0.004	0.379	0.014	0.645	0.840	-	0.001	0.209	0.058	0.000
8.240475079	Malaysia	-	-	0.099	0.000	-	-	0.085	0.259	-	5.643	0.193	0.009
7.635261699	Austria	0.082	0.819	0.017	0.978	-	0.839	0.024	-	-	0.011	0.000	0.000
7.378837226	Turkey	0.035	0.016	0.000	0.057	-	0.006	0.093	0.890	-	0.006	0.039	0.154
7.138214833	Canada	0.050	0.020	5.865	0.079	-	-	0.061	-	-	0.016	0.021	0.010
7.057189348	Republic of Korea	0.022	0.055	0.491	0.065	-	0.002	1.065	0.306	0.007	0.102	3.607	-
6.121054338	Russian Federation	0.014	0.028	-	0.014	0.003	0.000	0.054	-	-	-	0.071	0.783
5.814866036	Hungary	0.029	0.036	-	0.069	3.167	0.002	0.045	-	-	0.025	0.000	-
5.798266229	Singapore	0.032	0.001	0.062	0.022	-	0.074	0.027	0.057	-	-	0.248	0.058
5.163457275	China, Hong Kong SAR	0.011	0.022	0.080	0.013	0.008	-	0.280	0.023	0.107	0.356	0.783	0.450

(Reporters are in the horizontal row, Partner are in the vertical column)

Table D: Imports normalized by country in column

468.000	Total	23.0000	21.0000	21.0000	21.0000	20.0000	17.0000	17.0000	16.0000	15.0000	14.0000	14.0000	14.0000	13.0000
Total		Canada	France	Austria	Germany	Italy	United States of America	United Kingdom of Great Britain and Northern Ireland	South Africa	Republic of Korea	Finland	Ireland	Singapore	Norway
69.462491	Germany	0.147	7.983	7.152	-	6.020	2.561	4.987	1.967	0.599	3.564	0.445	0.200	1.492
55.075156	United States of America	19.601	1.293	0.102	1.354	1.200	-	1.447	0.991	4.491	0.435	0.254	3.365	1.068
28.750046	China	0.326	0.492	0.052	0.107	0.612	1.361	0.684	1.162	3.210	0.015	0.016	0.776	0.483
28.415264	United Kingdom of Great Britain and Northern Ireland	0.112	1.015	0.334	1.392	1.463	0.376	-	0.593	0.275	0.540	10.022	1.252	1.455
21.196774	France	0.325	-	0.331	1.669	3.854	0.329	0.566	0.366	0.137	0.618	0.927	0.016	0.023
18.16067	Belgium	0.452	4.295	0.520	2.884	0.773	0.136	0.283	0.002	0.018	0.731	1.537	0.003	1.283
16.516270	Italy	0.014	1.509	0.858	0.806	-	0.029	0.299	0.147	0.014	0.118	0.495	0.106	0.044
16.332269	Russian Federation	-	0.322	0.065	1.344	0.005	0.296	0.006	-	0.079	0.560	-	-	-
16.038443	India	0.047	0.039	-	0.165	0.177	0.276	0.031	1.330	0.105	-	-	0.919	-
15.323963	Netherlands	0.080	1.693	0.171	2.222	1.562	0.808	2.082	0.235	0.008	0.008	0.072	0.199	0.100
14.739858	Japan	0.506	0.021	0.004	0.047	0.000	1.268	1.151	0.031	2.881	-	-	1.398	-
12.081556	Singapore	0.016	0.063	0.037	0.001	0.038	0.095	0.013	-	0.140	-	-	-	-
11.766349	Czech Republic	-	-	1.074	1.753	0.074	-	0.021	0.274	-	-	-	0.000	-
8.9920572	Spain	0.235	1.179	0.694	0.187	1.699	0.194	0.264	0.045	0.013	0.013	0.147	0.103	0.007
8.7159895	Sweden	0.083	0.001	0.014	0.049	0.000	0.002	0.626	-	1.000	2.628	-	0.001	4.028
6.6217214	Canada	-	0.025	-	0.201	-	5.528	0.150	0.105	0.009	-	0.000	0.000	-
6.0920976	Australia	-	-	-	0.003	-	0.656	0.001	0.036	0.051	-	-	0.036	-
6.0574590	Switzerland	0.002	0.423	2.059	1.687	0.482	0.030	0.017	-	0.009	0.021	-	0.009	-
5.5650357	Malaysia	-	-	-	0.001	-	0.003	-	0.005	0.217	-	-	3.513	-
4.4666862	Hungary	-	0.023	3.654	0.101	0.130	0.037	0.003	-	-	0.013	-	-	-

(Reporters are in the horizontal row, Partner are in the vertical column)

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