Export of e-waste

Source: Greenpeace, Basel Action Network
Chapter-III

Global laws on e-waste management

3.1. The international experience

At global level, in last two decades many international conventions have been signed amongst many member countries on the subject of Hazardous Wastes as a whole. But on the subject of e-waste alone WEEE Directive established by European Union is the only exhaustive and exclusive source of guidelines, principles on e-waste management. In addition to this, others conventions are also important because these conventions also include concept of e-waste as a part of hazardous wastes.

3.1.1. The Basel Convention

The Basel Convention on the Control of Transboundary Movements of Perilous Wastes and their Clearance is the mainly comprehensive global ecological agreement on perilous and other wastes. It was signed by 173 nations on 22 March 1989 and entered into force on 5 May 1992. It was basically created to prevent the economically motivated dumping of perilous wastes from richer to poor nations, which had resulted from a tightening of ecological regulations and a steep rise in the outlay of perilous waste clearance in industrialized nations. In the first decade (1989-1999), the Convention was primarily devoted to three agenda: 50

1. Setting up a framework for controlling the ‘cross-border’ movement of perilous wastes, that is, the movement of perilous wastes across international frontiers;

2. Developing the criteria for ‘Ecologically Sound Management’ (ESM); and
3. Putting into place a ‘control system’ based on prior written notification.

The 1999 Ministerial Declaration adopted at the Fifth Conference of the Parties (COP-5) set out the agenda for the last decade (2000-2010), laying special emphasis on two areas:
1. Building on the cross-border framework by emphasizing full execution and enforcement of treaty commitments;
2. Minimization of perilous waste generation.

It was on the 10th Anniversary of the Basel Convention on Hazardous Wastes in December 1999 that the Government Ministers assembled in Basel, Switzerland adopted a declaration on the ecologically effective management of perilous wastes. The declaration which emphasized the urgent need to reduce the generation of perilous wastes, both in terms of extent and hazardousness, represented a foremost shift toward cleaner production and capacity building and strengthening predominantly in the emerging nations. In view of that, the declaration sought to guide the actions of the Convention in precise areas, as follows:51

1. Active promotion and use of cleaner technologies and production methods;
2. Further reduction of the movement of perilous and other wastes; the prevention and monitoring of unlawful traffic;
3. Improvement of institutional and technical capabilities in the course of know-how when appropriate predominantly for emerging nations and nations with economies in transition;

4. Further development of regional and sub regional centers for training and know-how transfer; and
5. Enhancement of information exchange, education and awareness-raising in all sectors of society

3.1.1.1. Compliance and Implementation

The Basel Convention contains precise provisions for the monitoring of its execution and compliance. A number of articles in the Convention oblige the Parties to take appropriate measures to implement and enforce its provisions, together with measures to prevent and punish conduct that breach the Convention.

3.1.1.2. Scheme to control the movement of perilous waste

One of the guiding principles of the Basel Convention is that, in order to minimize the impending threat to human health and environment, perilous wastes should be dealt with as nearly as possible where they are produced. Consequently, under the Convention, cross-border movements of perilous wastes or other wastes can take place only upon prior written notification by the State of trade out to the competent authorities of the State of trade in and transit. Each shipment of perilous waste or other waste must be accompanied by a movement document from the point at which a cross-border movement begins to the point of clearance. Perilous waste shipments made without such documents are, consequently, unlawful.

3.1.1.3. Technical assistance offered by the convention

In order to assist nations as well as interested organizations and private companies etc. to manage or dispose of their wastes in an ecologically effective way, the Secretariat of the Basel Convention cooperates with Indian authorities in emerging Indian law, setting up inventories of perilous wastes, strengthening Indian institutions, assessing the perilous waste management situation, and
preparing perilous waste management plans and guiding principle tools. It also provides legal and technical advice to nations in order to solve precise problems related to the control and management of perilous wastes.

3.1.1.4. Training in the management and minimization of perilous wastes

An integral part of implementing the Basel Convention is building the capability to manage and dispose off perilous waste. To this end, the Basel Convention has established Regional Centers for Training and Technology Transfer in several nations which include China, India and Indonesia in Asia. The Centers facilitate guidance on technical and technological issues as well as advice on enforcement aspects of the Convention. They also encourage the introduction of cleaner production technologies and the use of ecologically effective waste management practices.

3.1.1.5. Other important highlights of the Basel Convention

After coming into force, there have been several important milestones in the history of the Basel Convention, which briefly includes the 1995 Ban Amendment, which called for prohibiting exports of perilous wastes for any purpose from nations listed in a proposed latest Annexure VII to the Convention i.e. Parties that are members of the European Union (EU), OECD (Organization for Economic Co-operation and Development) and Liechtenstein to all other Parties to the Convention. The Ban Amendment has not yet entered into force as it has to be ratified by three fourths of the Parties who accepted it. As of now, it is considered to be morally binding. India has neither ratified the original Basel Convention nor the Basel Ban Amendment.

Classification and characterizations of wastes by the technical working group of the Basel Convention in 1998 into precise lists of perilous or non-perilous wastes were adopted by the Parties to the Convention, thereby clarifying the scope of the Convention.
The Protocol on Liability and Compensation was adopted in December 1999. This established rules on liability and compensation for damages caused by accidental spills of perilous waste during trade out or trade in or clearance.

The Compliance Mechanism was adopted at the Sixth Conference of Parties (COP6) in December 2002. This promoted the identification, as early as possible, of execution and compliance difficulties encountered by Parties such as dealing with unlawful traffic or meeting reporting obligations.

The Ministerial Statement on ‘Partnerships for Meeting the Global Waste Challenge’ was adopted at the Seventh Conference of Parties (COP7) in 2004. This called for the reduction of the impacts of perilous wastes on human health and the environment and promoted a fundamental shift in emphasis from remedial measures to preventive measures such as reduction at source, reuse, remanufacturing and resurgence.

The Eighth Conference of the Parties (COP8) on Basel Convention was adopted in Nairobi in November 2006. This convened a high-phase “Global Forum on E-wastes”.

A latest 10 year vision unveiled at the Seventh Session of the Open-ended Working Group (OEWG 7) of the Basel Convention on 14 May 2010. This laid greater emphasis on highlighting the couples between waste management, the achievement of the Millennium Development Goals and human health and livelihoods.

Developing global remanufacturing guidelines for used computers and support for furthering the objectives of the Ban Amendment to the Convention which prohibits the trade out of perilous waste from developed nations to emerging nations was one of the key outcomes of the Convention.  

Achim Steiner, Executive Director of the UNEP, under whose auspices the Basel Convention was adopted, has been quoted earlier saying that:

“Like the climate change treaties, the Basel Convention promoters clean technologies and methods that minimize unwanted by-goods. It provides the tools and incentives we need to both empower and motivate the manufacturers and end-users of goods that generate perilous wastes to pursue innovative solutions. In this way, the Convention also advances sustainable development and the UN’s Millennium Development Goals.”

An overview of the Basel Convention indicates that any nation exporting perilous wastes must obtain the prior permission of the importing nation. Besides, a permit detailing the contents and destination of the wastes must accompany the cargo throughout its voyage. In other words, the Convention mandates the exporting nation to notify the importing nations of the incoming perilous waste. In the case of an unlawful trade, the liable exporter is obliged to take-back the wastes and pay the outlay of damage and clean up. Initially, the Basel Convention had not highlighted the issue of e-waste even there were rules for remanufacturing and trade out of perilous wastes from developed nations to the emerging nations. The Global Forum on E-wastes held at Nairobi had finally brought the issue into primary focus. It was acknowledged in the Conference that 20 to 50 million metric tonnes of e-waste were generated world-wide every year, comprising more than 5 percent of all municipal solid waste. When the millions of computers purchased around the globe every year become obsolete, they leave behind a huge extent of lead, cadmium, mercury and other perilous wastes. The Forum, consequently, underlined the fact that the global consumer goods revolution. In addition to its various benefits, was generating massive quantities of end-of-life computers and other obsolete electronic equipments detrimental to public health and environment.

In fact, to reiterate a few figures, in the United States of America alone, 14 to 20 million PCs are thrown out every year. In the European Union (EU), the volume of e-waste is expected to increase by 3 to 5 percent a year. Developing nations are expected to quadruple their output of e-waste by 2015. Similarly, the use and clearance of mobile phones, which similar to PCs barely existed 20 years ago is increasing considerably. In fact, the use of mobile phones has grown exponentially. By 1970s, there were handfuls of users. It went up to 1.76 billion by 2004 and by 2008 the numbers stood at 3 billion. Even if, it is noteworthy that in 2002, during the Sixth Conference of the Basel Convention, leading cell phone manufacturers collaborated and launched the Mobile Phone Partnership Initiative (MPPI) to develop and promote the ecologically effective management of end-of-life mobile phones.\(^{54}\)

Keeping in view the latest waste streams that are consecutively created with latest technological developments, the Parties to the Basel Convention, have further endorsed the expansion of the technical guidelines on the ecologically effective management of mercury wastes. Mercury can be released from a number of goods that contain mercury, together with electrical applications (like switches and fluorescent lamps), laboratory and medical instruments (like clinical thermometers and barometers), batteries etc. The exposure to which has been found to leave a detrimental impact on health. With the renewed interest in the ecologically effective management of cross-border movement of waste, the UNEP prearranged the first negotiating session of the Inter-Governmental Negotiating Committee (INC 1) on a Globally Legally Binding Instrument on Mercury in Stockholm, Sweden from 7-11 June 2010.\(^ {55}\)


\(^{55}\) “First Session of the Inter-Governmental Negotiating Committee to prepare a global legally binding instrument on Mercury”, (Jun. 7-11, 2010) IISD Reporting Services, Earth Negotiations Bulletin, Vol. 28, No.1 (June 7, 2010)
3.1.2. The Rotterdam Convention

Like the Bamako Convention, the Rotterdam Convention on the Prior Informed Consent (PIC) Procedure for Certain Chemicals and Pesticides in International Trade regulates trade in perilous wastes except contains no commitment to reduce their use and release. Adopted in September 1998, the Rotterdam Convention came into force in February 2004. As of July 2007, it had 73 signatories and 117 Parties. As on date there are 140 parties. India had acceded to the convention on 24 May 2005. It is a multilateral treaty to promote shared responsibilities between exporting and importing nations in protecting human health and environment from the detrimental effects of perilous chemicals. The Convention promotes exchange of information among Parties over a broad range of potentially perilous chemicals that may be exported or trade-in. A key goal is to facilitate technical assistance for emerging nations and nations with economies in transition to develop the infrastructure and capacity necessary to implement the provisions of the Convention.56

The Rotterdam Convention calls on exporters of perilous chemicals to use appropriate labeling include directions on safe handling and inform purchasers regarding known restrictions or bans. Parties can decide whether to allow or ban the trade-in of chemicals listed in the treaty. nations exporting chemicals are obliged to make sure that manufacturers inside their jurisdiction comply with the directions and rules.

The Parties have nine months to prepare a response concerning the future trade-in of the chemical. The response can consist of either a final decision to allow trade-in of the chemical, not to allow trade-in or to allow trade-in subject to specified conditions or an interim response. Decisions by an importing nation must be trade neutral. This applies equally to domestic production for domestic use as well as to imports from any source. The Convention requires each Party to

notify the Secretariat, provided jointly by the FAO and UNEP, when taking a
domestic regulatory action to ban or severely restrict a chemical.\textsuperscript{57}

Apart from the principle of Prior Informed Consent (PIC), the Rotterdam
Convention highlights another principle of the Basel Convention which deals with
transparency and Ecologically Sound Management (ESM) of perilous
compounds. Among the 40 chemical compounds covered under the Convention,
mercury compounds, polybrominated biphenyls (PBB), polychlorinated biphenyls
(PCB) are also compounds that are found in e-waste.

\subsection*{3.1.3. The Bamako Convention}

The Bamako Convention or the Bamako Convention on the Ban of the
Import into Africa and the Control of Transboundary Movement of Perilous
Wastes was adopted by the twelve nations of the Organization of African Unity at
Bamako, Mali in January 1991 and came into force in March 1999.\textsuperscript{58}

The Convention aims to protect human health and environment from
dangers posed by perilous wastes by reducing their generation to a minimum in
terms of extent or perilous impending. All Parties are obliged to prohibit the
trade-in of all perilous wastes, for any reason, into Africa from non-Contracting
Parties (article 4.1). The categories of wastes listed in Annex-I to the Bamako
Convention, a waste possessing any of the characteristics listed in Annex II to the
Bamako Convention, as well as any waste considered to be perilous by the
domestic laws of either the state of trade-in, trade-out or transit are considered
perilous wastes for the purposes of the Bamako Convention. It is clear from the
provisions of the Bamako Convention that the dumping of radioactive wastes,
industrial wastes, sewage and sewage sludge is prohibited. The Bamako
Convention places the duty on the Parties to monitor their respective Waterways

\textsuperscript{57} “The Rotterdam Convention”, Simultaneous Extra-ordinary Meetings of the Conferences of the
Parties to the Basel, Rotterdam and Stockholm Conventions, Bali-Indonesia, (Feb. 22-24, 2010)
\textsuperscript{58} “Bamako Convention”, International Maritime Org., (Dec. 9, 2005)
to make sure that no dumping occurs. Each State Party has to report annually to the Secretariat.

The need to sign the Bamako Convention arose from the failure of the Basel Convention to prohibit trade of perilous waste to the less developed nations and from the realization that various developed nations were exporting noxious wastes to Africa. This impression was strengthened by several prominent cases. One important case, which occurred in 1987, concerned the trade in of 18,000 barrels of perilous waste into Nigeria from the Italian companies Ecomar and Jelly Wax, which agreed to pay local farmer Sunday Nana 100 US dollars per month for storage. The barrels, found in storage in the port of Lagos, contained noxious waste together with polychlorinated biphenyls. Their eventual shipment back to Italy led to protests closing three Italian ports.

This differentiates the Bamako Convention from the Basel Convention because the former uses a format and language similar to that of the Basel Convention, except which is much stronger in prohibiting all imports of perilous waste. Additionally, it does not make exceptions on certain perilous wastes similar to those for radioactive resources made by the Basel Convention.

3.1.4. Waste Electrical and Electronic Equipment (WEEE) Directives in European Union

Among all the existing laws on wastes, a way forward has been heralded by the European Union. The European law which implements the Basel Convention in its Directives prohibits all exports of perilous wastes from the European Union (EU) members to the emerging nations.59


59 “UNEP Responds to Abidjan Perilous Wastes Crisis”, Geneva (Sept. 8, 2006)
assortment, remanufacturing and resurgence targets for all types of electrical and electronic goods. The WEEE Directive obliged the twenty five European Union (EU) member states to transpose its provisions in to Indian law by 13 August 2004.

By August 2005, all member states except Malta and the UK had transposed at least framework regulations. In May 2001, the European Union (EU) Parliament approved a directive that requisite manufacturers of electronic gazettes to take liability financial and otherwise for the resurgence and remanufacturing of e-waste. Recognizing the scope and urgency of e-waste problem, the European Union has taken the lead in addressing it by proposing an ambitious system of the Extended Producer Responsibility (EPR). The EPR has been defined as:

“an ecological protection strategy to reach an ecological objective of a decreased total impact from a artifact, by making the manufacturer of the artifact liable for the entire life cycle of the artifact and predominantly for the take-back, remanufacturing and final clearance of the artifact.”

3.1.4.1. Obligations of the producer under the WEEE

The WEEE Directive imposes mainly the obligations on the manufacturer of the electrical and electronic equipment (EEE). Article 4 of the WEEE Directive requires the manufacturer to plan the goods in such a way that will facilitate dismantling and resurgence. In addition, the manufacturer is required not to prevent, in the course of precise plan features or manufacturing methods, the e-waste from being reused except it is compromising the environment and safety requirements. Under Article 5(3), the manufacturer is obliged to collect waste electrical and electronic tool at its end-of-life. The handling of the EEE (Electrical and Electronic Equipment), when handed over to a facility for disassembly,

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shredding, resurgence or preparation for clearance has to be the ‘best available handling’. This includes the removal of all fluids and in accordance with Annexure-II to the WEEE Directive. The removal of certain compounds, consumables and elements from any separately collected WEEE. Article 7(1) obliges the manufacturers to set up a resurgence system either individually or by joining a collective system. The liability for assortment, resurgence and the financing thereof are governed by two parameters. If an artifact or so-called ‘historical waste’ was put on the market on or before 13 August 2005, then the artifact is a industry-to-end-user (B2C) artifact and the liability has to be borne by the manufacturer according to his market share. While the user has to take care of an industry-to-industry (B2B) artifact. If the artifact was put on the market after the date, then the manufacturer is liable for his individual waste artifact. Finally, Article 12(1) requires the member states to draw up a register of manufacturers. The manufacturers of the EEE (Electrical and Electronic Equipment) have to register in the India where they are based and have to report in the registers the sales volume and the volume of collected and recovered goods.

3.1.4.2. Restriction of Hazardous Substances (RoHS) Directives

As a legislative initiative to solve the problem of huge amounts of noxious e-waste, a Directive on the restriction of the use of certain perilous compounds in electrical and electronic tool, namely 2002/95/EC, commonly referred to as the Restriction of Hazardous Substances Directive or RoHS was adopted in February 2003 by the European Union. The RoHS Directive came into force with effect from 1 July 2006 and is requisite to be enforced and become law in each member state. The Directive restricts the use of six perilous resources in the manufacture of various types of electronic and electrical tool.

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In order to prevent the generation of perilous waste, the RoHS Directive requires the substitution of various heavy metals, namely lead, mercury, cadmium, hexavalent chromium and brominated flame retardants similar to polybrominated biphenyls (PBB) or poly-brominated diphenyl ethers (PBDE) in latest electrical and electronic equipments put on the market since 1 July 2006.

In brief, the WEEE Directive obliges a manufacturer of electronic tool to be liable for the artifact at its end-of-life. The RoHS Directive takes a step further by requiring manufacturers to phase out the use of perilous compounds in the production of electrical and electronics equipment by 2008.63

3.1.4.3. Communication on the use of the Precautionary Principle

On 2 February 2000, the European Commission adopted the communication on the use of the precautionary Principle as a central tenet of its guiding principle. This Principle would form part of a structured approach to the analysis of risk as well as risk management. It is first and foremost aimed at building a common understanding of how to assess, appraise, manage and communicate risks which science is not yet able to evaluate fully and at the same time, avoid unwarranted recourse to the precautionary principle as a disguised form of protectionism.64 Application of this Principle would help prevent the use of a few high risk goods in electrical and electronic tools to a few extents.

3.1.4.4. Comparative e-waste management in Switzerland and India

Framing of regulations and their execution is an important aspect of the e-waste remanufacturing. An example of the role of regulations related to the e-waste management in the context of a developed and an emerging India has been reported in a comparative e-waste case study of Switzerland and India.

63 The Basel Action Network (BAN) and Silicon Valley Toxics Coalition (SVTC), Exporting Harm: The High-Tech Thrashing of Asia (Feb. 25, 2002)
Switzerland is one of the main technologically advanced nations with one of the highest per capita income in the world. As per 2004 estimates, it has an installed base of 3.15 million computers, with 99 percent household having refrigerators and 96 percent households having TVs. Switzerland ranks seventh on the 2005 Ecological Sustainability Index and has a score of 1.39 for ecological governance. It is the first nation in the world with established formal WEEE/E-waste management system, where first law on E-waste management was introduced in 1998. This law is based on the principle of the Extended Producer Responsibility (EPR).

India is one of the best ever growing economies across the globe, where the penetration of end-user durables is substantially lower than that of the developed nations. Besides, India is experiencing exponential increase in require since the last decade. It ranks 101st on the 2005 Ecological Sustainability Index and has a score of 0.10 (66th Rank) for ecological governance. E-waste is partially covered under the existing ecological regulations, except these do not stipulate the management and handling of e-waste generated inside the India.

In Switzerland, there is control at every phase or phase of the e-waste trade. In India, control is virtually non-existent. Even, existing ecological regulations partially control e-waste trade till the phase of the EEE (Electrical and Electronic Equipment) manufacturers and importers. This difference gets reflected in low ecological governance score. It also reflects that e-waste gets recycled in an unregulated manner in the unorganized segment which leads to uncontrolled emissions into the environment. At the same time, it gives a diverse socio-financial and occupational health and safety dimension to the e-waste trade.

3.1.5. The Nairobi Declaration

Member nations to the Basel Convention were agreed in Nairobi, Kenya on the issue of e-waste and declared that every member country will promote awareness at all stages on the issue of e-waste, challenges and solutions. They
will encourage and promote the exchange of information and transfer of best available technologies for the ecologically effective management of e-waste from developed nations to emerging nations and nations with economies in transition. The primary aim and objective of the declaration is to give effect to the declaration, promote clean know-how and green plan for e-goods, together with the phase out of perilous compounds used in production and included in elements and artifact stewardship and extended manufacturers responsibilities in the life cycle management of electronic and electrical goods. The Basel Convention is the primary global instrument for guiding the ecologically effective management of perilous e-waste and that its provisions need to be fully respected. The problem of unlawful traffic in e-waste is a stern concern that requires urgent action in the context of the execution of the Basel Convention. Member nations will encourage regional and global comprehensive actions for the ecologically effective management of e-waste and end-of-life equipments in the course of shared responsibilities and commitments from all concerned stakeholders. Member nations were agreed to promote integrated waste management in order to reduce the harm caused by the perilous elements contained in e-waste by ensuring appropriate assortment of end-of-life tool and its separation from household or municipal waste. To achieve this in the course of cooperation with municipalities, non-governmental organizations and the full participation of the general public is also required. Regarding question of e-waste management, members were agreed to improve waste management controls in the course of the establishment of robust Indian policies, law and diligent enforcement, together with manufacturers and traders responsibilities as well as take-back and remanufacturing schemes and their targets. Preventing and combating unlawful traffic of e-wastes was taken into account in the course of harmonization of national laws at the regional phase.

A strategic partnership was initiated inside the context of the Basel Convention targeting e-waste with a view to improving the ecologically effective management of e-goods globally. To develop and consolidate national, regional
and international cooperation and programmes or initiatives to support the execution of actions aimed at the ecologically effective management of e-waste utilizing, as appropriate, the Basel Convention regional centers was one of the agenda of the declaration.65

3.1.6. PACE (The Partnership for Action on Computing Equipment) 2011

The Partnership for Action on Computing Tool (PACE) is a multi-stakeholder partnership established to address the ecologically effective management of used and end-of-life computing equipments. The multi-stakeholder Working Group, comprised of representatives of personal computer manufacturers, remanufacturers, international organizations, academia, ecological groups and governments developed the proposed scope of work, terms of reference, financial arrangements and structure of PACE. The Partnership was launched at the ninth meeting of the Conference of the Parties (COP 9) to the Basel Convention, which took place in Bali, Indonesia in June, 2008.

PACE Working Group continues to seek a balanced and diverse partnership and welcomes latest members with special expertise, predominantly original tool manufacturer, refurbisher, recycler, as well as academia, ecological groups, international organizations and governments.

PACE intends to create sustainable commercial practices with financial and ecological benefits to all participants and in particular to emerging nations and nations with economies in transition. It provides a forum for governments, industry leaders, non-governmental organizations and academia to improve the current management of used and end-of-life computing tool in the course of the development of global refurbishment and material resurgence or remanufacturing guidelines on the ecologically effective management of computing tool. Furthermore, PACE offers following opportunities for stakeholders:

65 UNEP/CHW8/CRP24, (Dec. 1, 2006)
- To discuss and develop innovative practical approaches that would uphold the triple bottom line of social, ecological and financial advancement;
- To influence decision making in various nations on approaches to be taken to manage used and end-of-life computing tool, as over 175 (as of June 2011) nations are Parties to the Basel Convention;
- To assist in building capacity in emerging nations and nations with economies in transition; and
- To forge latest alliances and offer immense networking opportunities.

The Partnership on used and end-of-life computing tool aims to facilitate latest and innovative approaches for addressing emerging issues. It also aims to:
- Promote sustainable development in the course of efforts to repair, refurbish and reuse computing tool world-wide;
- Find incentives and methods to divert end-of-life personal computers from land clearance and burning into ecologically effective commercial material resurgence or remanufacturing operations;
- Develop technical guidelines for appropriate repair, refurbishing and material resurgence or remanufacturing, cross-border movement of used and end-of-life computing tool, together with criteria for testing, labeling of refurbished used tool and certification of ecologically effective repair, refurbishing and remanufacturing services; and
- End shipment of used and end-of-life computing tool to nations, in particular emerging nations and nations with economies in transition, which are unlawful to trade in under their domestic laws.

PACE actions will also include pilot demonstration projects to assist emerging nations and nations with economies in transition in assessing the current situation of used and end-of-life computing tool in their nations and to achieve the Partnership and the Basel Convention objectives.
3.2. E-waste management in United States of America

Use of electronic goods has grown substantially over the past two decades, changing the way and the speed in which we communicate and how we get information and entertainment. According to the Consumer Electronics Association (CEA), Americans now own approximately 24 electronic goods per household.\textsuperscript{66}

For each latest artifact that comes along, one or extra becomes outdated or obsolete. Consequently, we are storing or discarding older electronic goods faster than ever. In 1998, studies estimate regarding 20 million computers became obsolete in one year. In 2005, the Environmental Protection Agency (EPA or the Agency) estimates that around 26-37 million computers became obsolete. According to Consumer Electronics Association (CEA) estimates, it was projected that 304 million electronics devices like computers, TVs, VCRs, cell phones and monitors were removed from United States of America households in 2005, with regarding two thirds of those still in working order.

3.2.1. E-waste management model in the United States

Even used electronics represent less than two percent of the municipal solid waste stream, if we continue to replace old or outdated electronic tool at our current rate that percentage will probably grow. In 2005, used or unwanted electronics amounted to approximately 1.9 to 2.2 million tonnes. Out of that, regarding 1.5 to 1.8 million tonnes were primarily disposed off in landfills and only 0.345-0.379 million tonnes were recycled.

Recognizing the need to find better end-of-life management for these goods, EPA has been working with stakeholders to help improve awareness of the need for resurgence of electronics and access to safe reuse and remanufacturing options. State and local governments, manufacturers and retailers, who are

\textsuperscript{66} Consumer Electronics Association Market Research Report: Trends in CE Reuse, Recycle and Removal (April, 2008)
already aware of the pressing need to better manage these resources, are providing extra opportunities to recycle and reuse this tool. Seven states have banned many electronics from landfills and four states have instituted resurgence programmes. Many other states are considering a sort of law to manage used electronics. Over 800 communities have instituted electronics assortment events to manage obsolete electronics from households. Many computer manufacturers, TV manufacturers and electronics retailers offer a few kinds of take-back programme or sponsor remanufacturing events.

3.2.2. Key findings on the management of select electronic items in the United States of America in 2014

In an effort to get a better understanding of the scope of the issue, the Agency is providing a snapshot of electronics management and waste generation in the United States in recent years. As goods, usage patterns, and management options change, purchase, storage and end-of-life disposition patterns also are probably change.

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<th>Management of Used and End-Of-Life Electronics in 2014</th>
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<tr>
<td></td>
<td>Ready for End-of-Life Management (million of units)</td>
</tr>
<tr>
<td>Computers</td>
<td>47.4</td>
</tr>
<tr>
<td>Televisions</td>
<td>27.2</td>
</tr>
<tr>
<td>Mobile Devices</td>
<td>141</td>
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3.2.3. Artifact lifespan calculation method

A key part of the analysis involves determining the lifespan of the various goods from point of sale to end-of-life management such as remanufacturing, trade out or clearance. Since the lifespan of diverse types of goods vary, artifact-precise lifespan assumptions had to be derived. By combining sales and weight data and applying the lifespan assumptions for each particular artifact, we were able to predict the number and corresponding weight of goods that were ready for end-of-life management each year. Both approaches looked at artifact sales and predicted the annual extent ready for end-of-life management in the course e-waste management.

Two options were used to track the flow of goods from their purchase in the course of use, storage or reuse to disposition for end-of-life management. Approach one, relied on the age distribution of the goods collected by electronic assortment programmes and used that as a proxy for the lifespan of the goods before they reached the end-of-life phase. Approach two, also used the same assortment programme information, except aimed to account for variations in artifact flow that may be due to fluctuations in yearly artifact sales. It also projected by year, the number of goods being stored or reused.

The estimates of the annual number and weight of goods ready for end-of-life management should not be equated with the amount of waste electronics that might actually be collected if there were an assortment infrastructure in place. The end-of-life estimates represent, what is theoretically available for assortment? In practice, even if only a portion of the units available are brought to an assortment point.

3.2.4. US Policy and Law on e-waste management is different from EU WEEE Directives

The U.S. Government and the U.S. manufacturers have claimed that the European Union’s ecological and health protections constitute “unnecessary
barriers to trade, predominantly due to the ban on certain resources, burdensome take-back requirements for end-of-life tool and mandated designs.” United States Environment Protection Agency (EPA) initiated a green National Electronics Action Plan\(^67\) (NEAP) in 2005 in order to address ecological concerns arising out of the entire life cycle of electronics, together with plan, operation, reuse, remanufacturing and clearance of tool. Unlike the European Directives, the NEAP focuses mainly on computers, televisions and cell phones. Instead of emphasizing on the principle of the Extended Producer Responsibility, the EPA places liability for goods on a broader group of entities, together with manufacturers, retailers, users and disposers. The United States of America is involved in a number of initiatives and programmes aimed at reducing e-waste. For instance, the United States of America, Canada and Mexico are the members of the North American Pollution Prevention Partnership, which focuses on clean electronics in North America.

Even if, the United States of America Government has not yet ratified the Basel Convention and the Ban Amendment. There is also no federal law in place prohibiting or regulating e-waste generation, clearance and trade out. Several States in the United States of America such as California, Massachusetts, Maine and Minnesota have taken the initiatives, which have imposed strict and effective regulations on plan, manufacture, reuse, resurgence and clearance of e-waste. California has promulgated the Electronic Waste Remanufacturing Act of 2003, which is considered as landmark law for e-waste regulation and management.\(^68\) Electronic waste in California can neither be disposed off in a landfill nor be exported overseas. Unlike the European Union (EU) regulations, the Californian law establishes the system of shifting the financial burden of remanufacturing of

\(^67\) It is a Resource Conservation Challenge (RCC) 2005 Action Plan and one of the National Priority Areas (Green Initiatives-Electronics) identified by the Environment Protection Agency for the RCC.

e-waste on the end-user. The mainly significant provision of the regulation is the electronic waste remanufacturing fee, which is to be collected at the point of sale of certain goods. The fee ranges from six to ten US dollars.

The Act requires the retailers to remit these fees to the Board of Equalization (BoE). This fee system became effective from 1 January 2005. The law further lays down appropriate and fair procedure for distribution of resurgence and remanufacturing payments to qualified entities, covering the outlay of electronic waste assortment and remanufacturing. It recommends ecologically preferred purchasing criteria for state agency purchases of certain electronic equipment. The California Integrated Waste Management Board (CIWMB) and the Department of Toxic Substances Control (DTSC) have adopted several regulations to implement the Act in the mainly effective manner.

Colorado law requires education programmes that address the electronic waste problem. A law in the state of Washington which took effect in January 2009 requires manufacturers of electronic goods to pay for remanufacturing and establishing a statewide network of assortment points.

The programme, called ‘E-Cycle Washington’ is managed by the Department of Ecology and the Washington Resources & Financing Authority. Till 2008, seventeen States have manufacturer liability laws in a few forms or the other. In all 35 States in the U.S. have or are considering electronic waste remanufacturing laws.

3.2.5. E-waste management legal regime in USA

Electronic waste in the United States is being addressed with regulations at a state and federal phase.

3.2.5.1. Federal level

The United States Congress considers a number of electronic waste bills, together with the National Computer Remanufacturing Act introduced by
Congressman Mike Thompson (D-CA). Meanwhile, the main federal law governing solid waste is the Resource Conservation and Recovery Act of 1976. It covers only CRTs, even if state regulations may differ.\(^69\) There are also separate laws concerning battery clearance. Several trade organizations together with the Consumer Electronics Association are lobbying for the execution of comprehensive federal laws.\(^70\) On 25 March 2009, the House Science and Technology Committee approved funding for research on reducing electronic waste and mitigating ecological impact, regarded by sponsor Ralph Hall (R-TX) as the first federal bill to address electronic waste directly.\(^71\) On 6 July 2009, Senator Amy Klobuchar (D-MN) and Senator Kristen Gillibrand (D-NY) proposed the ‘Electronic Device Remanufacturing Research and Development Act’.\(^72\) Bill S.1397 not only focuses on stopping unlawful e-waste dumping, except it also calls for sustainable plan of electronic equipment as well as offers funding for research and development of added sustainable designs, which would reduce the amount of noxious waste and increase the reuse and remanufacturing of electronic goods.\(^73\)

During Earth Day, 22 April 2009, two bills were passed by the House of Representatives: H.R. 1580 Electronic Device Remanufacturing Research and Development Act, introduced by Rep. Bart Gordon on 18 March 2009\(^74\) and H.R. 957 Green Energy Education Act, introduced by Rep. Michael McCaul (R-TX).\(^75\) H.R. 1580 requires the Administration of Ecological Protection Agency (EPA) to

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\(^69\) “Final Rules on Cathode Ray Tubes and Redundant Mercury-Containing Equipment”, U.S. Ecological Protection Agency
\(^71\) “House Panel Approves Bill to Aid Clearance of Unwanted Electronics”, Congressional Quarterly (Apr. 13, 2012)
\(^72\) Jaymi, “U.S. Senate Considering Bill to Slow the Impacts of e-Waste”, (Discovery Communications, LLC) (Nov. 5, 2013)
\(^73\) Electronic Device Remanufacturing Research and Development Act of 2009, S. 1397, 111th Cong. (2009)
\(^74\) “H.R. 1580: Electronic Waste Research and Development Act”, Legislative Digest (Jul. 6, 2012)
\(^75\) “Ecological Bills”, Speaker Nancy Pelosi (Nov. 28, 2012)
give merit based grants to consortia of universities, government labs and private industries to conduct research with the purpose of finding latest approaches to remanufacturing and reduction of perilous resources in electronic devices and to “contribute to the professional development of scientists, engineers and technicians in the field of electronic device manufacturing, design, refurnishing and remanufacturing.”76 The bill will require the recipients of the grants to report every two years to Congress regarding the advancement of their research, gaps in the advancement, risks and regulatory barriers that might hinder their advancement.77 The Congressional Budget Office estimates that to put the bill in effect “would outlay 10 million dollars in 2010 and 80 million dollars over the 2010-2014 period.”78 The other bills passed, H.R. 957, authorizes the Department of Energy in partnership with the National Science Foundation to facilitate grants to Institutions of higher education to promote education and training for Engineers and Architects “in high energy and high-performance building plan.”  

3.2.5.2. State level

A guiding principle of “diversion from landfill” has driven law in various states requiring higher and higher volumes of electronic waste to be collected and processed to separate from the solid waste stream.

In 2001, Arkansas enacted the Arkansas Computer and Electronic Solid Waste Management Act, which requires that state agencies manage and sell surplus computer equipment, establishes a computer and electronics remanufacturing fund. This also authorizes the Department of Ecological Quality to regulate or ban the clearance of computer and electronic tool in Arkansas landfills.79

78 “Congressional Budget Office Cost Estimate”, Congressional Budget Office (Aug. 9, 2013)
79 Arkansas Computer and Electronic Solid Waste Management Act
California was the first state to legislate around the issue of e-waste. It implemented a broader waste ban, with advance resurgence fee funding in 2003. Electronic waste in California may neither be disposed off in a landfill nor be exported overseas. The 2003 Electronic Waste Remanufacturing Act in California introduced an Electronic Waste Remanufacturing Fee on all latest monitors and televisions sold to cover the outlay of remanufacturing. The fee ranges from six to ten dollars.\footnote{Royte, Elizabeth, “E-gad! Americans discard extra than 100 million computers, cell phones and other electronic devices each year. As “e-waste” piles up, so does concern regarding this growing threat to the environment”, Smithsonian Magazine (Smithsonian Institution) (Apr. 14, 2011)} California went from only a handful of remanufacturers to over 60 inside the state and over 600 assortment sites. The amount of the fee depends on the size of the monitor. It was adjusted on 1 July 2005 in order to match the real outlay of remanufacturing.\footnote{Anderson, Nate (2006) “California to electronics industry: No toxins for you!” (Apr. 5, 2013)} Cell phones are ‘considered perilous waste’ in California. Various chemicals in cell phones leach from landfills into the groundwater system.\footnote{Judkis, Maura (Jul. 30, 2008), “4 Ways to Earn Cash for Remanufacturing”, Fresh Greens, U.S. News and Global Report (Mar. 5, 2008)} Colorado law requires education programmes that address its electronic waste problem.\footnote{Law holds businesses liable for clearance of computers

A law in the state of Washington took effect on 1 January 2009, requiring manufacturers of electronic goods to pay for remanufacturing and establishing a statewide network of assortment points. The programme, called ‘E-Cycle Washington’, is managed by the Department of Ecology and the Washington Resources Management & Financing Authority.\footnote{Ibid.}

On 28 January 2010, Arizona introduced HB 2614, a manufacturer liability law modeled on the Oregon law that would have covered computers, laptops and TV monitors for remanufacturing. But it was withdrawn on 15 February 2010.\footnote{Ibid.}
### Table VII- List of enacted legislation in United States of America

<table>
<thead>
<tr>
<th>Legislation</th>
<th>Date signed into law</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arkansas Computer and Electronic Solid Waste Management Act</td>
<td>2003</td>
<td>Arkansas</td>
</tr>
<tr>
<td>Electronic Waste Remanufacturing Act Cell Phone Take back and Remanufacturing Rechargeable Battery Take back and Remanufacturing</td>
<td>2003</td>
<td>California</td>
</tr>
<tr>
<td>National Computer Remanufacturing Act Cell Phone Take back and Remanufacturing Rechargeable Battery Take back and Remanufacturing</td>
<td>July 2007</td>
<td>Colorado</td>
</tr>
<tr>
<td>CT Electronic Remanufacturing Law</td>
<td>July 2007</td>
<td>Connecticut</td>
</tr>
<tr>
<td>Hawaii Electronic Device Remanufacturing Program</td>
<td>July 2008</td>
<td>Hawaii</td>
</tr>
<tr>
<td>Electronic Goods Remanufacturing and Reuse Act</td>
<td>September 2008</td>
<td>Illinois</td>
</tr>
<tr>
<td>Amendment to Indiana ecological law</td>
<td>May 2009</td>
<td>Indiana</td>
</tr>
<tr>
<td>State/Region</td>
<td>Act/Program</td>
<td>Date</td>
</tr>
<tr>
<td>--------------</td>
<td>------------------------------------------------------------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>Maryland</td>
<td>Statewide Electronics Remanufacturing Program</td>
<td>2005</td>
</tr>
<tr>
<td>Michigan</td>
<td>SB No. 897</td>
<td>May 2007</td>
</tr>
<tr>
<td>Minnesota</td>
<td>Minnesota’s Electronics Remanufacturing Act</td>
<td>December 2008</td>
</tr>
<tr>
<td>Missouri</td>
<td>Manufacturer Responsibility and Consumer Convenience Tool Assortment and Recovery Act</td>
<td>June 2008</td>
</tr>
<tr>
<td>New Jersey</td>
<td>Act No. 394</td>
<td>December 2008</td>
</tr>
<tr>
<td>New York State</td>
<td>Electronic Tool Remanufacturing and Reuse Act (effective from 1 April 2011)</td>
<td>28 May 2010</td>
</tr>
<tr>
<td>New York City</td>
<td>INT 728</td>
<td>April 2008, vetoed, overrode by council May 2008</td>
</tr>
<tr>
<td></td>
<td>H819 (2008 Amendment)</td>
<td></td>
</tr>
<tr>
<td>Oklahoma</td>
<td>Oklahoma Computer Tool Recovery Act</td>
<td>May 2008</td>
</tr>
<tr>
<td>Oregon</td>
<td>House Bill 2626</td>
<td>June 2007</td>
</tr>
<tr>
<td>Rhode Island</td>
<td>Electronic Waste Prevention, Reuse, and Remanufacturing Act</td>
<td>June 2008</td>
</tr>
<tr>
<td></td>
<td>Date</td>
<td>State</td>
</tr>
<tr>
<td>----------------</td>
<td>-----------</td>
<td>----------------</td>
</tr>
<tr>
<td>House Bill 2714</td>
<td>June 2007</td>
<td>Texas</td>
</tr>
<tr>
<td>SB 6428</td>
<td>March 2006</td>
<td>Washington</td>
</tr>
<tr>
<td>SB 746</td>
<td>March 2008</td>
<td>West Virginia</td>
</tr>
<tr>
<td>SB 107</td>
<td>October 2009</td>
<td>Wisconsin</td>
</tr>
</tbody>
</table>

### 3.2.6. Emerging enforcement trends: e-waste cases in US

*U.S. vs. Executive Remanufacturing, Inc., et al.*[^86] is the first-ever guilty verdict in an electronic waste remanufacturing case, which involved a Colorado based e-waste remanufacturing company and two of its executives. A discount computer company in Michigan and its owner were convicted of trafficking in counterfeit goods and services, and violating environmental laws.

In another case in Canada, an e-waste remanufacturing company based in Surrey, British Columbia was charged with unlawful exportation of perilous e-waste. These cases suggest that criminal enforcement authorities in the United States and Canada may be subjecting e-waste management and clearance practices to increased scrutiny.

*Michigan E-waste or U.S. v. Mark Glover and Discount Computers, Inc.*[^87] In October, 2012, Mark J. Glover, the owner of Discount Computers, Inc. (DCI), pleaded guilty to various charges relating to trafficking in counterfeit goods and services, and environmental law violations. Between May 2007 and July 2011, Glover and DCI exported used cathode ray tube (CRT) monitors, which contain perilous compounds to foreign nations, together with Egypt. Egypt, even if, does not allow the trade-in of used CRTs more than five years past the date of...

[^86]: Case 1:11-cr-00376-WJM (D. Colo. 2011)
manufacture. Prosecutors alleged that Glover and DCI created counterfeit labels for the CRTs that concealed the age of the computer monitors and their impending as perilous waste. Throughout this scheme, DCI exported more than 0.1 million CRT monitors, with a projected value of 2 million US dollars, to Egypt. DCI pleaded guilty of violating the Resource Conservation and Recovery Act (RCRA) by failing to obtain a permit to store or dispose perilous compounds. In late March 2013, Glover was sentenced to 30 months in prison and a 10,000 US dollars fine and DCI received a 2 million US dollars fine.

This case was investigated and referred to the United States Attorney’s Office for the Eastern District of Michigan by the U.S. Environmental Protection Agency’s (EPA) Criminal Investigation Division. Cynthia Giles, assistant administrator for EPA’s Office of Enforcement and Compliance Assurance, explained that the sentence:

“It should serve as a warning that if you are caught illegally exporting perilous e-waste for profit, there will be stern consequences.”

This Advisory is intended to be a general summary of the law and does not constitute legal advice. You should consult with counsel to determine applicable legal requirements in a precise fact situation.

In another British Columbia e-waste case, also in late March, Electronics Remanufacturing Canada (ERC), a remanufacturing company based in Surrey, British Columbia with branch offices in Arizona, Colorado, Nevada and Oregon, was charged with 24 counts under Canada’s Environmental Protection Act for illegally exporting recycled batteries and CRTs to Macau (an administrative region of China) between 14 August 2011 and 10 November 2011. ERC’s president also faces charges in connection with the exports. These charges stand in contrast to prior e-waste enforcement actions in Canada that have resulted in relatively small fines.
On the Horizon, these cases, along with the Executive Remanufacturing Inc. case in Colorado, indicate that even if U.S. attempts at comprehensive federal e-waste law have stalled in Congress, federal enforcement officials have not lost interest in enforcing existing e-waste management requirements. These criminal cases may renew legislative focus on the pending House and Senate Bills, expected to be reintroduced this year that would expand the trade-out ban for CRTs to include other categories of e-waste.

In 2006, Canadian authorities fined twenty six companies with illegally exporting scrap metal and plastic to China and Hong Kong. Most of the companies were assessed fines with 2000 US dollars.

### 3.3. E-waste management in UK

The European Union (EU) Waste Framework Directive provides the legislative framework for the assortment, transport, resurgence and clearance of waste and includes a common definition of waste. The directive requires all member states to take the necessary measures to make sure waste is recovered or disposed off without endangering human health or causing harm to the environment. It includes permitting, registration and inspection requirements also.

The directive also requires member states to take appropriate measures to encourage firstly, the prevention or reduction of waste production and its treatment and secondly, the resurgence of waste by means of remanufacturing, re-use or reclamation or any other method with a view to extracting secondary raw resources or the use of waste as a source of energy. The directive’s requirements are supplemented by other directives for precise waste streams.

authorities must collect waste paper, metal, plastic and glass separately. It also imposes a duty on waste assortment authorities, from that date, when making arrangements for the assortment of such waste, to make sure that those arrangements are by way of separate assortment.88

These duties apply where separate assortment is necessary to make sure that waste undergoes resurgence operations in accordance with the directive and to facilitate or improve resurgence and where it is technically, ecologically and economically viable. The duties apply to waste classified as waste from households and waste that is classified as commercial or industrial waste. The amended regulations also replaced regulation 14(2) to reflect the changes to Regulation-13 to make sure a consistent approach.

3.3.1. Environmental permit policy for e-waste

The resurgence and clearance of waste requires a permit under European Union (EU) law with the principal objective of preventing harm to human health and the environment. This law also allows member states to facilitate for exemptions from the need for a permit. It also provides general rules laid down for each type of exempt activity and the operation is registered with the relevant registration authority. We have given effect to the European Union (EU) requirements in the course of the Environmental Permitting (England and Wales) Regulations 2010.

3.3.2. Waste shipment regulations

Waste shipment regulations are comprised of European Union (EU) Regulations, a UK statutory instrument and a UK Plan. Between them, they control movements of waste between the UK and other nations and facilitate a framework for enforcement. Some movements are prohibited, others are subject to prior written notification and consent procedures and a few are subject to basic

88 https://www.gov.uk/ (Visited on Sept. 25, 2013)
administrative controls. The control depends on the nature of the waste, its destination and whether it is destined for resurgence or clearance.

3.3.3. Electrical and electronic equipment

Waste Electrical and Electronic Equipment (WEEE) and Restriction of Hazardous Substances in electrical and electronic tool (RoHS) directives aim to reduce the extent of waste from electrical and electronic and increase its reuse, resurgence and remanufacturing. The RoHS directive aims to limit the ecological impact of electrical and electronic tool when it reached the end of its life. It does this by minimizing the perilous compounds in electrical equipment across the society.

3.3.4. Packaging waste regulations

These regulations aim to harmonize measures concerning the management of packaging and packaging waste to facilitate a high phase of ecological protection and to make sure the functioning of the internal market.

3.3.5. Landfill directive

This directive aims to prevent or reduce as far as possible negative effects on the environment from the land filling of waste, by introducing stringent technical requirements for waste and landfills and setting targets for the reduction of biodegradable municipal waste going to landfill.

3.3.6. End-of-life vehicles (ELVs) Regulation 2003

This regulation aims to prevent waste from end-of-life vehicles and promote the assortment, reuse and remanufacturing of their elements to protect the environment.
3.3.7. Batteries directive

This directive aims to improve the ecological performance of batteries and minimize the impact of waste batteries on the environment. It does this by:

- Restricting the use of cadmium and mercury in the plan and manufacture of latest batteries
- Setting assortment and remanufacturing targets for waste portable batteries
- Banning the clearance of untreated automotive or industrial batteries in landfill or by incineration
- Waste incineration law
- Ecological Protection Act 1990
- Environment Act 1995
- Information
- Producer liability obligations (packaging waste) regulations 1997


The revised WFD also provides that the European Commission may introduce a range of measures by means of cosmetology procedure like end-of-waste criteria for specified waste streams. These provisions will be available to the Commission from the date of the revised WFD’s entry into force.
3.3.9. Waste Hierarchy Guidance Review 2012

The expert panel comprising both independent specialists and scientists from Defra, DECC, WRAP, the Environment Agency and the Welsh government has considered the proposal submitted.

The proposed guidance is based primarily on life cycle assessment. The review will use the same criteria, except will also consider evidence based on other forms of life cycle thinking together with ecological footprinting. Consideration of such slightly diverse criteria has led to a diverse hierarchy of options for a few resources in the Welsh government’s guidance. Consequently, predominantly interested in evidence for those areas where the English and Welsh guidance currently differs, together with:

- High and low efficiency energy resurgence
- Open loop remanufacturing like of glass and plastics
- Plastics energy resurgence vs. landfill
- Paper energy resurgence vs. composting

The review was helpful to illustrate hierarchy of the waste so that we can establish the most dangerous waste and distinguish perilous wastes from others. It was helpful to underline the top priority of legislature to enact laws on most perilous waste at first and more stringent policies for their disposal.

3.3.10. Introduction to the waste hierarchy

Many businesses are unaware of how significantly waste impacts on their bottom line. As the need for resources grows globally, raising input cost, it makes sense for businesses to adopt the waste hierarchy. Article 4 of the revised European Union (EU) Waste Framework Directive sets out 5 steps for dealing with waste, ranked according to ecological impact, i.e., ‘the waste hierarchy’. Prevention, which offers the best outcomes for the environment, is at the top of the priority order, followed by preparing for reuse, remanufacturing, other
resurgence and clearance, in descending order of ecological preference. In E-waste management following stages has been followed in UK:

**Table VIII- E-waste management stages in UK**

<table>
<thead>
<tr>
<th>Stages</th>
<th>Include</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prevention</td>
<td>Using less material in plan and manufacture, keeping goods for longer, reuse, using less perilous resources</td>
</tr>
<tr>
<td>Preparing for re-use</td>
<td>Checking, cleaning, repairing, refurbishing, whole items or spare parts</td>
</tr>
<tr>
<td>Remanufacturing</td>
<td>Turning waste into a latest substance or artifact, includes composting if it meets quality protocols</td>
</tr>
<tr>
<td>Other resurgence</td>
<td>Includes anaerobic digestion, incineration with energy resurgence, gasification and pyrolysis which produce energy (fuels, heat and power) and resources from waste</td>
</tr>
<tr>
<td>Clearance</td>
<td>Landfill and incineration without energy resurgence</td>
</tr>
</tbody>
</table>

The waste hierarchy has been transposed into UK law in the course of The Waste (England and Wales) Regulations 2011. The regulations came into force on 29 March 2011. The provisions relating to the hierarchy (set out at in Regulations 12, 15 and 35) came into force on 28 September 2011.

**3.3.11. Remanufacturing and energy from e-waste**

Recovery actions such as energy from waste are also a key part of the hierarchy. The evidence shows that for mainly resources remanufacturing is better for the environment than energy from waste (EfW) and that EfW is better than landfill. Many governments want to reduce residual waste. Even if, there will be a need to deal with this type of waste for the foreseeable future and
remanufacturing alone cannot currently meet the ambition for diversion from landfill. There is no immediate risk of EfW services being deprived of feedstock.

3.4. E-waste management laws in Canada

E-waste management is one of the biggest ecological challenges of our time. Like other nations around the globe, Canada is grappling with the challenge of reducing stages of unsafe clearance and processing of e-waste and increasing stages of reuse, remanufacturing and resurgence. This is also encouraging manufacturers to plan safer goods.

E-waste management laws facilitate a comprehensive overview and analysis of e-waste management in Canada, in the context of the global e-waste management challenge. It shows the advancement that has been made in this segment in Canada and explores alternative approaches and industry models for e-waste management and their strengths and weaknesses.

E-waste jurisprudence provides an overview of the main legislative and standards related developments in Canada and its provinces. It also reflects the Canadian approach to e-waste management with that of the U.S. and the European Union. It also summarizes the current and emerging technologies being used in e-waste remanufacturing. The Researcher observed that Artifact Stewardship or Extended Producer Responsibility is currently the dominant model in Canada and globally and noted a few inherent weaknesses of this model that need to be addressed in order to make sure that programmes can achieve their e-waste management objectives.

In Canada, it was projected in 2010 that the population was disposing off more than 5 million computer and monitor units per year. Environment Canada reports that volumes of e-waste are increasing by 4 percent annually across the
nation. In olden times, 90 percent of Canada’s e-waste has been disposed of in landfills and only 10 percent recycled or refurbished.

3.4.1. Legislations and regulations on e-waste in Canada

In Canada there is no federal law directed specifically at e-waste management. Even, the Federal government does have an indirect impact on e-waste regulation in the course of its noxious substance control law. E-waste law in Canada has been set mainly at provincial phase. It has primarily taken the form of regulations requiring extended manufacturer liability (EPR) or artifact stewardship for designated electrical and electronic goods. In 2011, eight provinces had law for the management of e-waste in the course of EPR.

3.4.1.1 Toxic Substance Control Legislation

Under Part V of the Canadian Ecological Protection Act, 1999, Canada’s federal Environment Minister is given broad authority to enact regulations that prohibit or impose restrictions on goods containing compounds listed in the Act’s Toxic Substances List. The law is intended to:

- Minimize the noxious resources used in manufacturing; and
- Minimize the release of toxics from redundant goods.

Even if not focused specifically on electronics, the Toxic Substances List includes a number of compounds widely used in electronics manufacturing, together with mercury, cadmium and polybrominated di-phenyl-ethers (PBDEs).

Canada’s noxious substance control law also reflects international regulatory frameworks on international exports of perilous waste as set out in the Basel Convention on the Control of Transboundary Movements of Perilous...

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89 Stothart, P., “It’s time for Canada to get stern regarding metals remanufacturing”, *CIM Magazine* (Nov. 4, 2010)
Wastes and their Clearance and the Canada and United States of America Agreement on the Transboundary Movement of Perilous Waste, specifically the requirement for the prior informed consent of receiving nations. Canada is in the method of expansion of its controls on the trade-out and trade-in of e-waste inside these frameworks.\textsuperscript{92}

\textit{3.4.1.1.1 Electronics Artifact Stewardship Standards}

Even if Canada’s e-waste law has been set at provincial phase, there has been strong federal involvement in standards setting. In 2004, the Canadian Council of Ministers of the Environment (CCME) endorsed a set of national principles for electronics artifact stewardship with the objective of promoting artifact stewardship as the main approach to e-waste management inside Canada, and harmonizing e-waste management strategies between provinces.

The CCME principles are supported by two e-waste artifact lists formulated to facilitate guidance to provinces in their plan of e-waste law and to make sure consistency of approaches to e-waste management. These lists consist of:

1. “Common” goods recommended for e-waste management. These include information know-how, audio-visual and communications tool which are mainly probable to contain noxious and perilous compounds and whose life span as well as rate of production, and;

2. Other electrical goods recommended for “consideration” under e-waste management programmes in addition to the priority items, For instance, hefty and small household equipments, tools and monitoring tool etc.\textsuperscript{93}

In 2009 the Council of Ministers adopted a Canada-wide action plan for Extended Producer Responsibility which provides further guidance on the plan

\textsuperscript{92} Environment Canada (modified 2010) Past Consultations - Updating the Regulatory Framework for the Transboundary Movement of Waste and Perilous Recyclable Resources.
\textsuperscript{93} Canadian Council of Ministers of the Environment in (2004)
and execution of e-waste management regulation and strategies at provincial level. The plan was intended to strengthen the harmonization and consistency of EPR programmes across the nation and to promote the use of EPR as an ‘ecological risk management tool’. It requires Canadian jurisdictions to work towards the establishment of EPR programmes inside six years of adoption of the plan, in a number of areas together with electronics and electronic goods.\textsuperscript{94}

The development of federal guidance and standards on e-waste management in Canada has drawn heavily on the ‘National Model for E-waste Stewardship’ published by Electronics Artifact Stewardship Canada in 2004\textsuperscript{95}. Electronic Artifact Stewardship Canada is an industry organization with a mandate to create a National Electronics Stewardship Programme and to work with provinces and territories on the development of their programmes. Their national model has heftily driven the harmonization of e-waste management law and programmes across Canada. This programme covers various aspects of artifact stewardship together with roles and responsibilities, managing outlay, managing assortment and remanufacturing and a proposed national outlay model. The federal government has also produced other guidance relating to artifact stewardship, together with an Environment Canada Guide to the development of performance measures that is intended to harmonize performance measurement and reporting on artifact stewardship programmes across the nation.\textsuperscript{96}

Implementation of standards and oversight of provincial programmes is now the liability of the Electronic Goods Remanufacturing Association (EPRA), a national industry led non profit organization established in 2011.

\textsuperscript{94} Canadian Council of Ministers of the Environment, Canada wide Action Plan for Extended Producer Responsibility (2009)
\textsuperscript{95} Electronics Artifact Stewardship Canada, National Model for E-waste Stewardship (2004)
3.4.1.2. Impact of stakeholders

E-waste management law has various impacts on stakeholders. In general, the main stakeholders in any e-waste management system can be defined as:

- Government authorizing body (federal and provincial)
- Administrative body or stewardship organization
- Producers or suppliers (manufacturers, brand owners and importers)
- Distributors or Retailers
- Service providers (collectors, transporters and processors)
- Consumers (private individuals, households and businesses)

The actual impact of e-waste law or regulations on these groups will depend on the precise nature of the law or regulations. Some key differences between Canadian provinces and international law have been discussed in preceding sections. Focusing on the Canadian context, instances of the main types of legislative influences or impending influences on stakeholders, as well as the impending impacts arising from these are shown as below:

**Table IX- List of stakeholders and their potential impact on e-waste management**

<table>
<thead>
<tr>
<th>Stake Holder Group</th>
<th>Impact Influences mainly by:</th>
<th>Potential Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provincial Governments</td>
<td>Nature of law or regulation precise to e-waste</td>
<td>Requirement for the monitoring and enforcement of precise e-waste management requirements together with performance against targets</td>
</tr>
<tr>
<td></td>
<td>Provisions for establishment of an administrative</td>
<td>Need to establish administrative organizations to oversee execution</td>
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</tbody>
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<th>Administrative Organization</th>
<th>organization</th>
<th>Relevant federal and international law</th>
<th>Need to enforce reporting requirements and apply penalties if appropriate</th>
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<tbody>
<tr>
<td>Nature of law or regulation</td>
<td>Requirement to designate eligible goods, when not specified in law</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Existence of remanufacturing and reuse targets</td>
<td>Requirement to identify and enforce obligations on all eligible suppliers</td>
<td></td>
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<tr>
<td>Provisions regarding harmonization of programme details with other provinces</td>
<td>Requirement to collect fees from eligible manufacturers</td>
<td></td>
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<tr>
<td>Requirement to meet targets</td>
<td></td>
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<td></td>
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<tr>
<th>Distributors or Retailers</th>
<th>Requirement to collect a separate fee or distributive information at point of sale</th>
<th>Need to establish mechanisms to collect and remit fees</th>
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<td>Legislative restrictions on sale of non compliant goods</td>
<td>Need to establish information systems to collect and submit relevant financial information</td>
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<th>Service Providers</th>
<th>Any requirement for mandatory participation</th>
<th>Latest industry opportunities</th>
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<tr>
<td></td>
<td></td>
<td>Need to develop, strengthen or cease use of precise techniques</td>
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### 3.4.2. E-waste business models

Basically, six diverse types of models have been adopted by every state in Canada to generate funding and assign liability to manage e-waste.

#### 3.4.2.1. General Tax Base Funding Model

One e-waste management industry model involves the imposition of a tax on all taxpayers inside a precise jurisdiction, with the funds used to cover the outlay of the whole system or elements of it. Traditionally, this model has been widely used to cover household waste assortment and transportation outlay and in
a few nations has been extended to the remanufacturing of e-waste. For instance:

- In Denmark, a local household waste tax is used to fund the outlay of assortment, transportation and remanufacturing of e-waste by local authorities.
- Other European nations such as the Netherlands and Norway use a variation on this model, to fund parts of e-waste management system, such as assortment and transportation. Stages of tax vary between municipalities.

This system is relatively easy and straightforward to administer. Even if, it has been criticized as an e-waste management industry model because it does not encourage manufacturers to plan ecologically friendly goods in order to reduce their taxation burden, neither does it differentiate between diverse end-users in terms of the amounts of e-waste they generate. To sum up, this system provides no incentives for reducing volumes of e-waste. Additionally, under general taxation schemes it can be difficult to make sure that the funds raised are used for their intended purposes.

3.4.2.2. Deposit and Refund System Model

This industry model has been successfully used to encourage remanufacturing in the case of other types of lower value household waste, such as beverage containers. Consumers are required to pay a deposit on purchase of an artifact and receive a refund of this fee when returning the item after use to a designated recycler or collector. The deposits held are used to fund the outlay of assortment, transportation and remanufacturing. In relation to e-waste management, the probable difficulties with this system include:

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97 U.S. Department of Commerce, Technology Administration, Office of Technology Policy
98 Ibid.
• The relatively long life span of electrical or electronic items and the likelihood they may have several owners over time.

• The challenge of determining an appropriate deposit amount that would not deter end-users from purchasing goods except would also facilitate a sufficient incentive for them to recycle the artifact.

• The heterogeneous nature of e-waste and the widely varying remanufacturing outlay of diverse goods.

3.4.2.3. Advanced Clearance and Advanced Recovery Fees Model

In this form of industry model, manufacturers are required to collect a clearance fee from the end-user at the time of purchase, with the funding raised used to pay for remanufacturing programmes. A number of jurisdictions operate this type of system under remanufacturing law, together with the Netherlands and California.\textsuperscript{99} Usually, a clearly visible fee is shown on purchase receipts, separate from the sales price.

For instance, In California, Advanced Recovery Fees are used to finance the entire e-waste management system, together with the outlay of remanufacturing orphan goods. Recyclers are paid directly by the state. They are encouraged to enter the market by a guaranteed payment per pounds of goods recycled. The system is supported by California’s stringent laws restricting the use of perilous compounds in artifact plan.

The main advantages of this type of industry model for e-waste management is that it offers a clear source of immediate and sustainable funding. It can be used to recycle all designated goods, whether or not they have an identifiable manufacturer or brand owner. Point-of-sales fees also facilitate an opportunity to educate or remind end-users regarding the importance of remanufacturing. This type of system is often regarded as fair since it can allow

responsibilities for remanufacturing to be divided between manufacturers, governments, end-users and retailers. One of the main criticisms is that advanced remanufacturing fees can be difficult to enforce on internet sales, which increasingly account for a high proportion of certain types of electronic artifact sales, predominantly computers. The system also offers little incentive for manufacturers to modify their artifact designs to reduce the outlay of remanufacturing.100

3.4.2.4. End-of-life Fees Model

This model requires end-users to pay a fee when disposing of items at the end of their useful lives to cover the outlay of remanufacturing, with the fees often subsidized by manufacturers or retailers.101 Like advance clearance fees, these facilitate an immediate source of funding for remanufacturing. It can be used to cover the outlay of remanufacturing orphan goods for which no manufacturer is identifiable. The system is also fair in that only the users of goods are charged the fees, not all taxpayers. Furthermore, an End-of-Life Fees industry model can help reduce the overall outlay of e-waste management by encouraging end-users to prolong the life of their electronic and electrical items to avoid paying the fee. Few have argued that it can encourage remanufacturers to compete for industry, bringing down the fees. In theory, consequently, this model offers a range of financial benefits. In practice, it can be difficult to enforce and can encourage the use of unlawful and perilous clearance practices, as end-users seek to avoid paying the remanufacturing fees. Additionally, since electronics often have several owners before being recycled, it will fall to the final owners, often with the lowest incomes to fund the programme.

For Instance, In Japan, which has heftily focused its e-waste management efforts on improving system logistics and management, retailers are requisite to

100 U.S. Department of Commerce, Technology Administration, Office of Technology Policy
101 Ibid.
collect an end-of-life fee from end-user for a range of designated equipments such as televisions. The fees cover the outlay of assortment, transportation and remanufacturing, which are set by artifact manufacturers. There has been a high phase of harmonization of fees among leading electrical appliance manufacturers. In Belgium, the e-waste management system is financed by a combination of End-of-Life fees and Advanced Clearance fees.

3.4.2.5. Producer Take-Back Programmes Model

A model which requires manufacturers to take-back their own goods for remanufacturing is potentially the mainly effective in reducing the overall outlay of e-waste management. Since manufacturers will be encouraged to introduce environment friendly designs in order to reduce e-waste management outlay. Even if, such programmes can be difficult to implement and enforce and can have detrimental financial effects by deterring small manufacturers from entering the market due to the prohibitively expensive e-waste management outlay.

For Instance, A number of hefty electronics manufacturers, predominantly multi-national computer firms such as Hewlett-Packard, IBM and Dell, have voluntarily established North American remanufacturing services and take-back schemes for their own goods. These types of brand precise services have the impending to vastly increase the outlay effectiveness of remanufacturing since the composition of the e-waste scheme is less heterogeneous and can be heftily anticipated.

3.4.2.6. Extended Producer Responsibility Model

Extended producer liability (EPR) is the industry model which is being widely adopted across Canada and in various other nations together with those of the European Union. This has the impending to be the mainly outlay effective way of managing e-waste, depending on its precise plan. The objective of extended manufacturer liability, often also known as artifact stewardship, is to
make manufacturers accountable for the whole life cycle of their goods, together with remanufacturing or safe clearance. Under this industry model, manufacturers are required to fund the outlay of remanufacturing or clearance, either by implementing their own take-back programmes or by paying fees to a third party to administer an e-waste management scheme on their behalf. This is the mainly common variation on this industry model.

The concept of extended producer liability was first developed by Lindhqvist & Lidgren (1990) in a report to the Swedish ecological ministry as:

“An ecological protection strategy to reach an ecological objective of a decreased total ecological impact from a artifact by making the manufacturer of the artifact liable for the entire life-cycle of the artifact and predominantly for the take-back, remanufacturing and final clearance of the artifact. The extended manufacturer liability is implemented in the course of administrative, financial and informative instruments. The composition of these instruments determines the precise form of the extended manufacturer liability.”

The Organization for Economic Co-operation and Development (OECD) has described EPR in the following terms, which underpin the principles underlying mainly the artifact stewardship programmes that have been developed in Canada and globally. According to the OECD guidance manual:

“Producers of goods should bear a significant degree of liability (physical and financial) not only for the ecological impacts of their goods downstream from the handling (resurgence) and/or clearance of the artifact, except also for their upstream actions inherent in the selection of


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resources and in the plan of goods. The objective of EPR is to reduce the volume and hazard from goods at the post end-user phase. “

EPR is intended to shift responsibilities for e-waste remanufacturing and clearance, which have traditionally been borne by governments and taxpayers, to the manufacturers of the goods. In this way, the outlay of e-waste management is intended to be internalized in the artifact outlay. Producers often have the option inside such programmes of taking liability for establishing their own remanufacturing programme or by joining with other manufacturers in a collective system, in which a third party (stewardship association) manages e-waste on their behalf.

There are a number of variants on EPR. In full outlay internalization programmes, manufacturers are liable for the outlay of all e-waste management. They can decide whether to cover this outlay themselves or pass them onto end-users in the outlay of their goods. In partial outlay internalization programmes, manufacturers are liable for the outlay of a few stages of e-waste management, such as remanufacturing. The government pays for the remaining stages, such as assortment and transportation.

In a few EPR programmes, manufacturers are required to charge a standard ‘ecological handling fee’ or ‘advanced remanufacturing fee’ to end-users at the point of purchase, which is shown separately to the artifact price. In others, there is no separate charge or visible outlay to the end-user, even if this may be incorporated in artifact prices.

A further variation relates to the system of administration. Within Canada, one commonly used model requires that manufacturers register with a non profit stewardship organization appointed by the provincial government. The second

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main model found in Canada is industry led, with the regulation requiring businesses to form their own artifact stewardship programmes.\textsuperscript{104}

The main advantage of EPR is that, if appropriately designed, it provides a direct incentive to encourage artifact manufactures to incorporate ecological considerations into artifact plan. It also provides to enable them to keep artifact outlay low and maintain their market competitiveness. This should reduce the overall volume of e-waste that is generated and improve rates of reuse and remanufacturing. EPR also reduces the outlay of e-waste management to governments and end-users. Furthermore, it has been argued that EPR, by generating a direct and sustainable source of funding for e-waste management, can stimulate the development of competitive e-waste management and remanufacturing systems. They also offer flexibility in the plan of precise assortment and processing systems to suit the needs of diverse jurisdictions and their market participants.\textsuperscript{105}

The ability of EPR systems to achieve improved ecological plan of goods, even if, depends on the plan of the system and the ways in which outlay are allocated between manufacturers. In various programmes, there is no differentiation between manufacturers by marketplace share or artifact plan and manufacturers may be requisite to take liability for a share of the outlay of remanufacturing historic or orphan goods. In this situation, there is may be little financial incentive to improve the plan of their goods in order to reduce the overall outlay of remanufacturing that is incurred by the company. Even if, manufacturers can improve their brand image by promoting their participation in the programme and highlighting their environment friendly plan practices. Furthermore, supporters of EPR also argue that the collective nature of mainly EPR programmes encourages manufacturers to work together to improve the ecological aspects of artifact plan.

\textsuperscript{104} Northwest Artifact Stewardship Council (2009)  
\textsuperscript{105} U.S. Department of Commerce, Technology Administration, Office of Technology Policy
After citing various models adopted in US, UK and Canada, the researcher found that e-waste management responsibilities have been laid upon the manufacturers, remanufacturers and end-users. They contribute in e-waste management model adopted by the nation in terms of paying the fee directly to the managing agency. The Researcher also cited the enormous piece of legislation enacted in various states in US. The best implementation of policy on e-waste was found in California State.

3.5. E-waste management laws in Japan, South Korea and Taiwan

Since the Extended Producer Responsibility (EPR) entered the spotlight as an impending guiding principle alternative for waste management around 2000. Now, Laws on e-waste management has been promoted at an international level. The WEEE Directive, which incorporated EPR as a basic principle, was announced in 2003. European Union (EU) members are accordingly requisite to make sure their own domestic regulations are compatible with it.

Similar guiding principle tendencies can be found in Asian nations. The nations leading the change i.e., Japan, South Korea and Taiwan have been tackling e-waste management since around 2000. Furthermore, in recent years several emerging Asian nations together with China and Thailand have been adopted latest regulations on e-waste management. Even if, it is hard to deny that these nations are being strong armed to keep up with the guiding principle execution, as exemplified by the WEEE Directive, of the developed nations and may have failed to properly examine their own domestic situations. This failure could lead to problems in attaining guiding principle objectives in the future.\textsuperscript{106}

In this context, the objective of following e-waste management model is to present practical guiding principle implications to the emerging nations willing to introduce latest regulations or revise existing regulations for more effective e-

\textsuperscript{106} Sung-Woo Chung and Rie Murakami-Suzuki, \textit{A Comparative Study of E-waste Remanufacturing Systems in Japan, South Korea and Taiwan from the EPR Perspective: Implications for Developing nations}
waste management. For this purpose, e-waste remanufacturing systems in Japan, South Korea and Taiwan are compared and analyzed mainly from the EPR perspective. These three nations have been selected for the following reasons: Firstly, they have implemented e-waste management agreement regulations in the past 5 to 10 years and have undergone a method of trial and error to construct effective management of e-waste. Furthermore, because the guiding principle development and legislative backgrounds of three nations vary, it can be considered to cover almost all types of e-waste management systems found in Asian nations.

It is worth taking a brief look at the e-waste management situations in emerging Asian nations for a comprehensive understanding of the underlying implications of this study.

3.5.1. E-waste management situations in emerging Asian nations

As a general proposition, it is reasonably uncertain if regulations adopted by developed nations will bring regarding similar outcomes in emerging nations. This can be understood intuitively considering the diverse legislative backgrounds of diverse nations and is also applicable to e-waste management. The first consideration is the low outlay of labour. This is one of the substantial reasons for continuously export of e-waste to emerging nations by developed nations pursuing low handling outlay? Secondly, because the diffusion rate of home equipments is comparatively low, demand for used goods is fairly high. Lastly, commercial remanufacturing companies play an extra significant role in e-waste remanufacturing than in the developed nations. Even if, in regards to e-waste handling, ecological impacts caused by improper practices are questionable.107

Among Asian emerging nations, China and Thailand are ready to implement latest regulations that include EPR perspectives. In respective drafts of e-waste management policies of these two nations, one common characteristic

107 Kojima (2007)
aspect is confirmed, that is, financial liability for e-waste management is imposed on manufacturers reflecting the principle that manufacturers should pay for the outlay of remanufacturing waste.

3.5.2. E-waste management in Japan

Japan deals with e-waste in two ways. One is the Law for the Promotion of Effective Utilization of Resources (LPUR). This focuses on enhancing measures for remanufacturing goods and reducing waste generation. The other is the Law for the Remanufacturing of Specified Kinds of Home Appliances (LRHA). This imposes certain responsibilities related to the remanufacturing of used home equipments or manufacturers and end-users.

Flow Chart I- General flow of used computers from households in Japan

When discarding used home equipments, end-users are liable for the outlay of transportation as well as e-waste remanufacturing. Remanufacturing fees range from 2,400 yen (washing machines) to 4,600 yen (refrigerators). Transportation outlay is paid separately to retailers who convey the used home
equipments to the assortment sites, which are designated by the manufacturers. Upon the request of end-users, retailers are obliged to take-back used home equipments. Retailers then must transport the used home equipments from the end-user to the assortment site.

**Flow Chart II- Flow of used home appliances and the role of associated actors under Japan’s LHRA**

Manufacturers are required to either establish their own remanufacturing services or commission commercial remanufacturing companies to fulfill their remanufacturing obligations. They are additionally required to achieve compulsory remanufacturing rates to make sure effective utilization of resources. Remanufacturing rates are 55 percent for television sets, 50 percent for

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108 In various cases, transport company offices or existing clearance company yards are used.
refrigerators and washing machines and 60 percent for air conditioners of the original price.

Regarding the role of municipal authorities in assortment, they are no longer obliged by the LRHA to collect used home equipments. Even if, they still collect and treat used home equipments in their area of jurisdiction, which includes equipments that have been illegally dumped. In this case, municipalities, similar to retailers do receive fees for transportation and remanufacturing from end-users and deliver the used home equipments to designated assortment sites.

From the above information, it is evident that LRHA provides a legal framework for assigning responsibilities to manufacturers, retailers and end-users with manufacturers having the liability of physically collecting and remanufacturing used home equipments disposed off by end-users. Still, the LRHA regulates only a part of the total method. The methods described outside the box are not managed under the current law. At present, the latter part constitutes a ‘hidden flow’, the actual conditions of which require urgent clarification from the perspective of material control.

3.5.2.1. Treatment and guiding principle challenges

Under the LRHA, manufacturers are required to construct a remanufacturing infrastructure for used home equipments. Even, the precise method of doing so is not regulated. In absence of precise method, the manufacturers address the latest situation created by the law by following procedures. Their responses can be broadly divided into two types: Group A and Group B.\textsuperscript{109} It has been pointed out that the reason Japan came to have two types of remanufacturing infrastructure is because of the promotion of competition between manufacturers and the need to avoid violating antitrust law. Additionally,

\textsuperscript{109} In case of manufacturers and importers not joining in Group A or Group B, they commission their legal obligation to the Association for Electric Home Appliance (AEHA)
Group A and Group B had dissimilar viewpoints on how to reduce general outlay together with assortment and remanufacturing of used home equipments.\textsuperscript{110}

Specifically, Group A and Group B each facilitate 190 Indian assortment sites. Group A, tempted to keep remanufacturing outlay down in the course of maximum utilization of existing waste management companies, which can be classified into three main types:

1. Industrial waste handling companies
2. Existing local scrappers, and
3. Companies belonging to a Marisoru Network.\textsuperscript{111}

Facilities of existing remanufacturers are usually used as assortment sites. Because Group A fulfills its legal obligations by contracting with 32 existing remanufacturing plants, a flexible response to fluctuations in volume is possible. This is important when assortment of used home equipments fall short of expectations.

In contrast, Group B built 16 remanufacturing plants and attempted to reduce total outlay by adopting efficient logistics systems. Even if the initial investments were burdensome, Group B is able to make adjustments to match operating conditions at remanufacturing plants. Unlike Group A, Group B generally uses transport company warehouses as assortment sites.

Because Group A and Group B’s assortment sites are managed separately, retailers may not choose their nearest assortment site if outlay are lower elsewhere. This creates a heavy financial burden on retailers as in reality they may not ask the end-users to pay transportation.

\textsuperscript{110} HADA (2003)
\textsuperscript{111} A Marisoru Network is a national organization of industrial waste handling companies.
3.5.3. E-waste management in South Korea

The Producer Deposit Refund (PDR) system depends upon three main actors:

1. The Ministry of Environment (MOE)
2. The Korea Remanufacturing Corporation (KORECO), and
3. The manufacturers.

For each artifact item, the MOE requires manufacturers to pay advance deposits to cover remanufacturing outlay. These deposits are calculated from the number of goods shipped during the previous year. KORECO manages the administration regarding remanufacturing accomplishment and unreturned deposits. Deposits are returned to the extent that e-waste is properly collected and recycled.

Flow Chart III- General e-waste flows in South Korea
The defining characteristic of the PDR system is that it emphasizes the manufacturer’s financial liability for promoting e-waste remanufacturing, institutionalizing it in the form of deposits. The deposit rate rose from 30 won per kilograms in 1992 to 38 won per kilograms in 1996 for extra remanufacturing by manufacturers.

3.5.3.1. Challenges for treatment and guiding principle

Manufacturer’s reactions to the PDR system is divided chronologically into two periods i.e., before and after 1996, the year in which the deposit rate was increased. In the first period from 1992 to 1996, manufacturers contracted out their e-waste remanufacturing to commercial remanufacturing companies to secure the return of their deposits. In the latter period from 1997 to 2002, manufacturers chose to construct several remanufacturing plants on a regional basis for e-waste remanufacturing.

The increase in deposits since 1997 was caused by the addition of refrigerators and the increase of deposit rate in the previous year. Free take-back by Samsung started in 1995 and the build-up of remanufacturing plants together with that of ASAN, both had an effect on the steady rise of the refund rate. Even if, from the guiding principle perspective, a refund rate less than 10 percent is considered to be quite a low level of accomplishment.

There are two main guiding principle challenges understood to be exist inside the PDR system. The first is the lack of financial incentives for manufacturers. The deposit rate is far lower than the actual outlay of remanufacturing. As such, it made extra financial sense for manufacturers to pay the deposit rather than to recycle e-waste. The actual outlay was 169.1 and 160.1

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112 Three main manufacturers i.e., Samsung, Hyundai, Daewoo agreed to build remanufacturing plants on a regional basis to cover the whole country. Due to diverse understandings of e-waste remanufacturing, construction of e-waste remanufacturing plants was carried out separately under the PDR system.
won per kilograms\textsuperscript{113} for television sets and refrigerators, respectively. This is approximately extra than four times higher than the deposit rate.\textsuperscript{114} The second point relates to the improper remanufacturing of e-waste via the municipality route. There was a strong possibility that e-waste discharged to the municipalities would be improperly treated, thus causing environment impacts.

3.5.3.2. Producer remanufacturing system from 2003 to present

Since unification of the OECD in 1996, South Korea’s ecological guiding principle has been directly affected by the direction of guiding principle in Western nations. In the field of remanufacturing, the publication of the OECD Government Manual for the execution of EPR in 2001 was essential for the development of South Korea’s ecological guiding principle. In January 2003, the Producer Remanufacturing (PR) system, which emphasizes the role of manufacturers in e-waste remanufacturing as a substantial one, was launched under an amendment to the remanufacturing act. In addition to the four established items, computers in 2003, audio equipment and mobile phones in 2005 and OA equipment (printers/copy machines/faxes) in 2006 were included, making the total 10 items by 2006.

3.5.3.2.1. Structure of assortment and outlay allocation

The PR system was instituted for the purpose of extending the formerly limited liability of manufacturers and even suggesting specifically inducing manufacturers to participate extra, directly in e-waste remanufacturing. The PR system works in the following ways. Firstly, while considering the recent remanufacturing performances and remanufacturing quantities undergone by manufacturers, the MOE annually announces the item precise rates i.e., for refrigerators, washing machines etc. Thus, in the case where a latest appliance is

\textsuperscript{113} Note: 100 won = 10.01 yen = 0.10 U.S. dollars (May 13, 2008)
\textsuperscript{114} KORECO (1990)
purchased, manufacturers are obliged to collect the used home appliance as per end-user’s request. Each item has a certain remanufacturing target inside the range of 55 to 70 percent based on weight. Each manufacturer can fulfill their legal obligation in one of the following three ways:

1. To construct their own remanufacturing plant and do their own remanufacturing
2. To outsource the job to commercial remanufacturing companies
3. To join the Producer Responsibility Organization (PRO), pay the requisite fees, and have them do the remanufacturing. Manufacturers can choose whichever option suits them best.

3.5.3.2.2. Treatment and guiding principle challenges

The PR system was launched in 2003, except a two year pilot programme which laid the foundations for the PR system was carried out prior to that, following a voluntary agreement entered into in June, 2000 by three foremost manufacturers i.e., Samsung, LG with Daewoo and MOE. During this period, manufacturers were required to construct nationwide remanufacturing infrastructure rather than depositing.

In reality, the actual remanufacturing was carried out by the Association of Electronics Environment (AEE) by proxy. Specifically, within a few year gaps between each, the manufacturers constructed three remanufacturing plants, starting with Samsung’s ASAN Remanufacturing Plants in 1988 and followed by LG’s Chilseo Remanufacturing Plants in 2001 and finally the Metropolitan Remanufacturing Plants in 2003, by which they successfully increased their remanufacturing capacity. These plants constructed by the manufacturers mainly remanufacture refrigerators and washing machines.

The commercial remanufacturing companies that contract with AEE are paid by volume recycled. In 2006, there were 28 such companies out of these, 6
for television sets and monitors, 10 for computers, 7 for CRTs and 5 for mobile phones.

Even if, only regarding 40 percent or 98 out of 232 of the municipalities actively cooperate with manufacturers. Cooperation between manufacturers and municipalities does not occur smoothly due to the insufficient financial situation of the municipalities. Instead, remanufacturing outlays are imposed on manufacturers and municipalities are required to pay the outlay of transportation to the manufacturer’s remanufacturing services.

When high-quality used home equipments are discharged to the used equipments market, they are usually traded at positive rates. It is generally understood that considerable amounts of used home equipments are reacquired via this route. The assortment and remanufacturing method under the PR system are summarized as follows.

Irrespective of a sharp increase in assortment by manufacturers, several guiding principle challenges can be pointed out. Firstly, regarding the management of perilous wastes, manufacturers are required to collect CFCs, except environment friendly handling after assortment is not mandated. At present, the ASAN remanufacturing plant is the only one that destroys CFCs contained in refrigerator insulation. Most CFCs collected are reused without their detrimental characteristics being nullified. Secondly, the PR system primarily focuses on increasing the amount of remanufacturing. It guarantees appropriate handling, rather than on promoting Design for Environment (DfE). In the manufacturer built plants, fulfilling of mandatory remanufacturing targets takes a higher priority than DfE. Know how obtained in the remanufacturing method is hard to incorporate in latest artifact plan if it is not economically profitable.

3.5.4. E-waste management in Taiwan

Taiwan’s e-waste remanufacturing scheme can be summarized as having three main features. First, the Remanufacturing Fund Management Committee
(RFMC) system emphasizes the financial liability of manufacturers. The second feature is the financial incentive or subsidies used to induce commercial remanufacturing companies to participate in the scheme. The third is that the appropriate handling of e-waste is thoroughly guaranteed, which creates a huge monitoring outlay.

In Taiwan, the fund paid by the RFMC is used as a source of revenue for subsidies to organizations participating in the assortment and remanufacturing of e-waste. Even, only entities monitored by public auditing institutes are able to claim a return for assortment and remanufacturing. Recyclers, who do not participate in the scheme are not penalized except are rather not able to claim subsidies.

Flow chart IV- Flow of funds and subsidies in Taiwan
In other words, under the RFMC system, only manufacturers bear financial liability for e-waste remanufacturing. This liability comes only in the form of the fees paid to the RFMC and not for the collecting or remanufacturing of e-waste. Meanwhile, in the course of the incentive of subsidies, end-users, retailers, assortment firms and commercial remanufacturing companies performing the actual tasks of collecting and remanufacturing are inclined to operate inside the RFMC system in Taiwan.

3.5.4.1 Treatment and guiding principle challenges

Under the RFMC system, five types of used home equipments i.e., television sets, refrigerators, washing machines, air conditioners and used personal computers have been selected respectively as one category in the system.\textsuperscript{115}

Remanufacturing plants buy e-waste from assortment sites\textsuperscript{116} and recycle them to obtain subsidies from the RFMC. At the remanufacturing plants, the number of units to be processed is checked prior to acceptance. Again after remanufacturing, subsidies are paid by the RFMC when the unit counts are confirmed to be in agreement.

Assortment firms obtain revenue by selling e-waste, which is generally collected from various routes such as retailers, local governments and collectors. Consumers can freely choose their preferred route for clearance of e-waste. Regardless of the ecological burdens from the processing and remanufacturing methods that are acknowledged to be a problem. One reason is that, manufacturers are thought not to be assigned liability during assortment and remanufacturing stages and home appliance manufacturing segment in Taiwan is made up of numerous small and medium-sized manufacturers. There are no leading companies, thus, no single manufacturer is able to act as a driving force.

\textsuperscript{115} Chang and Shaw (2000)

\textsuperscript{116} Unlike in Japan, the assortment sites are managed by the precise assortment firms rather than the manufacturers. Manufacturers are not required to organize assortment sites in Taiwan.
Even, since the system is set up such that the remanufacturers actually carrying out the processing and remanufacturing are not compelled to perform all remanufacturing inside the RFMC scheme, except are free to choose whether or not to participate. It must be concluded that this system is inadequate as a system for managing improper processing and encouraging appropriate processing methods throughout the India.¹¹⁷

**Flow Chart V- General flow of e-waste under the RFMC system in Taiwan**

Around 2007, nine remanufacturing plants together with eight companies were remanufacturing e-waste inside the RFMC system. Two of them together with one company were jointly built with investment from relatively foremost companies. The rest are the existing remanufacturers and remanufacturers prearranged by retailers. These remanufacturers purchase used home equipments from 116 assortment firms at an Indian phase. In the case of IT equipment, 17 remanufacturers collect from 118 assortment firms. Out of those 17, 12 collect

¹¹⁷ Murakami (2005)
home equipments as well as IT equipment. In the case of used home equipments, it seems that an agreement was made among remanufacturing plants to avoid over concentration.

There are currently two challenges for guiding principle makers. The first is that the financial incentive for remanufacturers to join the RFMC system is insufficient. Because the decision, whether or not to join the system can be made entirely at the discretion of the commercial remanufacturing companies, such decisions are typically based only on financial concerns. This has resulted in a considerable number of the commercial remanufacturing companies not joining the RFMC system. This is problematic as there is no monitoring of remanufacturing undertaken outside the RFMC system despite the fact that the RFMC system targeted the promotion of the appropriate handling. The second is that the RFMC has only a weak influence on DfE. Under the current system, manufacturers are fulfilling their responsibilities by offering a remanufacturing fund configured by Taiwan EPA. Fluctuations in the fees do not facilitate sufficient incentives for manufacturers to actively take part in DfE actions.

3.6. E-waste management in China

Electronic waste in China has gained global attention as a stern ecological issue. Guiyu in Guangdong Province is the location of the heftiest electronic waste site on earth in China. Chinese laws are primarily concerned with eliminating the trade-in of e-waste like India. China has ratified the Basel Convention as well as the Basel Ban Amendment, officially banning the trade in of e-waste. In October, 2008, the Chinese State Council also approved a draft regulation on the management of electronic waste with the objective of promoting the persistent use of resources in the course of remanufacturing and monitoring the end-of-life handling of electronics. Under the latest regulations, the end-user is required to recycle electronic goods. It also requires the remanufacturing of unnecessary resources redundant in the manufacturing method.
The Restriction of Hazardous Substances (RoHS) in China, officially known as the ‘Administrative Measure on the Control of Pollution Caused by Electronic Information Goods’ is a Chinese Government regulation to control certain resources, together with lead. It was jointly promulgated by the seven Government Departments and administrations of the People’s Republic of China (PRC) in February 2006 and became effective from 1 March 2007.

According to Article 1 of the Administrative Measure, it was formulated on the basis of the legal and administrative laws of the ‘Law of the People’s Republic of China on Promotion of Clean Protection’, the ‘Law of the People’s Republic of China on the Prevention and Control of Ecological Pollution by Solid Waste’ etc. These laws were promulgated in order to control and reduce ecological pollution caused by the redundant electronic information goods, promote manufacture and sale of low pollution electronic information goods, and protect environment and human health. All items shipped to China have to be marked as to whether the items contained in the box are compliant or noncompliant. The Electronic Information Products (EIP) logo or other label is used to mark parts and assemblies that do not contain acceptable amounts of compounds identified by the regulations and those that are ecologically safe. Units which contain perilous compounds are marked with the EIP logo together with an Environment Friendly Use Period (EFUP) value in years. EFUP is the period of time before any of the RoHS direction’s restricted compounds are probable to leak out, causing possible harm to health and the environment.

There are currently six compounds considered ecologically perilous by the Chinese RoHS Directive (Article 3 of Chapter 1), namely:

1. Lead
2. Mercury
3. Cadmium

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118 “Administrative Measure on the Control of Pollution Caused by Electronic Information Goods” (Feb. 28, 2006) (English Translated Version), Ministry of Information Industry of the People’s Republic of China (No.39)
4. Hexavalent chromium  
5. Polybrominated biphenyls  
6. Polybrominated di-phenyl ethers and other noxious or perilous compounds or elements set by the state.

Hong Kong’s Waste Clearance Ordinance bans the trade-in of batteries and cathode rays. Currently, there is no law in place to bar the entry of other electronics into the ports of Hong Kong.

3.6.1. Potential directions for future work  
The broad range of action points that might serve as the focus of future multi-stakeholder actions on e-waste in China in the future includes research cooperation, technology development, establishment of a communications platform and capacity building. From a content point of view, key topics requiring future attention include cross-border shipments, law execution and assessment, emissions control, technology transfer and upgrade, financing and eco-plan of goods. The following contents highlight a few impending areas of interest for future projects and development, according to the research and knowledge gaps identified in the previous sections.

3.6.1.1. Cross-border shipments  
It is apparent that there is a lack of data and information related to the cross-border routes and the extent of e-waste flowing into China. Defining the extent and nature of the problem can help to improve enforcement and cooperation among customs agencies. It can also help support mutual understanding of diverse country’s trade-in and trade-out provisions and terminology. This may help to reduce or eliminate negative ecological impacts arising from such actions.
3.6.1.1.1. Capacity building on management of cross-border shipments

In order to effectively manage e-waste flows, it is essential to determine and monitor the routes in the course of which e-waste from the developed nations is transferred into China. One possibility for tracking cross-border e-waste flows is to monitor various assortment points or scrap yards in selected nations and using GPS to track their shipment routes. Key sources of illegally shipped e-waste include the United States of America, even if only certain e-waste exports are unlawful under United States of America, Europe, Japan and South Korea. This type of monitoring, even if, is very challenging work that requires considerable coordination and effort. The investigation of shipments and underground trading of e-waste requires assistance from government agencies such as police, customs, municipalities etc. both in China and in the source nations. Furthermore, the assortment of quality of information and data must entail rigorous customs checks, tracking and sampling of containers.

In the meantime, conducting training actions and workshops on the monitoring and management of cross-border e-waste flows can increase awareness and capacity among key stakeholders, such as customs officers. Clearly defining e-waste, artifact categories and administrative policies and disseminating them effectively among relevant stakeholders can also help to improve mutual understanding and collaboration.

3.6.1.1.2. Extent of unlawful shipments to China

From a strategy perspective, determining the volume of e-waste shipments entering China would greatly highlight further understanding of the extent of the cross-border shipment problem and facilitate important information to domestic e-waste customs agencies seeking to manage both outgoing and incoming shipments. Many efforts are under way to calculate across the globe flows of used
electronics, together with the StEP\textsuperscript{119} database and collaborative projects between the United States of America EPA, StEP and the Massachusetts Institute of Technology, as well as in the course of the Commission for Ecological Cooperation. These efforts may be able to estimate the quantities of used electronic goods exported from the United States of America, Europe and other developed nations. Complementary efforts to identify shipments that reach China and that are trade-in against Chinese law would help support best practices and customs enforcement at the global level.

### 3.6.2. Domestic e-waste flows in China

Both, the amount of e-waste being generated in China and the destinations for e-waste inside China remain unclear. It would be worthwhile to carry out research study on existing e-waste flows and update it regularly. The information and data would help policymakers to understand the roles of the various actors inside the formal and informal systems and the material flows between and among them. Such information would also help formal segment planning regarding the number of assortment points, the capacity of remanufacturing services and the phase of financing necessary and it would enable an extra accurate grasp of the extent of the informal segment and complementary flows.

#### 3.6.2.1. Standardizing calculation of EEE (Electrical and Electronic Equipment) sales and e-waste generation

Various methods and data sources are used to calculate the amount of latest EEE (Electrical and Electronic Equipment) put on the Chinese market. Some of the calculations produced are inconsistent or incompatible with each other. It is consequently essential to establish a standardized method for calculating the amount of EEE (Electrical and Electronic Equipment) put on the

market. Currently, United Nations University (UNU) is doing such research in the Netherlands and other European Union (EU) nations, applying the ‘Eurostat data and coding system’. A similar method can be applied in China by using data on domestic artifact ion and international trade.

A standardized method for calculating the amount of EEE (Electrical and Electronic Equipment) put on the market and the amount of e-waste generated might include the following eight steps and elements:

1. Define the categories and scope of e-waste generated according to various data sources and known artifact properties.
2. Couple the type of EEE (Electrical and Electronic Equipment)/e-waste to national and international registration, statistics, trading and goods codes.
3. Calculate the total EEE (Electrical and Electronic Equipment) put on the Chinese market over time.
4. Investigate the normal lifespan of various types of EEE (Electrical and Electronic Equipment) in China over time.
5. Determine the normal weight of various types of EEE (Electrical and Electronic Equipment) in China over time.
6. Determine the reuse rates for various types of EEE (Electrical and Electronic Equipment) and their feedback loops into sales and home stocks.
7. Investigate household penetration rates for various types of EEE (Electrical and Electronic Equipment).
8. Study end-user attitudes and habits regarding the discarding of EEE (Electrical and Electronic Equipment).

By adopting above calculation procedures, we can estimate the total e-waste generation and plan for e-waste management thereto in China. One view held that domestic e-waste generation in China and dumping of e-waste in China
from other nations is more than the total e-waste generation by the rest of the world.

3.6.3. Health and ecological conditions for the informal segment involved in e-waste management in China

The informal segment can be generally divided into informal collectors i.e., scavengers, dealers, brokers, refurbishers and remanufacturers. Most of the ecological impact has been generated by the informal remanufacturers, even if other stakeholders greatly contribute to the formation and operation of informal e-waste trading networks.

Informal collectors are doing an efficient job of collecting obsolete equipments from end-users. Informal collectors have both higher penetration rates and are more flexible than formal collectors. The primary concern around informal assortment is that the collectors sell mainly the collected e-waste to informal remanufacturers. Their actions have been proven to have negative impacts on both the environment and worker’s health. It is consequently necessary to work with informal collectors and remanufacturers to improve the health and safety of the informal remanufacturing industry without sacrificing financial opportunities for people working in the informal segment.

Informal handling of e-waste in China involves intensive labour and low proficiency to handle various sub-assemblies. A thorough investigation of informal handling practices is necessary to determine which practices are acceptable and which practices cause damage to the environment and to the health of workers. Ecological studies of such method can help to characterize and quantify exposure pathways and identify perilous goods or methods that involve high stages of bio-accumulative toxics. Technical, financial and social assessments of informal remanufacturing methods can help to identify opportunities to change, upgrade or abandon particular informal handling actions.
The accumulation of noxious compounds such as heavy metals, PCBs and di-oxins in the water, soil and air at the remanufacturing sites in Southern China has reached a vital phase. Without concerted ecological remediation measures in polluted sites, these persistent chemicals will continue to pollute the water, soil and air of these sites for a long time, posing significant health risks to local residents. In order to prevent further damage to local ecological systems and threats to the well-being of local residents, ecological rehabilitation and pollution prevention measures must be taken in key e-waste remanufacturing sites, such as Guiyu and Taizhou. In addition, solution oriented research such as ecological and affordable technologies, financial measures, effective managing guiding principle will fundamentally help to transfer or upgrade the pollution actions of informal remanufacturing.

3.6.4. Development of domestic e-waste management law in China

In early 2011, a key piece of China’s domestic e-waste law called “the Regulations on the Administration of Remanufacturing and Treatment of Waste Electric and Electronic Goods” went into effect. Known as China WEEE due to its equivalence to the European Union (EU) WEEE Directive, the purpose of this law is to institute appropriate e-waste assortment and remanufacturing in China. The StEP Initiative has accumulated abundant knowledge regarding the advancement of WEEE Directive execution in the European Union (EU). Experiences and insights from WEEE law execution in the European Union (EU) and other nations could be drawn upon to help guide the execution of e-waste law in China and help Chinese policymakers adapt successful policies and avoid making the similar mistakes. Finally, the experiences of other nations, such as the United States of America, where the federal government has developed national recommendations for electronic stewardship and various states have developed electronics take-back laws, may also be helpful in shaping Chinese guiding principle and practice.
3.6.5. Improvement and promotion of enterprises involved in e-waste handling

Many formal e-waste handling enterprises have grown and prospered as a result of the execution of the ‘Old for Latest Programme’ and the promulgation of China’s e-waste law. Some formal handling enterprises have not thrived, even if, due to factors such as lack of handling capacity, appropriate technologies or best practices. Project demonstration can enhance the introduction and exchange of best technical, financial and ecological processing practices.

3.6.5.1. Establishing a certification system

In the United States of America, there are currently two accredited certification programmes for electronics remanufacturers i.e., the Responsible Remanufacturing Practices and the e-Stewards standards. They aim to reduce ecological and human health impacts from improper remanufacturing. In China, establishing a third-party certification system, which would operate in conjunction with the current licensing system, could help strengthen standards for the ecologically effective management of e-waste. Similar certification system is requisite in China also.

3.6.6. Artifact Tracking- Technology assessment, identification and transfer

China’s economy and its e-waste remanufacturing industry are currently undergoing a transition period. There is an ample spectrum of e-waste handling services and practices, ranging from low technological tools, manual labour intensive, informal handling to high technological and highly mechanized formal handling. Even, there is a lack of detailed technical, ecological and financial assessment of these services. This would require precise investigation into the various handling methods, together with full records of material balances and emissions. Such detailed assessments would fill technical and knowledge gaps. This would also facilitate valuable insights for further improvement on such
important aspects as control of emissions and noxious compounds, among others.\textsuperscript{120}

After citing the e-waste management laws, models, principles adopted in various nations, the researcher strongly recommends that effective e-waste management not only includes the liability principles over end-user or onto the manufacturer, but e-waste management is a process. For an effective e-waste management process it is the collective duty of everyone involved in the process to imminent care to manage e-waste properly. From manufacturing to remanufacturing, EEE (Electrical and Electronic Equipment) goes from one hand to other hand and it travels from nation to nation. Collectively, across the globe, we do not have the system to calculate that how much amount of EEE has been produced across the world and how much EEE is in use and how much e-waste has been collected for remanufacturing and how much e-waste has been dumped every year? The researcher recommends the system to provide Product Identification Number (PIN) for EEE across the globe so that we can trace every EEE and collect for disposal or recycling effectively.

\textsuperscript{120}http://isp.unu.edu/ (Visited on Aug. 12, 2013)