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The Challenges of E-Waste Management in India: Can India draw lessons from the EU and the USA?

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Summary
This article examines e-waste management in India, identifying lessons and implications from e-waste management in the European Union and the United States which may influence or predict both strengths and obstacles to effectiveness in Indian e-waste regulation. India's new draft E-waste (Management and Handling) Rules are much more comprehensive than any US e-waste regulations and contain several similarities to the EU's current WEEE Directive. The inclusion of the EPR principle and the role of stakeholders in formulating the draft rules are both positive developments that are essential to address the e-waste problem successfully. Once in effect, however, the draft rules are likely to face many of the same obstacles to implementation and enforcement present in the EU and the US. Ultimately, until an international definition of e-waste is in place and the economic causes of illegal e-waste export and handling are addressed in all three entities, enforcing regulatory compliance and eliminating the health and environmental hazards related to e-waste dismantling in India will remain difficult.

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1 Introduction

In recent decades, the use of electronic and electrical devices has increased significantly, leading to rapidly rising amounts of waste electrical and electronic equipment (WEEE), often also called e-waste, throughout the world. E-waste is a highly complex waste stream as it contains both very scarce and valuable as well as very toxic components.[1] It also lacks a uniform international definition. In this article, we have chosen to use the terms WEEE and e-waste interchangeably. According to the definition put forth by the Solving the e-Waste Problem (StEP) Initiative, e-waste is

> "a term used to cover almost all types of electrical and electronic equipment that has or could enter the waste stream. Although e-waste is a general term, it can be often considered to cover almost any household or business item with circuitry or electrical components with [a] power or battery supply" (StEP 2009).

[1] E-waste has been dealt with extensively in academic literature. Several studies have examined the regulatory aspects of e-waste. These studies have tended to focus on the regulation in one particular area (e.g. GAO, 2008; Huisman et al., 2007) or compared regulatory mechanisms in a more general manner (e.g. Kahhat et al., 2008).

Over the last few decades, India, along with other Asian and African countries, has become a major destination for e-waste exports from OECD countries. In addition, Indians have been generating rapidly increasing amounts of e-waste domestically. As of September 2010, there was no comprehensive regulation in effect covering the management, recycling and disposal of e-waste in India and the import of WEEE into the country. Consequently, much of the domestic and imported WEEE ended up in illegal dismantling and recycling facilities where workers use processes hazardous to both their health and the environment. The new draft E-waste (Management and Handling) Rules, hereafter "draft rules" or simply "the draft", are expected to come into effect by the end of 2010. The draft rules aim to address both domestic e-waste management and the import of e-waste into India.

This paper focuses on how the problems surrounding e-waste regulation in other countries – particularly those that export to India – may influence or predict potential points of success as well as obstacles to the effectiveness of Indian regulation. We use the examples of WEEE management regulation and enforcement in two of the world's largest e-waste producers and the two biggest exporters of e-waste to India, the United States of America (US) and the European Union (EU). These examples are useful for two reasons: firstly, obstacles encountered in implementing and enforcing e-waste regulation in the EU and the US may contain important lessons for the implementation and enforcement of such regulation elsewhere – including the draft e-waste rules in India. Secondly, examining existing e-waste regulation and enforcement in these entities can reveal whether or not the EU and the US can be expected to stop or decrease exports to India. Both entities possess the technology to treat their own e-waste – so the questions of why and how some of this WEEE ends up in India and which laws the EU and the US have to regulate these exports are relevant to assessing whether or not the Indian regulation will be able to lessen the e-waste problem. If the EU and the US are unable to stop their own WEEE from being exported, India will continue to carry a double burden in e-waste management, having to address the handling of both the country's own domestic e-waste and the imports.

The paper first describes the sources of Indian e-waste and the circumstances under which e-waste is currently recycled in India. It then presents an overview of the regulation and enforcement of e-waste management, particularly with regard to WEEE exports, in the US and the EU. Bearing in mind the strengths and weaknesses of regulation in the EU and the US, the paper then explores Indian e-waste regulation and the provisions of the new draft rules. We conclude that the draft rules represent an impressive step in addressing the problems caused by e-waste in India, far surpassing any attempts made by the US to regulate e-waste management and containing the same advanced EPR principles as the EU's comprehensive WEEE regulation. Once in effect, however, the rules are likely to face many of the same obstacles to implementation and enforcement present in the EU and the US. We suggest that a unified international definition for WEEE should be introduced and

additional policy approaches should be considered, including more research into flexible mechanisms and regulations that not only provide specific methods of enforcement, but also address the economic incentives to export and handle e-waste illegally. Until the economic causes of illegal e-waste export and handling are addressed worldwide, enforcing regulatory compliance and eliminating the health and environmental hazards related to e-waste dismantling in India will remain difficult.

This exploration of e-waste regulation in India, the US and the EU is only one aspect of a larger project conducted by the authors with the purpose of evaluating the effectiveness and sustainability of the Basel Ban, an amendment to the *Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal*, proposed in 1995, which forbids the export of e-waste from OECD countries to non-OECD countries. This is a mechanism by which to address the problems caused by e-waste exports. Our conclusions in both the project and this article are based on expert interviews and careful research of publications, statistics and studies on e-waste issued by government and business organisations, NGOs and academia. We interviewed academic, NGO and European Commission experts involved in the development and enforcement of WEEE legislation in both Europe and India as well as the Chief Operating Officer of ATTERO Recycling in India.

2 Background: sources of e-waste and its management in India

The complexity of e-waste flows within India and inadequate record-keeping by industry participants make an estimation of the quantities of e-waste within India difficult (Streiche-Porte et al., 2007: 36; Sinha, 2008: 36). However, a study limited to an examination of computers, mobile phones and televisions reckoned that 382,979 tonnes (t) of e-waste were generated in 2007, 50,000 t (approx. 13%) of which were imported illegally (Khattar et al., 2007: 8). Of the e-waste imported into India, it is estimated that approximately 80% is imported from the US, while the remaining 20% is predominantly imported from the EU (Sander & Schilling, 2010: 66; Pratap, 2009). Nonetheless, as the import of e-waste is illegal (Jain, 2009: 2) and e-waste is often shipped via third countries (Pratap, 2009), it is unrealistic to expect these statistics to be exact.

Of the estimated 382,979 t of e-waste generated in India, 144,143 t entered the e-waste stream. The e-waste not entering the waste stream became obsolete, but was not thrown away or sold (Khattar et al., 2007: 8). A pervasive view of e-waste as a commodity causes a reluctance to dispose of e-waste immediately (Sinha, 2008: 36), although modest incentives (e.g. a free coffee mug) have been demonstrated to be effective in encouraging disposal among consumers (Pratap, 2009).

Because of the important role of the refurbishment and resale market in India, only 19,000 t were ultimately recycled (Khattar et al., 2007: 8). As large household

appliances constituted approximately 20% of the e-waste stream in India in 2007 (Dwivedy & Mittal, 2009), the inclusion of these appliances increases this figure by approximately 25%. The informal sector recycles 90-95% of the e-waste recycled in India (Khattar et al., 2007: 9; Raghupathy, 2009).

The dominance of the informal sector can be explained by the toxic, yet efficient methods used in recycling. The toxicity of the informal recycling sector has been widely covered in previous studies (Bridgen et al., 2005; Keller, 2006; Sepulveda et al., 2005; Sarkar, 2008). One study comparing the activities of an informal recycler using mercury amalgamation and cyanide leaching to those of a formal recycler using an alternative gold-stripping substance found that while both recyclers achieved similar gold-recovery yields during dismantling (16-56%), the informal recycler's yield during chemical processing was 36-60%, compared to 25-40% achieved by the formal recycler (Keller, 2006: 49). However, the formal recycler recovered additional gold when the waste liquids underwent further treatment. State-of-the-art recyclers such as Umicore in Belgium and Attero in India can achieve gold-recovery rates of approximately 99%. This level of recovery involves considerable extra cost, however, making it difficult for state-of-the-art recyclers in India to obtain enough e-waste to operate at full capacity (Gutpa, 2009).

Although perhaps only slightly less efficient than recyclers not using state-of-the-art technology, the informal recyclers' process used between 3 and 21 kilograms of chemicals, over 50 litres of water and lost between 1.3 and 3 grams of mercury to evaporation while recovering a single gram of gold and six grams of silver (Keller, 2006). In the thirty litres of waste water produced and disposed of without further treatment, arsenic, lead, cadmium, copper, nickel and zinc were found at levels 5, 8, 10, 370, 4.5 and 8.5 times the maximum threshold value established by Swiss legislation respectively (Keller, 2006). This level of toxicity is relatively high compared to the minimal environmental hazards caused by the formal recycler, where the only potential hazard comes from stripped circuit boards stored in such a way that heavy metal can leach out. In the formal sector, recyclers pay to have their waste effluent sent to a treatment plant, thereby increasing their operating costs.

With roughly similar recovery rates to formal recyclers being common across India, lower legislation compliance costs and the ability to externalise significant environmental costs (Streiche-Porte et al., 2007: 326), the informal recycling sector is able to out-compete the formal sector, including state-of-the-art recyclers, in bidding for e-waste in India. The informal sector thus dominates e-waste recycling in India (Chaturvedi, 2009). Modelling has also revealed that this dominance would be maintained even if metal prices and concentrations were to move in favour of formal recyclers (Streiche-Porte et al., 2007).

Legislation designed to reduce the environmental hazards of e-waste recycling in India thus needs to address the ability of informal recyclers to outbid formal and state-of-the-art recyclers. Legislation must either prevent informal recyclers from accessing e-waste in the same markets as formal recyclers or prevent them from externalising their costs. Ideally, this would be done in such a way that the informal sector would be integrated into the formal one.

3 E-waste legislation and enforcement in the US and the EU

The US and EU have developed different approaches for managing e-waste, diverging both in the legislative scope and the instruments' effectiveness. By examining the effectiveness and enforcement of the two entities' legislative approaches to manage e-waste, we hope to identify relevant features which may allow us to predict potential strengths and weaknesses of the new Indian draft regulations. Although we believe the lessons drawn from the US and the EU are important for Indian e-waste regulation, the US and EU's experiences cannot illustrate exactly what to expect from the Indian draft rules. India's status as a country in transition and the recipient of e-waste exports indicates that the e-waste problem in India is likely to encounter other obstacles in addition to those experienced in the US and the EU.

E-waste regulations and enforcement in the EU

The EU has been passing comprehensive and progressive e-waste legislation that is partly comparable to the new draft rules in India ever since the mid-1990s. This legislation not only controls e-waste flows as stipulated in the Waste Shipment Regulation, but also governs the disposal and collection of WEEE (WEEE Directive) as well as the restriction of hazardous substances in electronic and electrical equipment (RoHS Directive).

The export of e-waste is governed by Council Regulation No. 259/93, the so-called Waste Shipment Regulation (WSR), which was passed in 1993 and amended in 2007. Its main purpose is to control and regulate the supervision of waste shipments in order to prevent environmentally harmful shipments to countries without adequate provisions to deal with those wastes. According to the WSR, no EU member state is allowed to export e-waste classified as hazardous to non-OECD countries, including India (ECT/RWM, 2008: 14-15; IMPEL, 2004: 7-9). As a substantial number of e-waste components do not fall under the WSR's definition of hazardous, however, these components may be exported to non-OECD countries under special provisions. These provisions depend primarily on the importing country's acceptance of such waste. The export of non-waste used electrical and electronic equipment (EEE) to non-OECD countries is allowed in principle (ECTS/RWM, 2008: 15; Huisman et al., 2007: 195).

In addition to export regulations, the EU has passed e-waste legislation targeted at changing product designs and increasing recycling rates of discarded WEEE (Sander & Schilling, 2010: 21). The WEEE (Waste Electrical and Electronic Equipment) and RoHS (Restriction of the use of certain hazardous substances) Directives have been in force since 2003. While the RoHS Directive addresses the beginning of the EEE life cycle by attempting to eliminate hazardous substances such as mercury, lead and fire retardants in domestically produced or imported electrical and electronic products, the WEEE Directive concentrates on the end-of-life stages of EEE. The main objectives of the latter are to reduce the amount of EEE disposed of in landfills and to increase recycling and recovery of e-waste. Member states are required to set up collection and treatment schemes where consumers can return their used e-waste free of charge.

The Directive also intends to encourage product designs that facilitate the recycling, repair, disassembly and reuse of WEEE by introducing the concept of Extended Producer Responsibility (EPR). EPR allocates the financial responsibility for collecting and managing WEEE in line with the Directive to the producers (Hester & Harrison, 2009: 6). Individual Producer Responsibility (IPR) applies for the management of new products put on the market. For historical waste, i.e. products put on the market before 13 August 2005, the financial responsibility is divided among producers in proportion to their market share of a specific type of equipment (WEEE Directive, Article 8). The rationale behind producer responsibility is the "polluter pays" principle, which intends to include the costs of disposal and treatment in a product's price, thus reflecting the product's environmental effects (Nnorom & Osibanjo, 2008: 845).

Despite the wide-ranging legislation, only a third of the WEEE arising in the EU is officially reported as being treated in line with the WEEE Directive. Part of the remaining two thirds, which have been collected but not reported, is suspected of being treated in the EU without appropriate environmental care or of being shipped illegally to treatment sites outside the EU that do not meet European environmental and health standards. Some of the e-waste may also be dumped in developing countries (EC, 2008a: 2).

Although the current data situation regarding e-waste shipments out of the EU is not sufficient to determine the exact quantities of e-waste being exported legally and illegally, some general tendencies can still be identified.[2] Only a small fraction of the total amount of WEEE generated in the EU is legally exported to non-EU countries, although the quantities of e-waste actually shipped are believed to be much higher

[2] The lack of sufficient and reliable data is due to a variety of reasons: data retrieved from trade statistics can only be used to a limited extent as these figures do not allow classification of EEE as waste, used or new products and only a small number of codes are clearly on WEEE (ETC/RWM, 2008: 51); the potentially most reliable source at present, i.e. data reporting according to the WEEE Directive, only started in 2005 and is published with a time lag. Fraud in documents also contributes to the difficulty of determining the true quantity of e-waste (EEA, 2009: 50).

(ETC/RWM, 2008: 50-54). Both our interview partners and studies conducted indicate that a substantial amount of WEEE is still exported illegally despite EU legislation proscribing the export of e-waste to non-OECD countries (EC, 2008b: 5; Zoeteman et al., 2009: 29-30). The occurrence of illegal exports to non-OECD countries shows that both the WSR and the WEEE Directive have enforcement deficits. A brief overview of the main factors behind this situation is presented below.

Although the complex regulatory system for waste shipment set up by the WSR has a significant impact on the export of WEEE, various legal and implementation issues hamper the legislation's overall effectiveness. These include a lack of capacity on the part of the authorities involved, for instance to pursue inspections more proactively; gaps in national law for enforcement in case of non-compliance; and legal grey areas in the WSR concerning the classification problems regarding waste, particularly the difficult distinction between functioning second-hand and waste products, among other things (IMPEL, 2006: 22, 28). The lack of criteria for distinguishing new, used and waste products is one of the main reasons for illegal exports. Various cases have been detected in which used EEE was declared to be second-hand and functioning, when in fact it was not working and in part considered hazardous (ibid.: 49; Huisman et al., 2007: 195).

The WEEE Directive influences both the management and – albeit rather indirectly – the export of e-waste. The Directive does so by setting collection targets for recycling e-waste and trying to promote reuse of WEEE while diminishing its generation. However, there are indications that the Directive's existing requirements for treating the separately collected WEEE have not been effective (EC, 2008c: 2). The interviews conducted even pointed to an increase in illegal e-waste exports as a result of the WEEE Directive – a situation quite contrary to its actual intention. This situation results mainly from the fact that the high and ambitious environmental standards stipulated in the Directive involve additional costs of treatment, likely fuelling e-waste trade with non-OECD countries where the costs are much lower (EC, 2008b: 8).

In an effort to address the Directive's insufficient effectiveness and efficiency, the European Commission proposed a revision of it in 2008. Several modifications currently under discussion could possibly help to reduce illegal e-waste exports to non-OECD countries. These include setting a higher mandatory collection target for e-waste, establishing minimum monitoring requirements for WEEE shipments and introducing a legally binding provision for the distinction between new, used or waste products to tackle the false labelling of WEEE as used EEE (EC, 2008a: 7; Sander & Schilling, 2010: 22).

The European experience with legislating WEEE indicates that India's new draft rules may well experience similar enforcement problems. The European example has shown that enforcement issues related to e-waste legislation are not trivial and are mainly related to the nature of e-waste itself. Firstly, concerning export regula-

tions, the existence of many export points, i.e. many different ports in the case of transboundary shipments, and a huge number of goods exported with a relatively low specific value make it impossible to check all containers or even control the reusability of second-hand EEE. Currently, spot checks exist and are going to be extended. Yet economic forces ultimately limit the effectiveness of these means even if they are combined with joint enforcement and awareness-raising projects (e.g. IMPEL 2006). These forces, driven by a huge demand for EEE in non-OECD countries and a significant price difference for the recycling/dismantling of e-waste between OECD and non-OECD countries (Basel Secretariat, 2009: 1-4), constitute the strongest incentive not to comply with export regulations at present. India is therefore likely to face similar problems related to the monitoring of e-waste imports into India.

Secondly, in terms of legislation targeted at the disposal and collection of e-waste, the WEEE Directive's recast points to a number of problems India might also encounter when setting up a sophisticated collection system for e-waste. These include issues such as the leakage of WEEE from the official collection system (EC, 2008a: 2), but also unnecessary administrative costs for stakeholders in compliance with the Directive. These costs stem, inter alia, from differences in managing national producer registers which could apply on the state level in India (EC, 2008b: 50).

The example of the EU indicates that clear legal provisions, including those for monitoring and enforcement, the need to raise awareness of existing regulations among all relevant stakeholders and the recognition of e-waste's potentially hazardous nature in conjunction with a more sustainable use and reuse of EEE are necessary for effective handling of e-waste.

E-waste regulations and enforcement in the US

Unlike the EU, the US Congress has failed to pass federal legislation specifically targeting either the national management or the export of WEEE. As a result, only two federal regulations address e-waste and its export: the Resource Conservation and Recovery Act of 1976 (RCRA) and the Environmental Protection Agency (EPA)'s CRT Rule.

RCRA proscribes a "cradle to grave" tracking system for hazardous waste. The law requires individuals or companies handling, disposing of or shipping hazardous waste to obtain permits from the EPA and/or get permission from importing countries (EPA 2009b; GAO, 2008: 32). However, RCRA contains two main loopholes that result in a failure to regulate most e-waste. Firstly, RCRA regulates WEEE disposal only when the electronics in question fall under the act's definition of hazardous waste. When disposed of in landfills in the US, most e-waste does not meet this definition; when dismantled abroad, however, exposure to toxins increases (GAO,

2008: 32; Puckett et al., 2002). Additionally, EPA has created exemptions for the export of certain hazardous items (EPA, 2010b; ETBC, 2008: 6).

Secondly, households and businesses producing up to 220 pounds of hazardous waste per month may dispose of that waste in landfills within the US (EPA, 2010b). A good deal of the small amount of WEEE that falls under the hazardous-waste definition thus remains unregulated (GAO, 2009: 3-5). An unknown quantity of this waste may be shipped abroad. In sum, RCRA does little to regulate either the disposal of municipal e-waste within the United States or its export.

Only items containing cathode ray tubes, or CRTs, presently fall under RCRA's definition of hazardous waste. Consequently, the EPA has created a rule regulating the disposal of these items, which are primarily televisions and computer monitors. If e-waste exporters wish to ship CRTs abroad for recycling, they are required to inform EPA of shipments planned for a period of 12 months or less; the EPA then contacts the importing country and obtains written permission for the shipments (EPA, 2009a).

The CRT rule currently in effect also contains important loopholes that weaken its already limited regulation of US e-waste exports. Firstly, the rule only regulates the export of unsorted CRT glass and CRTs destined for recycling. Exporters of intact CRTs intended for reuse merely need to submit a one-time notification of export to the EPA and maintain records that prove that the CRTs will be reused. Notifying the importing country is not necessary (EPA, 2009a). Secondly, the EPA does not restrict the export of unused, intact CRTs intended for reuse or recycling or that of processed CRT glass (ibid.).

Thus, as the federal government does not consider most e-waste hazardous, American recyclers may ship the electronics abroad with virtually no restriction. The federal CRT rule limits exports, but only of a small fraction of the total e-waste stream. Furthermore, a GAO (2008) study turned up significant evidence that the EPA has failed to implement and enforce the CRT rule. Many recyclers either directly violate the rule by not notifying the EPA of their exports or seek to circumvent it by labelling shipments as destined for reuse, regardless of the electronics' actual level of functionality. They have received few sanctions (ibid; GAO, 2005a: 14-15).[3]

In the absence of federal legislation regulating most types of e-waste disposal, an increasing number of US states have begun to develop their own e-waste regulation and management systems. 23 states have passed EPR legislation that restricts the disposal of certain types of e-waste, but the strength and scope of the provisions

[3] In August 2010, the EPA announced "cleaning up e-waste" as one of its six new international priorities (EPA, 2010c). The announcement indicates that changes in this area might occur in the near future.

vary greatly from state to state. The other 27 states have no restrictions on e-waste disposal.

Although state programmes have had some success in increasing recycling, the states are also encountering enforcement problems due to their limited powers and the vast scope of WEEE. Additionally, their power to enforce their legislation ends at their borders (NREC, 2006: 15). As a result, the five states whose laws seek to restrict or impose conditions on the international export of e-waste can do very little to enforce these provisions.

Indeed, the "patchwork" of state laws has indirectly resulted in an increase in e-waste exports for two reasons. Firstly, exports are growing because the state laws mandating recycling are working. The percentage of e-waste collected for recycling has indeed increased in recent years (EPA 2008: 23; Wagner 2009; GAO 2005b: 15). Since recyclers export the large majority of that WEEE, increasing amounts of waste and a higher percentage of recycled products almost certainly indicate higher absolute and per capita export volumes (GAO 2008: 42; Tonetti 2007: 6).

Secondly, the absence of federal e-waste laws strengthens the existing economic incentive to export e-waste. American recyclers and manufacturers send their e-waste abroad because recyclers in developing and transition countries can extract the precious materials more cheaply (Puckett et al., 2002). In the absence of a national collection system, electronics recyclers operating in the United States have difficulty obtaining enough e-waste to operate their expensive machinery at an economy of scale. As in the EU, the environmentally sound treatment of e-waste incurs high costs, thereby encouraging illegal trade. Furthermore, with few regulations attempting to influence or encourage changes in product designs, electronic products become obsolete quickly and remain difficult and expensive to disassemble in both the US and the EU (GAO, 2005a: 9)

As a result, the state e-waste laws actually make WEEE management and recycling in the US more economically inefficient. Each state's regulations differ from the others' and sometimes even conflict with them. This regulatory "patchwork" has significantly increased the costs to both e-waste recyclers and electronics manufacturers (NCER, 2006; Daly, 2006; GAO, 2005b: 17-18). One study found that complying with and enforcing the 20 overlapping and conflicting state regulations costs government, recyclers and electronics manufacturers an extra US$125 million per year (NCER, 2006). Several voluntary programmes run by manufacturers exist, but these have not been very successful at increasing the recycling volume, especially in states without any e-waste regulation (Wagner, 2009: 3017; Daly, 2006; Dempsey, 2009). The large amount of e-waste currently stockpiled in US businesses and households and being disposed of in landfills represents a tremendous economic opportunity for the US recycling industry. However, most electronics manufacturers and recyclers agree that this potential cannot be realised without a federal e-waste programme (NCER, 2006; Daly, 2006).

The situation in the United States has a number of implications for the effectiveness of e-waste management regulation in India. On the positive side, India, while also a federal system, appears to have escaped the US problem of conflicting state regulations by creating the draft rules on a national level. There are also several more problematic implications for India found in the American example, however.

Firstly, the US does not appear to enforce the part of its WEEE legislation that regulates exports. Given the limited scope of federal regulation concerning these exports, this failure seems to be less a question of capacity than of willingness (ETBC, 2008). However, the US does face a number of real obstacles to regulating e-waste. For instance, the lack of a common e-waste definition both at home and internationally makes the creation of legislation difficult. Without an international customs code differentiating between different types of e-waste, the EPA would have difficulty identifying and monitoring shipments sent abroad (GAO, 2008). In the case of India, this could indicate a potential difficulty in monitoring incoming shipments. As also seen in the EU, the large number of ports dealing with e-waste shipments also makes reliable enforcement difficult. India will face many of these same logistical problems when trying to control e-waste collection and imports. In addition, the lack of enforcement in the US puts virtually the entire burden of stopping US e-waste exports on India's shoulders.

Moreover, the experience on the US state level indicates that enforcing compliance with e-waste regulations can involve a great deal of expense. Tracking down manufacturers and/or consumers of electronics to hold them responsible for their waste can be costly, time-consuming and burdensome for both state and federal governments (Wagner, 2009; NCER, 2006; Daly, 2006). This cost disincentive, the economic incentive for recyclers and collectors to dispose of e-waste illegally and the complex logistics involved in monitoring e-waste have all proven to be major obstacles to enforcement in both the US and the EU. Additionally, differences in implementation and enforcement between the Indian states could lead to a version of the patchwork situation that exists in the US, complete with additional costs for companies and governments. The American example thus indicates several potential obstacles that India may encounter while trying to implement and enforce regulations concerning not only e-waste imports but domestically generated WEEE as well.

4 E-waste regulation in India

The environmentally sound management of e-waste is a significant challenge for India. The challenge relates not only to imported e-waste, but also to the increasing amounts of domestically produced WEEE. Despite this situation, as of September 2010, neither the central government nor the state governments had legislation in effect solely dedicated to e-waste. The following section examines the current regulatory framework for e-waste in India, examining existing legislation, voluntary

e-waste guidelines released by the central government, and the new draft rules dedicated to e-waste management.

The Environment (Protection) Act (EPA), enacted in 1986 following the Bhopal gas tragedy, was the first comprehensive environmental law. The Act only defined hazardous waste in very broad terms and did not address e-waste at all (Abraham & Abraham, 1991). However, what it did do was confer the power to enact regulations concerning environmental issues on the executive. Since then, the precautionary and the "polluter pays" principle have both become part of Indian environmental policy. Yet despite these developments, no regulation on e-waste has been enacted and no Indian environmental law has implemented or enforced the concept of EPR to its full extent (Mohan et al., 2008: 183).

Although no e-waste laws currently exist, two regulations established under the provisions of the EPA – the Hazardous Waste (Management and Handling) (HWM) Rules and the Batteries (Management and Handling) Rules – are applicable to some extent (Alexeew et al., 2009: 6). The Indian Municipal Solid Wastes (Management and Handling) Rules of 2000 do not cover e-waste at all (Mohan et al., 2008: 184), although some e-waste could potentially be regulated on a municipal level.

The HWM Rules require any company or individual receiving, treating, transporting or storing hazardous waste to first obtain permission from the relevant State Pollution Control Board (SPCB). Furthermore, the HWM Rules also banned the import of hazardous waste for disposal or dumping. The central government can, however, issue an import authorisation for hazardous waste that is to be processed or reused. An amendment to the HWM Rules in 2000 expanded the scope of the Rules to include provisions on e-waste for the first time. However, these provisions only applied to import and export activities (HWM Amendment Rules, 2000).

The new Hazardous Wastes Management, Handling and Transboundary Movement Rules of 2008 replaced the old HWM rules and now contain additional provisions on e-waste handling within India. These provisions require every person planning to recycle or reprocess e-waste to obtain prior authorisation from the relevant SPCB. However, the SPCB registration process has been criticised for granting the same authorisation to collectors, dismantlers and recyclers without assessing their capability to treat the e-waste in an environmentally sound manner (Gupta, 2009). Furthermore, responsibility is split between the states and the federal government. The central government authorises individuals importing e-waste for processing or reuse, and the SPCBs authorise collectors, dismantlers and recyclers.

The Batteries (Management and Handling) Rules exclusively cover lead acid batteries and thus have a very limited impact on e-waste. The Batteries (Management and Handling) Rules were, however, the first regulation to implement aspects of EPR in India. Under the regulation, manufacturers, importers and assemblers are responsible for organising a collective take-back system for batteries. They must also ensure that the batteries are then handed to registered recyclers (Batteries (Managing and

Handling) Rules, 2001). Dr. Raghupathy (2009), advisor to the Manufacturer's Association for Information Technology (MAIT) and author of the new draft rules on e-waste, has criticised the Batteries rules' lack of an effective enforcement mechanism and argued that the rules have failed because the collection system failed.

As in the US, the patchwork of regulations covering e-waste has led to a number of problems that hamper WEEE regulation and enforcement (Sinha-Ketriwal et al., 2005: 498). Like the lack of differentiation between new, used and old EEE in EU customs codes, customs documents under the current Indian regulatory system do not differentiate between old and new computers. Only one export-import (EXIM) code exists for both old and new computers, preventing targeted compliance monitoring (Sinha, 2008: 33). Furthermore, imports are often falsely declared to be for charity, going instead to informal recyclers or becoming e-waste within two or three years (Basu, 2008: 45).

The allocation of responsibility under existing legislation also causes problems. Responsibility for monitoring some activities falls to the states, while the federal government is responsible for others. As in the US, this can be expected to increase compliance costs for formal recyclers and cause difficulties in enforcement and monitoring in an environment where capacity is both limited and strained. In a similar vein to the CRT legislation in the US, the EPR system introduced by the Battery Rules operates in isolation. Lacking an effective enforcement mechanism, the legislation remains ineffective. This combination of factors has resulted in the dominance of the informal recycling sector as environmentally sound recyclers have difficulty sourcing enough e-waste to operate at capacity (Gutpa, 2009; Schreiber, 2009). Many stakeholders have thus argued that "the absence of legislation is one of the biggest stumbling blocks in implementing an e-waste management system" (GTZ et al., 2009: 4). Stakeholder contributions to the draft rules on e-waste published by the Ministry of Environment and Forestry (MoEF) in 2009 are thus all the more important (Saroj, 2009).

The draft E-waste (Management and Handling) Rules are the most recent attempt to regulate e-waste in India. They are not the first one, however. Largely as a result of pressure from stakeholders following the publication of the Toxics Link study on e-waste in 2002, the Central Pollution Control Board (CPCB) released guidelines on e-waste management in 2008. These guidelines advocated the voluntary adoption of producer responsibility, the restriction of hazardous substances (RoHS) in manufacturing and the adoption of environmentally sustainable technologies in e-waste recycling (Chaturvedi, 2008: 15; Raghupathy, 2009). However, Dr. Saroj, from the Indian Ministry of Environment and Forests (MoEF), has acknowledged that the guidelines are obsolete because nobody actually adheres to them (Saroj, 2009). The failure of previous attempts at e-waste regulation makes the current draft rules' success all the more urgent.

The latest version of the draft rules was made available by the MoEF on 14 May 2010 and was opened for comments until the end of July. While the draft rules have not entered into force yet, we do not expect any significant changes to be made to them. The draft's scope includes all the stakeholders involved in e-waste handling, with a focus on producers, dealers, refurbishers, collection centres, consumers, dismantlers and recyclers. The regulation is based entirely on the EPR and IPR principles. If enacted, it would be the first piece of Indian regulation to integrate these principles comprehensively.

The draft rules state that e-waste producers have to ensure that their waste products cause no harm and that their products have been produced in line with the *Reduction in the use of Hazardous Substances (RoHS) in the manufacture of electrical and electronic equipment* requirements. They will also have to ensure that all their products have a unique serial number or individual identification code and take responsibility for all previously generated waste branded with their name. Additionally, producers are responsible for implementing and financing an effective take-back system only involving authorised stakeholders (MoEF, 2010: 4).

E-waste dealers, refurbishers, dismantlers, recyclers and collection centres are all required to register with the relevant State Pollution Control Board (SPCB) or Pollution Control Committee (PCC). They are also required to comply with detailed provisions on how to handle the e-waste to ensure that they do not create any health hazards or harm the environment. Dealers of electrical equipment are responsible for collecting e-waste by providing a collection box. They are also required to submit information about the e-waste collected to the SPCB or PCC (MoEF, 2010: 5-9). Although the draft rules require consumers to dispose of e-waste by taking it to authorised dealers and collection centres, large consumers are still allowed to auction their waste. However, they may only auction it to authorised collection centres, dismantlers, recyclers or to the collection services offered by the producers (MoEF, 2010: 7).

The draft rules assign all responsibility for ensuring enforcement to the respective SPCB or PCC. Every institution registered by the authorities has to provide the SPCB or PCC with annual reports. If a registered and authorised institution fails to comply with the regulations, the SPCB or PCC may revoke its authorisation (MoEF, 2010: 9). However, the draft does not specify any further concrete measures to ensure proper monitoring, implementation and enforcement. This could lead to future implementation and enforcement problems, particularly given the previous reluctance of producers to take responsibility for their waste, the failure to enforce EPR in the Batteries Rules, and the complex logistics and high potential costs involved in tracking and collecting e-waste seen in other countries.

Importantly, the draft rules also address imports. An initial draft of the rules stipulated that imports would not be allowed for recycling or disposal. WEEE imported for refurbishment or repair would be allowed "subject to the same being exported"

(MAIT, 2009: 12). However, the latest draft simply states that: "Every [sic!] producer(s), dealer(s), collection centre(s), refurbisher(s), dismantler(s), recycler(s), auctioneer(s) consumer(s) or bulk consumer(s) shall not import used electrical and electronic equipment in India for use" (MoEF, 2010: 12). This total import ban will be very difficult for India to enforce. As all shipments are illegal, many would be falsely declared; any future distinction that export-import codes make between old and new computers would also be redundant. Although current enforcement is not working, the current draft rules do not specify how such an import ban should be enforced.

The draft rules also address the informal sector; their inclusion is implied by the draft's reference to a multi-stakeholder approach (Raghupathy, 2009: 1). The regulation seeks to formalise the informal sector by organising, registering and monitoring their activities rather than aiming to shut them down. The draft rules intend to shift recycling and metal-extraction activities to the formal sector. Ideally, the informal sector would become part of the EPR solution (Raghupathy, 2009: 1; Chaturvedi, 2009: 2). However, beyond requiring registration, the draft does not specify how it will ensure that informal recyclers reduce their operations to dismantling and collection activities. Furthermore, the underlying incentives that result in the informal sector being able to outbid the formal sector remain unaddressed. While formalisation may be an appropriate goal, the draft rules are ill-equipped to achieve it.

A further obstacle to the new draft rules' implementation is a lack of awareness of the hazards of improper e-waste disposal. Most manufacturers currently ship their products without any information about how to handle them at their end-of-life. Consequently, consumers are unaware of proper disposal methods. The Indian Central Government has not made any attempts to educate the general public about the issue thus far; the only education campaigns were small ones run by NGOs (Sinha, 2008: 42). Informal collectors, traders and dealers of e-waste are often either unaware of the problems or do not see the necessity of acting upon them. Without seeing a reason to adopt environmentally sound recycling processes, informal recyclers will be reluctant to integrate into the formal sector.

In sum, the proposed draft rules are a comprehensive piece of regulation that at least refers to all important e-waste issues. Such ambitious and comprehensive regulation goes a step beyond the US effort and represents an important first step in dealing with the complex problems that e-waste poses. Although commendable, the draft rules are likely to encounter many of the difficulties experienced in the EU and US; the draft does little to address monitoring and enforcement mechanisms, the role of informal recyclers in India or how the import ban will be enforced.

The damage caused by informal e-waste recycling activities in India is immense. Informal e-waste recycling dominates the industry, accounting for 90 to 95 per cent of all recycling. Future increases in metal prices are unlikely to erode the advantages

that have ensured the informal sector's dominance, and the problems related to informal recycling will only increase as domestic production of WEEE grows. As a result, including the informal sector is key to achieving a successful transformation of the current e-waste handling and recycling processes. Unfortunately, the draft rules do not address this problem adequately. The formalisation of collectors and dismantlers may be effective, but as long as informal recyclers are able to pay more for e-waste, an incentive exists for market participants to shirk compliance and illegally sell toxic material to informal recyclers. The regulation's effectiveness at reducing the role of informal recyclers will thus depend on the ability of the respective bodies to present a credible threat of enforcement.

Unfortunately, enforcement will be difficult. The draft rules contain several mistakes already made in the EU and US; the consequences of this are likely to be magnified in India, a country where capacity for enforcement is already strained. Devolving enforcement to a state level may result in 'leakage' from states actively enforcing the regulation to states taking a less stringent approach, as seen within the EU and US. Both the maintenance of the registry of authorised market participants and compliance with the regulation's requirements are also likely to be expensive, adding administrative costs to formal recyclers already struggling to compete. In the EU such costs may have increased the incentive for actors to illegally export e-waste to countries such as India; in India the incentive will be to sell to unauthorised recyclers. The continuation of e-waste auctions and the requirement that only authorised participants are able to buy the e-waste does, however, overcome the problem that diffused sources pose agencies charged with enforcement in the EU. By concentrating e-waste sources, the auctions provide Indian regulators with the ability to target their enforcement to some extent.

The most positive aspect of the draft rules is the inclusion of RoHS provisions. Addressing the toxicity of e-waste recycling by preventing pollutants from becoming part of the e-waste stream is likely to be enforceable and represents a further convergence of India's legislation with that of the EU. However, given the role of the refurbishment market in India, it may take considerable time for the benefits of this provision to become evident in recycling facilities.

5 Conclusion

The purpose of this article was twofold: to examine the implications that the legislative and enforcement successes and problems in the US and the EU might have for the new Indian draft rules; and to assess the degree to which the forthcoming Indian draft rules on e-waste would address the complexity of the problem in India, deal with e-waste imports and avoid the enforcement problems seen in the EU and the US.

The historic experience of the US and India demonstrates the paramount necessity of developing a comprehensive piece of legislation dedicated to e-waste. As the EU

example has shown, dedicated legislation can be expected to address the complexities of the problem better than the hotchpotch of existing Indian regulations. The new draft rules will provide a consistent mechanism for e-waste regulation, employ the concepts of producer and manufacturer responsibility, introduce RoHS standards into the electronics manufacturing industry and address the WEEE imports. The draft also addresses the integration of the informal recycling sector through a registration of their activities.

However, both the importance and the burden of India effectively implementing the new legislation are increased by the failure of the EU and US to monitor and enforce legislation preventing e-waste exports from increasing. India must manage increasing amounts of domestically generated e-waste and imports from the EU and US and do so with an already strained capacity for implementing, monitoring and enforcing environmental policy. The examples of the difficulties in regulating and enforcing e-waste legislation in the US and the EU also indicate that the Indian draft rules, should they become law, will almost certainly face a number of similar difficulties.

Firstly, the draft rules are unlikely to stop e-waste imports, illegal or legal, as the complex mechanisms involved with monitoring imports, exports and domestically generated e-waste are all extremely resource-intensive. Monitoring efforts in the EU, the US, and India are hampered by a lack of international customs codes differentiating between new computers, old computers and e-waste, and a large number of entry and exit points for e-waste in each country. Additionally, as in the EU and the US, the fact that the states possess the main responsibility for determining methods of monitoring and compliance may lead to additional administrative and compliance costs as well as differing degrees of enforcement.

India's new draft rules do not address these problems and are thus unlikely to prevent e-waste shipments or control domestic e-waste successfully. However, by allowing e-waste auctions to continue, the draft rules may enable domestic generation points to become somewhat more concentrated. This would avoid some of the difficulties that a large number of generation points within the EU and US have caused enforcement authorities and enable targeted monitoring of domestically generated e-waste.

Secondly, the enforcement of any e-waste regulation is hindered by economic incentives that encourage non-compliance and favour illegal markets. In the EU and the US, incentives exist to lower dismantling costs by exporting e-waste to areas with lower labour costs and less stringent environmental standards. Unnecessary administrative costs caused by legislative (US) and monitoring (EU) contradictions and overlaps further add to the financial burden of enforcement activities. In India, the lower compliance burden shouldered by the informal WEEE recycling sector and the latter's ability to externalise significant environmental costs create an incentive for e-waste to bypass the legal framework. It also encourages formal recyclers to use

crude, environmentally harmful extraction methods. As neither India's draft rules nor legislation in the EU and the US does much to address these economic incentives, both the informal recycling sector in India and the imports from the EU and the US are likely to continue.

In conclusion, the draft rules contain several necessary provisions for tackling the e-waste problem and are an important first step, despite requiring some additional details. However, the crucial question is still whether India will be able to enforce the legislation effectively or not, particularly as the experiences of the EU and the US illustrate the difficulty of enforcing regulations addressing such a complex problem. With regard to the import of e-waste, many have argued that an import ban would contribute to solving the problem.[4] We found in our report on the Basel Ban that a ban on imports would be unlikely to be effective or sustainable since it will be difficult and costly to implement and might destroy a potentially beneficial source of income for some of India's poor. Instead, it would be more useful to look at and try to find ways to address the root causes behind the imports and the illegal recycling sector, in this case the primarily economic incentives outlined in this paper, and promote a more sustainable use of EEE.

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[4] See, for example, Puckett et al., 2002; BAN, 2006; GAO, 2008.

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