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Difficulties in applying extended producer responsibility policies in developing countries: case studies in e-waste recycling in China and Thailand

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Abstract Developing Asian countries have started to apply the principle of extended producer responsibility (EPR) to electronics and electrical equipment waste (e-waste). This policy approach aims to give electronic appliance manufacturers and importers responsibility for the collection and recycling of discarded electronic equipment. China and Thailand have drafted regulations on the recycling of e-waste with common characteristics such as the financial responsibility of producers and subsidies for collection. Although the proposed system is sensible, taking into account the fact that e-waste is a market-traded commodity, there are two major difficulties in implementing EPR in developing countries. First, it may be difficult for governments to collect funds from producers or importers if smuggled, imitation, or small shop-assembled products have a large share in the market. Second, the system creates incentives for collectors and recyclers to over-report the amount of collected e-waste in order to gain extra subsidies from the fund. Other policy measures such as the enforcement of pollution control regulations on informal recyclers, the prevention of smuggling, and the protection of intellectual property rights should accompany EPR policies.

Key words Extended producer responsibility · WEEE · Free rider

Introduction

Extended producer responsibility (EPR) has been a key concept in promoting the 3Rs (reduce, reuse, and recycle) in developed countries. Under this approach, the financial responsibilities, physical responsibilities, or both of collecting obsolete items have been placed on the producer instead of on municipal authorities. The Organization for Economic Co-operation and Development (OECD) has reviewed experiences with EPR policy in member countries and has published a guidance manual on EPR for policymakers.¹

In Asia, the concept of EPR is gradually spreading. Up to now, it has been applied to several kinds of waste, such as packaging waste, electronics and electrical equipment waste (e-waste), and end-of-life vehicles in Japan, South Korea, and Taiwan. Japan enforced the Container and Packaging Recycling Law in 1997 and the Law for the Recycling of Specified Kinds of Home Appliances in 2001. The latter law covers four home appliances: TV sets, air conditioners, refrigerators, and washing machines; freezers were added to the list in April 2004. A recycling system for personal computers was also established based on the Law for Promotion of Effective Utilization of Resources. These regulations placed different types of financial responsibilities, physical responsibilities, or both on manufacturers and importers of these products. Chung and Murakami-Suzuki² compared the e-waste recycling systems in Japan, South Korea, and Taiwan and noted that the details of the systems differ significantly in terms of the responsibility of producers and cost-sharing mechanisms. Basically, EPR-based recycling systems have been introduced in order to reduce the social cost of waste management in these countries.

Developing Asian countries have made efforts to establish recycling systems based on EPR for several years. Both China and Thailand have drafted legislation for e-waste recycling and released it for public review. Other developing Asian countries are also moving forward to apply EPR to selected types of waste. Vietnam revised the Environmental Protection Law in 2005 (No.52/2005/QH11), to state that the producer and/or retailer shall be responsible for

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collecting expired and discarded products such as batteries, electronic and electrical equipment, lubricants, and tires among others (Article 67).³ However, because a detailed regulation has not yet been issued, this article is still not fully enforced. In 2007, Malaysia enacted the Solid Waste and Public Cleansing Management Act (Act 672), which stipulates that the government can place responsibility for the collection of products on the manufacturer, assembler, importer, or dealer (Article 102).⁴ The government can specify which kinds of products shall be collected by manufacturers, and the Department of Solid Waste Management in the Ministry of Housing and Local Government is preparing detailed regulations to implement this act. Indonesia enacted the Law on Rubbish Management in May 2008, which also applies the principles of EPR.⁵ Under article 15 of this law, producers are given the responsibility to manage packaging and/or products which are neither biodegradable nor easily disposed of by natural processes. In the Philippines, the National Solid Waste Management Commission is also considering applying EPR to e-waste and packaging waste (based on hearings by the author (M. Kojima) from the members and staff of the National Solid Waste Management Commission of the Philippines, in July 2007).

Some previous studies, including those of He et al.⁶ and Hicks et al.,⁷ proposed applying EPR in specific developing countries, especially in e-waste management, but they did not fully discuss the social and economic background of the e-waste problem in developing countries. In addition, such studies have not examined obstacles in implementing EPR in developing countries.

This article discusses the efforts and potential obstacles involved in applying EPR policies to combat e-waste in developing countries in Asia. We provide the background for the introduction of EPR in developed and developing countries, a comparison of the draft legislation on e-waste recycling in China and Thailand, and an overview of obstacles to the implementation of EPR in developing countries.

The concept of EPR and the background of its introduction

Background of the introduction of EPR in developed countries

The concept of Extended Producer Responsibility was originally defined by Lindhqvist⁸ in a report to the Swedish Ministry of Environment and Natural Resources in 1990 as: "Extended producer responsibility is an environmental protection strategy to reach an environmental objective of a decreased total environmental impact from a product by making the manufacturer of the product responsible for the entire life cycle of the product and especially for the take-back, recycling, and final disposal of the product. The extended producer responsibility is implemented through administrative, economic and informative instruments. The composition of these instruments determines the precise form of the extended producer responsibility."

The background of this concept stems from a reaction to the increase of waste that leads to an increase in waste management costs by local governments. Existing waste management systems should be revised to internalize disposal costs in the economy.

Lindhqvist's argument is similar to previous efforts in other countries such as the management of packaging and containers in Germany and the Netherlands and the deposit-refund system in Sweden and in several states of the United States. However, EPR had not been conceptualized when these policies were formulated.

Lindhqvist⁸ redefined EPR as "a policy principle to promote total life-cycle environmental improvements of product systems by extending the responsibilities of the manufacturer of the product to various parts of the entire life cycle of the product, and especially to the take-back, recycling and final disposal of the product." This reflects a recognition of broad objectives in addition to proper waste management, including design for the environment, which is considered to be the key to reducing the life-cycle cost of a product.

The OECD Guidance Manual¹ defines EPR as "a policy approach in which producers accept significant responsibility (financial and/or physical) for the treatment or disposal of post-consumer products." In addition, it states, "assessing such responsibility could provide incentives to prevent waste at the source, promote environmentally compatible product design, and support the achievement of public recycling and materials management goals."

Developed countries have expanded the application of EPR. Japan began enforcing the Packaging and Containers Recycling Law in 1997, the Home Appliance Recycling Law in 2001, and the Automobile Recycling Law in 2005. South Korea also established a system based on EPR in 2003, which not only covers electronic products but also packaging and containers, batteries, tires, and lubricants. European Union countries have also introduced e-waste legislation in response to the Waste Electrical and Electronic Equipment Directive (2002/96/EC). Regarding e-waste, the EPR system has had an impact on the Design for Environment program (DfE). It is reported that some manufacturers in Japan have since reduced the number of bolts in their products, reduced the number of plastics used, and specified the type of plastic on all plastic parts.⁹ However, the social benefits of DfE are still unclear because new DfE products have not yet been disposed of. Meanwhile, municipal governments will likely shoulder a smaller burden for waste management if producers establish independent collection systems.

Background of the introduction of EPR in developing countries

The background of the introduction of EPR in developing countries, including China and Thailand, has not been clearly reported by government agencies. However, in interviews and discussions with government officials and experts in both countries, three reasons have been mentioned for moving forward with EPR policies.

First, officials and experts recognize that EPR is a significant policy trend in the field of waste management, and, through international conferences and seminars, have become well informed of the movement in Europe and Japan. Second, even in developing countries, the increase of municipal solid waste and industrial waste has become a major social issue. Collection services tend to be insufficient and this results in uncollected waste being burned or thrown into rivers, leading to air and water pollution; leachate from landfills also contaminates rivers. Landfill landslides have caused deaths among people living near landfills in the Philippines and Indonesia. In places such as China, the Philippines, Thailand, Malaysia, and Indonesia, people have opposed the construction of new landfills and incineration sites near their homes. Thus, officials have come under pressure from politicians to find an alternative solution.

Still, it is rare to find e-waste in the landfills of developing countries. Local authorities do not regard e-waste as a major factor in the increase of waste, and e-waste is generally traded at a positive value. If discarded items cannot be repaired they are dismantled for spare parts and recyclable materials, and only the leftover parts are then brought to landfills. Since most landfills in developing countries are open dumpsites, hazardous substances in e-waste may dissolve into leachate.

Third, pollution from e-waste recycling industries has been recognized in developing countries. Open burning of coated wire, heating of printed circuit boards to remove IC chips, and acid baths for extracting gold are known sources of pollution in several areas of China (Basel Action Network and Silicon Valley Toxic Coalition,¹⁰ Deng et al.,¹¹ and Brigden et al.¹²) These methods of informal recycling, which do not involve investments in pollution control, can be found in other developing countries, although the scale is smaller than in China. Nnorom and Osibanjo¹³ propose the introduction of EPR in developing countries in order to prevent pollution as a result of e-waste recycling, based on a discussion of the case of Guiyu in China.

EPR is regarded as a policy option for reducing pollution from the current e-waste recycling system in developing countries. It can be expected that EPR policies can promote the development of a formal recycling sector by bringing the informal sector into the open.

Characteristics of e-waste recycling legislation in developing countries

This section outlines and compares the common characteristics of proposed draft laws on e-waste recycling in China and Thailand.

Chinese WEEE legislation

To prevent environmental pollution from e-waste, the Chinese government has been preparing legislation on waste electrical and electronic equipment (WEEE) since

2002. This work was initiated by the National Development and Reform Commission (NDRC) and is also supported by other government agencies. In the beginning of the legislation process, the government dispatched survey teams to Japan, the European Union, and the United States to inquire about the legal systems and the collection and recycling systems of each country. Also, based on reviews of the comments of experts in the industry, the Management of Recycling of Waste and Secondhand Home Appliances and Electronic Equipments (Chinese WEEE) legislation was drafted in November 2004 and publicly reviewed.^{14,15}

According to the draft legislation in September 2004, the Chinese WEEE legislation targets five categories: TV sets, refrigerators, washing machines, air conditioners, and personal computers. An e-waste recycler certification system was also introduced (Article 18). E-waste collection can be done by any interested party under the condition that they deliver the collected items to certificated recyclers. Multiple open collection systems need to be established (Article 6). Retailers and repair shops have an obligation to accept discarded appliances and hand them over to formal recyclers (Article 11). Electronic appliance manufacturers, retailers, and after-service providers should also collect discarded appliances (Articles 11, 24, and 27). Consumers have a responsibility to hand over their old appliances to retailers, after-service providers, or recyclers properly, and should not dispose of them or dismantle them by themselves (Article 14).

Figures 1 and 2 show the current WEEE flow in China and the proposed flow after the enforcement of the Chinese WEEE legislation, respectively. A national fund for e-waste recycling is to be funded by producers and other sources (Article 10). Formal recyclers will receive a subsidy from this fund based on the amount they recycle. During the drafting process of the Chinese WEEE legislation, major brand manufacturers, such as Haier, Little Swan, Panasonic, Gallants, Sony, and Siemens, joined in the drafting process. To solve the financial problems of WEEE recycling, many meetings and public hearings were conducted. However, because the Chinese electronics market is competitive, some critics have pointed out that it is unrealistic to expect manufacturers to bear the burden of recycling costs.

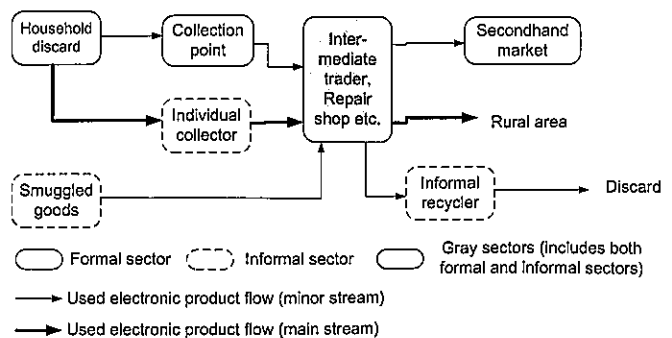


Fig. 1. Current flow of waste electrical and electronic equipment (WEEE) in China

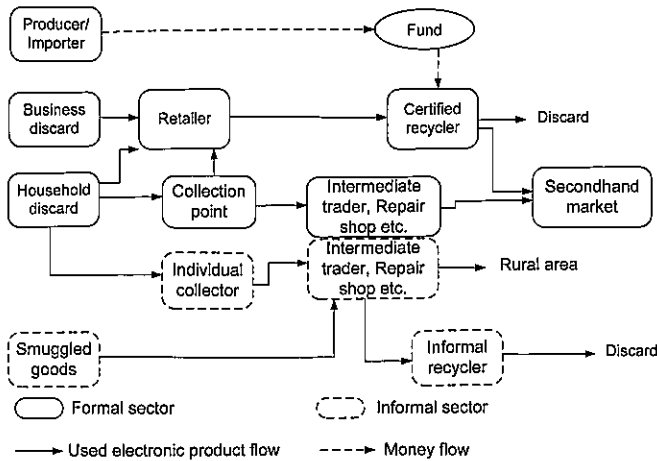


Fig. 2. Proposed flow of e-waste after the enforcement of Chinese WEEE legislation

The Chinese WEEE legislation appears to favor a reuse standard. In developed countries, the average product life spans tend to be shorter than the physical life span of the product. Products tend to be replaced and disposed of quickly, so it is necessary to convince consumers to use products longer. The situation in developing countries is the exact opposite. Average product life spans are much longer than what manufacturers originally intended, and it is common for electrical products to be repaired and refurbished several times. However, this creates other problems involving product safety and energy conservation. In order to solve these issues, the Chinese government plans to set up national standards for secondhand goods and a compulsory disposal cycle.

Thailand's WEEE legislation

In 2005, the Pollution Control Department in the Ministry of Natural Resources and Environment published a draft of the Promotion of Hazardous Waste Management from Used Products Act.¹⁶ The draft has 78 articles, and although it covers various products containing hazardous substances, the primary target is e-waste. Thus, it is referred to as the Thai WEEE Bill.

The Thai government asked the Japanese government for cooperation in the field of e-waste in 2001. The Ministry of Economy, Trade, and Industry and the Japan External Trade Organization then dispatched an expert and conducted a survey on e-waste recycling in Thailand. This was the first study on the volume of e-waste generated and its treatment processes.¹⁷ It was found that most discarded electronic products were traded in the secondhand market, some of them were repaired by workshops, and that TV tubes were not being recycled but rather were being dumped illegally.

The Thai government and industries reacted by accelerating efforts toward establishing Thai WEEE Bill, following the issuing of directives on WEEE and RoHS (Restriction of Hazardous Substances) in the European Union, which is

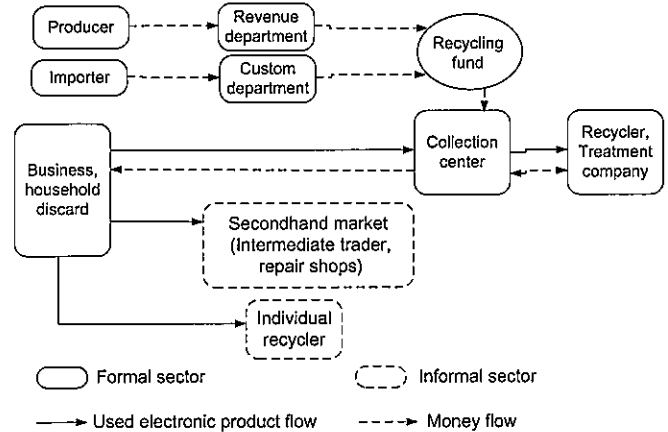


Fig. 3. Proposed flow of Thai WEEE Bill

Thailand's second largest export market after the United States. The government established a working group to produce a draft act on WEEE in 2003 which consisted of 16 organizations, including several departments within the central government, industrial associations, and academic institutions.

Figure 3 shows the flow of money and e-waste under the proposed Thai WEEE Bill. Manufacturers and importers shall pay a "recycling tax" to the Excise Department and Customs Department. According to the chairman of the working group, it was decided that the recycling tax rate would be 2% and was to be kept in a "recycling fund."

Consumers will be able to collect refunds when bringing e-waste to a certified collection center at an amount set by the management committee of the recycling fund, and collection centers will receive a subsidy from the recycling fund based on the amount collected. Collection centers will then sell e-waste to recycling factories or ask them to treat the e-waste.

Local governments will be able to certify business entities such as retail and repair shops, recycling companies, community organizations including waste banks, and hazardous waste treatment companies as collection centers. Regarding collection, the existing collection network can be maintained. However, measures to control informal recycling have not been discussed. It is likely that some existing recycling companies or collectors will not participate in the formal system and will possibly compete against the formal system.

Comparison of EPR-based recycling systems in China and Thailand

Common characteristics of the EPR systems are, first, that there is no producer responsibility for physically taking back and recovering products. Although the reasons for this are not clearly explained, it may be difficult to ignore existing e-waste recycling companies. In addition, it is plausible that since the financial responsibility of collection will become a significant burden on producers, the additional

obligation of requiring physical collection is seen as unrealistic.

A second common characteristic is the policy of a recycling fund based on the financial responsibility of the producer to be used for subsidies to formal recyclers. Since e-waste is traded at a positive value in the market of developing countries, formal recyclers also must buy e-waste from the market. However, the recycling costs of formal recyclers are higher than those of informal recyclers, because informal recyclers do not invest in pollution control or in labor protection. If the formal sector received no subsidies, it could not compete with the informal sector in collecting e-waste.

Market conditions in other developing countries are considered to be the same as those in China and Thailand. Postpayment recycling fees paid by consumers, which have been implemented in Japan, are not realistic in developing countries. This recycling fund system is likely to be adopted by other developing countries.

Difficulties in implementing EPR for recycling systems in developing countries

Identification of producers

One precondition for implementing EPR is that a producer or importer can be identified. Even in developed countries, it is difficult for governments to place responsibility on all producers or importers, including brand holders of original equipment manufacturer (OEM) products. For example, if a producer or importer goes bankrupt, no entity exists to bear the responsibility. There are more than a few cases of small shops or individuals assembling computers, and it is difficult for governments to identify these producers and impose responsibility upon them.

The OECD (2001) mentioned the free rider problem, part of which is being a producer or importer without any registration. The degree of this problem in developing countries is much more severe than it is in developed countries. The amount of products assembled by small shops may be larger in developing countries. According to a distributor of computers in Malaysia, it is estimated that computers assembled by small shops make up over 60% of the market. A survey on discarded computers in Thailand indicated that it was difficult to estimate the average life span of a computer because most of the samples were nonbrand products. The market share of air conditioners assembled by miscellaneous companies was 35%. An expert from the Electrical and Electronic Institute of Thailand indicated that small manufacturers import parts and assemble air conditioners by themselves.

Repair businesses are also very popular in developing countries because labor costs are low, and the secondhand market, where repaired items are sold, is also large. During the repair process, original parts are often replaced. In secondhand TV sets and computer monitors, repair shops usually reuse the CRT tube with a new casing, and imitation brand logos are put on new casings. Chips are added to the

original printed circuit boards and the tuner is readjusted to accommodate the broadcasting methods and frequencies in the importing country, which usually differ from those in the exporting country. As such, if these repair businesses make major modifications to the original products, the responsibility of the producer should be transferred to the repair shop.

Smuggling is another obstacle to overcome in implementing EPR. Regarding imported goods, it is common for importers to take responsibility for collection and recycling in the place of the original producers, but smugglers can easily evade this financial and physical responsibility. In Indonesia, smuggled products reportedly make up more than 50% of the electrical and electronic goods market (BCRC-SEA¹⁸).

Imitation products also create problems. The manufacturers of imitation products are underground operations, creating an environment in which the EPR system cannot function effectively. In the Philippines, the replacement cell phone battery market is dominated by imitation goods, and while imitation goods are cheaper, they suffer from shorter product life spans.

There are several measures required to solve these problems. Regarding smuggling, customs regulation enforcement must be strengthened. It is also important for governments to regulate imitation products, which violate the intellectual property rights of manufacturers. Regarding products assembled by small shops, placing the financial responsibility on parts manufacturers can be an alternative mechanism for recycling fee collection. In fact, Taiwan applies EPR policies to major computer parts, such as motherboards and hard disc drives.

However, it may be difficult for developing countries to control repair businesses and small assemblers because to do so would interfere with income-generating practices for low-income people. Thus, the EPR system should take financial measures for collecting and treating "orphans," including products assembled by small-scale industries, imitation products, and smuggled products. For example, for computer recycling systems in Japan, the consumer must bear the financial responsibility for "orphan" computers. As for the packaging and container recycling system, small business entities that employ less than five people and report sales of less than ¥70 million (about \$600,000) bear no financial responsibility. In such cases, local governments bear the recycling costs.

Consumers and local governments are candidates for providing financial assistance. It is thought that the postpayment scheme would be ineffective in most developing countries because consumers can sell obsolete goods to informal collectors or recyclers. Local governments are also reluctant to contribute to recycling funds because they usually do not deal with e-waste.

As mentioned in the above arguments, there are several difficulties in identifying the producer or importer who is responsible for the collection and recycling of discarded products, but the market share of these items is unclear. If the market share is small, it may not create a serious problem, but if it is large, it becomes a major obstacle to

implementing EPR and a reformed recycling system. It must also be defined who is responsible for repaired or modified goods.

Manomaivibool et al.¹⁹ discuss the identification problem of producers in developing countries based on observations made in India. They consider the identification problem to be manageable by reforming the tax structure to eliminate the gray market, where shops sell nonbranded goods without paying taxes, and by applying EPR to computer parts manufacturers. However, the identification problem is more complex than this. The elimination of imitation and smuggled products is considered to be the most important precondition for applying EPR policies in developing countries.

Subsidies for collectors and recyclers

Another difficulty in implementing a recycling fund system in developing countries involves how to use the recycling fund. The recycling fund systems in China and Thailand are designed to support formal recyclers within the country. Formal recyclers are supposed to comply with environmental standards, pollution control investments, and proper labor protection measures. Since informal sectors ignore such regulations, they can reduce their costs and can afford to buy discarded e-waste at higher prices than the formal sector can.

In fact, some pilot collection programs that make no payment to consumers in developing Asian countries are facing a shortage of e-waste. Nanjing Jinze Metallic Material Co. Ltd. in China conducted a cell phone collection program in June 2004 with Motorola. They established collection points around the nation and invested in machines and facilities to remove IC chips from printed circuit boards automatically and recover precious metals from printed circuit boards. However, they were forced to cease regular operation in December 2004 because they ran short of discarded cell phones (based on interviews with the staff in Nanjing Jinze by the authors in December 2004). Hangzhou Dadi, a company dismantling e-waste in Hangzhou, China, is also facing a shortage of e-waste²⁰. Hangzhou is a designated area for pilot e-waste recycling by the government. It established 36 collection points and a treatment plant with the capacity for 7000 tons per year. The operation was started on January 15, 2005. As of March 2006, it had collected only 133 tons of e-waste and 1325 discarded home appliances, and had dismantled only 92 tons and recovered 59 tons of steel, copper, and plastics. This indicates that it is difficult for formal recyclers with modern facilities to collect enough e-waste without paying for it.

In general, subsidies to formal collectors and recyclers might create incentives for formal recyclers to over-report the amount of collected e-waste. Collectors and recyclers also have incentives to sell collected items in the second-hand market. To prevent these false reports, the management body of the recycling fund or the government should have monitoring systems to check the amount of collected and dismantled e-waste. In fact, Taiwan introduced a moni-

toring system including third-party inspectors and automatic videotaping of factory operations. A method to reduce monitoring costs has been debated in Taiwan in the process of the revision of the recycling fund system.

Subsidy amounts should also be carefully determined. Government and management committees of recycling funds usually do not want collectors and recyclers to benefit too greatly, although subsidies should at least be enough to allow collectors and recyclers to compete with the informal sector. If resource prices rise, recycling factories can sell the materials at a higher price. In such a case the government may want to reduce subsidies in order to balance the benefits recyclers can attain. However, the informal sector can also increase its prices for buying e-waste. Subsidy amounts should be determined by taking into account the market price of e-waste, recovered materials, and the costs of recycling.

Conclusion

In this article, current efforts in applying EPR policies to discarded products, especially e-waste, have been reviewed and potential obstacles to implementing EPR policies in developing countries have been elucidated. The authors reviewed the concept of EPR, which was developed in the context of an increased burden on public waste management systems. Before EPR was introduced, e-waste was collected by the public sector in developed countries. The introduction of EPR shifts the responsibility from the public sector to producers and importers. In contrast, e-waste is usually collected on a market basis in developing countries. Most local authorities in developing countries state they do not see e-waste in its original form in landfill sites. The reasonable motivation for applying EPR policies to e-waste in those countries is to solve environmental pollution brought about by informal recycling.

We also considered the proposed recycling system for e-waste in China and Thailand. The common characteristics of these systems are that they place financial responsibility on producers and create a recycling fund from the contributions of producers to subsidize formal recycling. These characteristics originate from the fact that e-waste is traded on a market basis and that formal recyclers often face a shortage of e-waste.

Corresponding with these two characteristics, two potential difficulties in implementing EPR were identified. The first difficulty lies with the identification of producers. It is difficult for government bodies to identify every small shop and individual who assembles computers and other products, as well as smugglers of imported goods and producers of imitation items. The second difficulty is that the system creates an incentive to report more e-waste than is actually collected.

To prevent or mitigate these difficulties in identifying producers, the government should strengthen measures against smuggling. Before the enactment of WEEE legislation, the government also had to identify the share of goods

smuggled and of imitation and nonbranded goods through an inventory survey. As for incentives for recyclers to submit false reports on the amount of e-waste collected, governments should carefully design monitoring systems.

The arguments put forth in this article are not limited to e-waste, but can be extended to packaging and container waste. There are many small-scale companies that manufacture packaging and containers in developing countries. It may not be feasible for governments to place the burden of proper disposal on all small producers and shops. The situation for automobiles may be different from that of e-waste and packaging and containers, but even in developing countries automobiles are manufactured by a limited number of big companies, and an EPR-based recycling system already exists for automobiles in Japan and Taiwan. Because it is easier to identify an individual car and its producer or importer, monitoring the number of dismantled automobiles is easier than that of e-waste.

The proposed recycling fund systems in China and Thailand have been designed to subsidize formal recyclers. Otherwise, the informal sector would be able to offer higher prices for e-waste collection. An additional and supplementary policy is to strengthen pollution-control measures against informal recyclers. If this weakens informal recyclers, the recycling fund can reduce subsidies to formal recyclers. EPR policies are not a panacea for e-waste problems in developing countries. Inventory studies on e-waste generation and material flow of e-waste should also cover an investigation of the market share of smuggled, imitation, and small producer-assembled products. Other policy measures, such as tightening border controls to combat smuggled products and enforcing intellectual property rights, should be conducted in tandem with EPR policy.

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