

Managing Used Lead Acid Batteries in India: Evaluation of EPR-DRS Approaches

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Introduction

Lead is one of the most recyclable metals in the world.¹ The demand for lead is met by primary lead from ores extracted from mines or from secondary lead obtained from recycled scraps containing lead. Lead has a wide usage, with 70% of global lead going into the manufacture of lead-acid batteries (LABs) used in automobiles and power back-ups. Lead-acid batteries continue to be the most recyclable consumer product. Ninety-eight percent of all battery lead is recycled.² Used lead-acid batteries (ULABs) of all types on average have 10.5 kg of lead.³ This serves as a major source of secondary lead. Lead is also one of the most harmful metals and has been cited among the seventeen most dangerous substances.⁴ Since lead poses a serious threat to human health, policies for effective management of ULABs are essential for the economy.

In India, the automotive industry has been the largest consumer of LABs and the sector registered a compound

Background. India has a well-defined deposit refund system (DRS) based on the principles of extended producer responsibility (EPR) for recycling used lead acid batteries (ULABs). However, the presence of an informal sector and lack of monitoring have resulted in an ineffective system of recycling mainly driven by the interests of the informal sector.

Objectives. The present study attempts to understand the existing recycling mechanism and comparatively analyses a base case and three alternative scenarios developed taking into consideration the existence of a very active informal recycling sector.

Materials and Methods. A base case and three alternative scenarios which were developed for this study were evaluated. Scenario I is the base case scenario representing the existing system. Scenarios II and III integrate informal recycling with the mainstream recycling system through a separate collection agency. Scenario IV proposes a strong upstream-defined deposit refund where the manufacturer pays a 'green tax' and receives a refund on green recycling of ULABs. The major gains and losses both upstream and downstream in the recycling chain are analysed for all of the scenarios.

Results. Scenario II was determined to be the most effective, as it takes care of the interests of both the formal and informal stakeholders. By using the services of the itinerant collectors and eliminating informal smelters, Scenario II strengthens formal recycling. The introduction of a separate collection agency in Scenarios II and III benefits almost all of the major stakeholders in the system. Scenario IV gives the manufacturer more responsibility for used batteries. In all four scenarios, the downstream stakeholders of the EPR-DRS were the major beneficiaries.

Conclusions. A successful EPR-DRS for ULABs in India can be achieved by integrating informal recycling through the introduction of a separate collection agency, strengthening the upstream DRS, completely eliminating informal recycling, and effective compliance monitoring.

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Keywords. Used lead acid batteries, deposit refund system, extended producer responsibility, informal recycling, separate collection agency

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annual growth rate (CAGR) of 13.03% from 2008–2012.⁵ This has contributed to the growth in demand for automotive batteries. Furthermore, it is projected that by 2020, India will be the third largest vehicle market in the world,⁶ resulting in subsequent increase in the demand for LABs. These batteries typically have a lifespan of three to four years, after which they are recycled and reused. Improper and environmentally unfriendly recycling by the informal sector has been a major concern for policy makers. A well-defined deposit refund system (DRS) has been in

practice in the battery market to ensure safe recycling of lead.⁷ At present, India has a legal framework in the form of the Batteries Management and Handling Rules (BMHR) 2001, with amendments in 2010 to deal with the issue of recycling ULABs.

The rules are essentially based on the principles of DRS, where the consumer gets a discount on the purchase of a new battery when he or she returns the used one to the retailer. This DRS can be an important tool in the implementation of 'Extended Producer

Responsibility' (EPR). EPR is an environmental policy approach which extends a producer's responsibility to the post-consumer stage of a product's life cycle, including its final disposal.⁸⁻¹¹ This paper attempts to understand the existing EPR-DRS for recycling ULABs under BMHR (2001), and the reasons for its ineffectiveness. It also suggests the most effective DRS by developing alternative scenarios.

Theories of EPR-based DRS

Several policy instruments have been proposed and discussed for proper disposal of recyclable materials. The literature on disposal of recyclable waste suggests that a DRS functional under the EPR approach is one of the most important economic instruments used for environmental protection. The system combines taxes and subsidies to prevent litter and promote material recovery. It requires consumers to pay deposits that add up to the price of the product which are refunded to them upon returning the used product. High recycling rates can be achieved with low monitoring costs, as consumers have an incentive to return the used product. Various studies have put forward different theoretical aspects of a DRS. Bohm¹² identified deposit refund systems as consumer deposit arrangements which are generated by the market or elicited by government action. They could also take the form of a refund provided without taking a deposit, such as exchange offers in the white goods (consumer durables) sector that have a profit or consumer retention motive. A DRS requires less funds than a system which offers subsidies for returned used products, as refunds are paid from the deposits. The arrangement induces return of recyclable waste, replacing the tendency of free disposal. While it fails to achieve reduction in waste generation, it does reduce the volume of litter by stimulating freelance collectors.

Abbreviations			
<i>BMHR</i>	Batteries Management and Handling Rules	<i>LABs</i>	Lead-acid batteries
<i>CAGR</i>	Compound annual growth rate	<i>MoEF</i>	Ministry of Environment and Forest
<i>CPCB</i>	Central Pollution Control Board	<i>OECD</i>	Organization for Economic Co-operation and Development
<i>DfE</i>	Design for environment	<i>PET</i>	Polyethylene terephthalate
<i>DRS</i>	Deposit refund system	<i>PRO</i>	Producer's responsibility organization
<i>EOL</i>	End-of-life	<i>Rs.</i>	Rupees
<i>EPR</i>	Extended producer responsibility	<i>SPCB/PCC</i>	State Pollution Control Board/Pollution Control Committee
<i>Kg</i>	Kilogram	<i>ULABs</i>	Used lead-acid batteries

The importance of price-based policy mechanisms in encouraging recycling of automobile batteries has been empirically analysed by Sigman.¹³ The study uses four recycling policies: virgin materials tax, deposit/refund programmes, recycling subsidies, and recycled content standards to compare and deduce the most cost-effective policy measure for achieving waste disposal. Both a deposit/refund and virgin materials tax increased the price of lead only to non-recycling consumers. The virgin materials tax and deposit/refund were found to be the most cost effective and best of all possible policies. Any reduction in disposal is considered equivalent to a reduction in virgin lead use. Unlike a recycling subsidy and recycled content standards, these policies do not subsidize the substitute, but impose the tax on the good itself. Moreover, under these two policies, only the lead that is disposed is taxed. As these policies effectively tax disposal, they

act as a Pigouvian taxes.

A DRS may be more politically acceptable if the system is revenue-neutral. Mrozek¹⁴ discusses the consequences of revenue-neutrality of DRS based models. This type of deposit refund system requires smaller than efficient deposits and larger than efficient refunds. As a result, the regulated good is over consumed, increasing the welfare of both producers and consumers. The potential welfare gain is found to vary with the price elasticity of demand, compliance costs, degree of correlation between willingness to pay and compliance costs, and the magnitude of externalities. Revenue neutrality works better for a DRS that diverts waste from landfills to recycling.

Environmental protection is one of the most important objectives of any economic instrument for waste disposal. This can be achieved by

a change in the design of products to reduce waste management costs, known as 'design for environment' activities.¹⁰ Studies show that an appropriate deposit–refund system could theoretically bring about an improvement in the design for environment (DfE). Fullerton and Wu¹⁵ compared different policy options using a simple general equilibrium model which encompasses the entire life-cycle of each product and the price paid along the way. If all prices for all products and all forms of disposal reflected social costs, the market would send the correct signals about how to consume and dispose waste. If appropriate disposal charges can correct market signals, consumers will induce improvement in design of the product to facilitate easier recycling. Alternatively, welfare can be improved by policies directed at firms such as recycling subsidies or subsidies for recyclability.

When consumers are not paid for their recyclables, this generates inadequate signals for producers to undertake DfE. In the absence of a fully functioning recycling market, the first-best outcome cannot be reached. However, it is possible to achieve the constrained (second-best) optimum using a modified DRS.¹⁶ The constrained setting adopts a more realistic approach about solid waste and the functioning of the recycling market. Under such an arrangement, the deposit depends on whether the product qualifies as a waste with a large enough recycling potential to induce collection by recyclers from households. The producers of recyclable products pay a tax up-front that is equivalent to the refund received by recyclers. In the case of non-recyclables, producers have to pay an advance disposal fee equal to the marginal social cost of disposal. Deposits are paid by producers, and the refunds are paid to recyclers. Households "downstream" are not directly taxed or subsidized. A DRS placed "upstream" avoids

the transaction cost of dealing with households. An "upstream" DRS has also been suggested by Fullerton and Wolverton¹⁷ and Palmer et al.¹⁸

The DRS used to be voluntary when the cost of the virgin material was less than the collection and recycling cost. As the reverse has happened in recent times, a mandatory DRS has replaced a voluntary DRS. However, a mandatory DRS has not been popular because of its negative impact on suppliers. This negative impact includes a decrease in sales due to the addition of a deposit to the price, an increase in collecting cost, and huge initial cost for establishing a collection system. Retailers are the most affected stakeholder in the recycling chain.¹⁹ The negative impact on retailers can be mitigated by letting retailers keep unredeemed deposits and the government paying a handling commission to retailers.^{19,20}

The EPR-based DRS has been very successful in Taiwan for recycling bottles made of polyethylene terephthalate (PET bottles).^{21,22} PET manufacturers and importers are required to pay into a recycling fund according to their sales. A deposit fee collected from the producers is used to pay consumers a financial incentive to bring back the used PET bottles to the collection point. The scheme matched the recycling rate of the Organization for Economic Co-operation and Development (OECD) countries within 4 years of its implementation. The reasons for its success include convenient drop-off collection points, better incentives for retailers, adequate financial incentives for end-users, clear labelling, and controlling measures for free riders. In South Africa, voluntary industry initiatives for EPR- DRS for recycling of used cans, glass, and PET bottles have been successful even without any legislative interference.²³ In each of these schemes, producers pay to the producer's responsibility

organization (PRO), a separate agency with responsibility for recycling on behalf of the producers. Consumers get cash for returning the waste to the collection point for recycling.

In India, a mandatory DRS for recycling ULABs was brought into force in the year 2001 with the set of rules laid down as BMHR (2001). The rules lay down the legal framework of EPR.⁷ Unlike most of the mandatory DRSs where negative impacts on the suppliers and retailers in particular serve as a major hindrance in the realization of the scheme,¹⁹ the Indian DRS faces a unique problem with the involvement of an informal sector in the recycling of ULABs. Informal recycling is characterised by small-scale, labour-intensive, largely unregulated and unregistered, low-technology recycling units. These units neither pay taxes nor have any trading license. Thus, they fail to avail any social or economic benefits from government schemes. The main driver of informal recycling is the viable profit margins that the units make due to low wages, low prices, and an absence of environmental and overhead costs.

To date, very few studies have considered the role of informal recycling and its impact on the effectiveness of DRS. This paper examines the aspects of effective EPR-DRS in the Indian context, currently dominated by informal recycling. It conducts an in-depth analysis of the existing EPR-DRS for ULABs and proposes policy options by developing three different scenarios for an EPR-based DRS.

Materials and Methods

The present study analyses existing EPR-DRS for recycling of ULABs in India in order to understand the recycling chain and the role of different stakeholders (including the informal sector) in the life cycle of ULABs. The following four scenarios

are evaluated based on an in-depth review of literature and key informant interviews. The objective of all of the scenarios is to strengthen the existing rules BMHR (2001).

Scenario I: Base case scenario or the existing battery recycling system (formal and informal) in India.

Scenario II: Scenario with a separate collection agency and informal collection system only.

Scenario III: Scenario with a separate collection agency and informal collection and smelting.

Scenario IV: Scenario involving imposition of a green tax.

The major gains and losses experienced by stakeholders both upstream and downstream in the recycling chain are analysed for all of the scenarios. Based on the findings of the comparative analysis of the four scenarios, policy recommendations are then made.

Base Case and Alternative Scenarios

Current EPR-DRS for ULABs in India

The Ministry of Environment and Forest (MoEF) implemented a specific rule in 2001 to deal with the issues of end-of-life (EOL) management of ULABs known as the Batteries (Management and Handling) Rules, 2001 (BMHR). Based on the principles of EPR, they require the manufacturers to collect (through the DRS or buy-back system) at least 90% of new batteries sold for organized smelting/recycling. It is mandatory for the retailers to sell the used batteries to registered smelters only. As with the other EPR schemes in developing countries, this also faces a major challenge from recycling in the informal sector. The rules do not take into account the coexistence of the informal sector which is involved in recycling a major share

of the ULABs. The major hindrance in the success of the EPR-DRS scheme is the weak collection system and the intense competition for ULABs from the informal sector due to the low cost of recycling. In addition, the informal sector has an elaborate network of itinerant collectors (known as *kabadiwalas* in India) with greater penetration and high frequency of visits to retailers. The higher price offered and frequent visits (which result in lower storage costs) for collection of the ULABs provide incentives to dealers/retailers to sell the ULABs to the informal sector.⁷ As a result, the amount of battery scrap reaching registered smelters is very limited. A study by the Indian Bureau of Mines in 2011 showed that only 40% of the 353 registered recyclers were operating, but at 50% capacity.²⁴

Dealers/retailers serve as the main source of leakage of ULABs from the formal to the informal system.⁷ In order to make them more accountable, the MoEF created the Batteries (Management and Handling) Amendment Rules, 2010. The amendment required manufacturers to sell new batteries only to dealers registered with the State Pollution Control Board/Pollution Control Committee (SPCB/PCC). These registered dealers are now required to file returns every six months on the number of ULABs collected, and if they fail to comply, their registration could be cancelled. The amendment made dealers equally responsible along with manufacturers for non-compliance. Since the number of retailers is very large, monitoring of downstream compliance is administratively very difficult compared to upstream monitoring of a few manufacturers.

Scenario I

Base Case Scenario—Existing Formal and Informal Battery Recycling in India
At present, the DRS provides consumers

of lead acid batteries with a discount on the purchase of new batteries upon the return of ULABs to retailers (without any prior deposit made). The discount given by the retailers is determined by the market price of lead at the London Metal Exchange. Once consumers return used batteries to retailers, the recycling of these batteries is carried out through two modes—formal and informal. The formal mode complies with the rules and involves retailers selling used batteries returned by the consumers to the manufacturers who either have their own recycling unit or who have them recycled at registered recyclers. The registered recyclers also recycle ULABs which they buy from bulk consumers such as the railways, defence establishment, and large industrial houses. All of the recycled lead is sold to manufacturers. The second pathway involves informal recycling, which represents non-compliance with the rules. This involves retailers selling the used batteries to itinerant collectors or '*kabadiwalas*' who sell them to scrap dealers, who then sell them further to informal smelters or '*bhattis*'. These informal smelters sell the recycled lead to local battery manufacturers, assemblers, and reconditioners.⁷ Figure 1 shows the existing EPR-DRS pathway for battery recycling in India, which includes both formal and informal battery recycling.

Scenario II

Separate Collection Agency Involving the Informal Collection System

Scenario II is a modified form of the base case scenario. It involves setting up separate collection agencies at the municipal/town/city/regional level to collect used batteries from retailers, consumers, and scrap dealers. This agency could be a registered society, designated agency, company, association, or an NGO registered with the SPCB/PCC. By setting up separate collection agencies, the physical responsibility of the battery

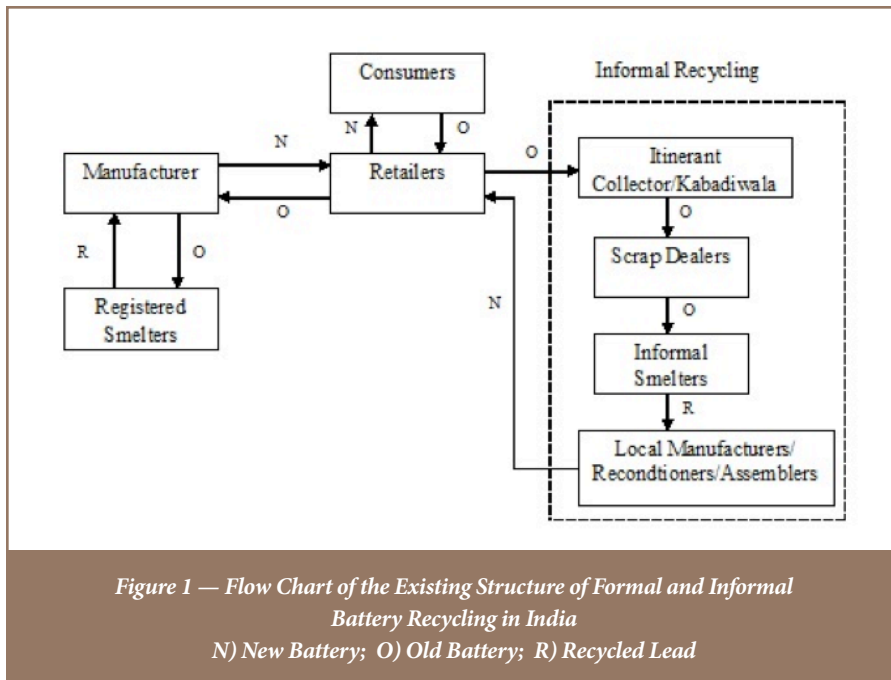


Figure 1 — Flow Chart of the Existing Structure of Formal and Informal Battery Recycling in India
N) New Battery; O) Old Battery; R) Recycled Lead

manufacturer involving direct buy-back or the recycling process itself would be shifted to the collection agencies and associated smelters. However, the manufacturers would have the financial responsibility for paying a recycling fee to a government recycling fund which would be used to fund (subsidise) these collection agencies. The manufacturers would meet their obligation as laid down in the BMHR (2001) by paying the fees to the recycling fund. The recycling fee would be calculated based on regular market surveys of the cost of recycling of ULABs. In India, the informal sector of this industry is very significant. The complete elimination of informal recycling would have both economic and social implications. Therefore, there is a need to integrate the two modes of recycling in a way that is mutually beneficial.

In this scenario, the separate collecting agency would enhance its collection efficiency by integrating the collection portion of the informal

recycling pathway comprised of the itinerant collectors/ 'Kabadiwalas' and scrap dealers (Figure 2). The informal collection system has an extensive network in place and greater penetration in the market. The subsidy received by the agency would enable it to offer higher prices for ULABs compared to informal smelters. This would stop the flow of ULABs to informal smelters. In addition, the retailers would then be left with the option of selling to the 'Kabadiwalas' or to the collection agency. The high frequency of visits by the 'Kabadiwalas' solves the storage problem faced by the retailers; one of the major causes of non-compliance in Scenario I. This would direct the movement of ULABs to formal recycling using the existing informal collection network.

Unlike the base case scenario, there is a provision for a penalty in this scenario in the case of non-compliance. Non-compliance could take the form of continued failure of payment of recycling fees or submission of false

or inaccurate reports of battery production. These infractions could be referred to the courts for enforcement.

Scenario III

Separate Collection Agency Involving Informal Collection and Smelting
Scenario III differs from Scenario II in including the informal smelters as a part of the system. In this scenario, battery manufacturers have the option to buy recycled lead from the informal smelters as well, provided the informal smelters have adopted the required pollution control measures. Some part of the fee collected from the manufacturers would be used for upgradation and pollution control in the informal smelting units through a separate collection agency. This would make the manufacturers responsible for pollution control in these informal smelters. The separate collection agencies would be subject to regular audits to be eligible for subsidies from the government recycling fund. The manufacturers would benefit from this arrangement, as they would then get a supply of recycled lead both from registered as well as informal smelters. This would enable them to get the recycled lead at a lower cost from these informal smelters. Under this scenario, the interests of the registered smelters would be safeguarded by providing fiscal incentives like lower taxes, permission to buy the ULABs from both the bulk consumers and the collection agencies, and relaxing the terms and conditions for importing ULABs. Figure 3 provides a flow chart of Scenario III for the proposed changes in the existing recycling system. This scenario would also incorporate a penalty for non-compliance similar to Scenario II.

Scenario IV

Scenario Involving Imposition of a Green Tax

Scenario IV completely eliminates the problem of informal recycling.

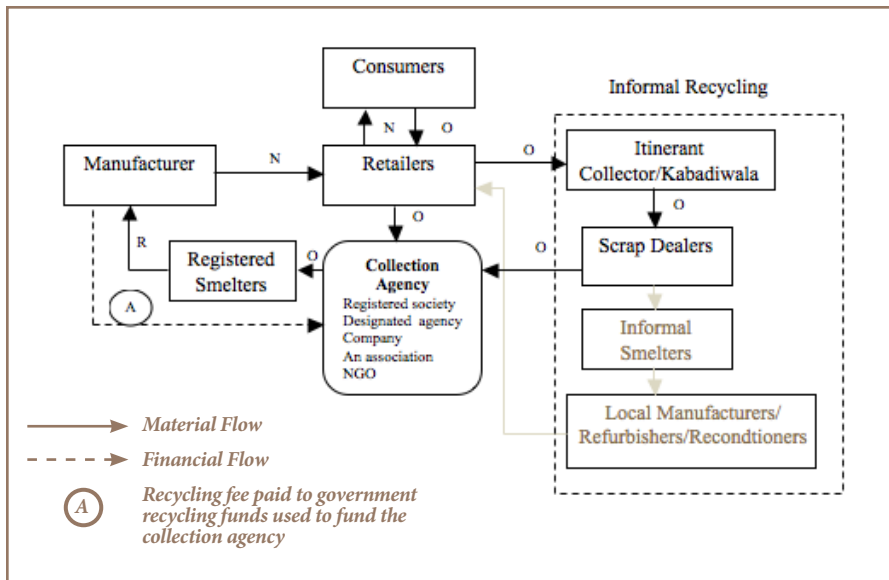


Figure 2 — Scenario II — Separate Collection Agency Integrating Informal Collection
N) New Battery; O) Old Battery; R) Recycled Lead

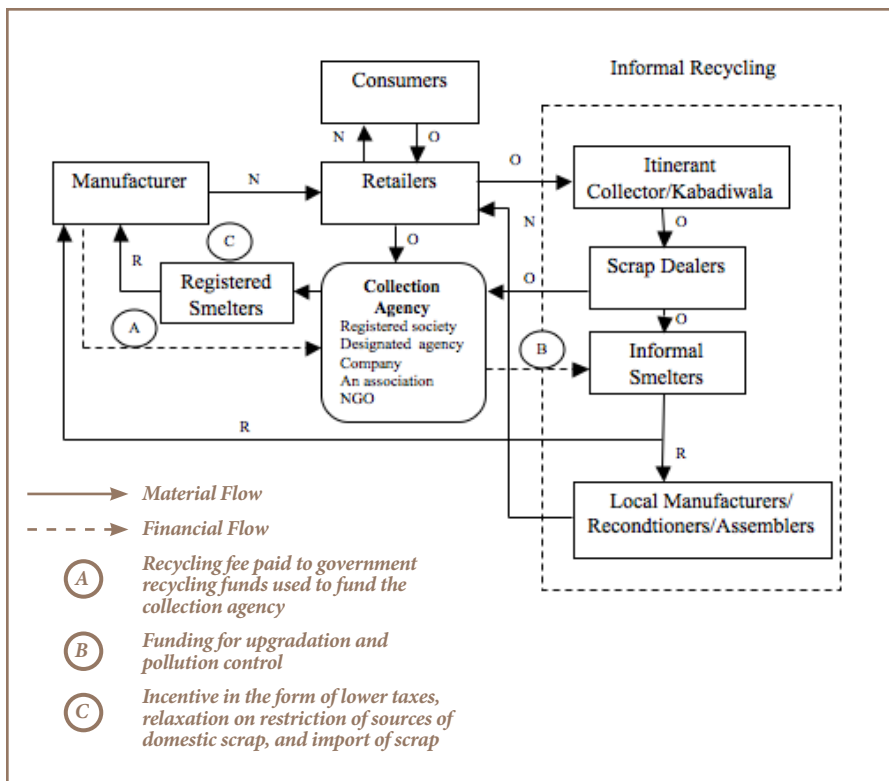


Figure 3 — Scenario III — Separate Collection Agency Integrating Informal Collection and Smelting
N) New Battery; O) Old Battery; R) Recycled Lead

Manufacturers would be made more responsible for green recycling. This is similar to the base case scenario where the manufacturers are responsible for collecting the ULABs from retailers. The manufacturer then ensures that the ULABs collected are recycled by registered smelters only. In this scenario, a green tax is imposed on each battery produced, which is refunded when the manufacturer shows that the battery has been disposed/recycled in a clean manner. In addition to the tax, the refund also includes an amount that would cover any additional expenses incurred in collecting the battery. This removes any incentive on the part of the manufacturer to under report battery production. The manufacturer could be charged a lump-sum amount based on past production levels to cover the additional amount refunded. In the event of a manufacturer not fulfilling the obligation of clean recycling of all batteries produced, the tax collected would be used to subsidize the adoption of clean technology in the informal sector.

Results

Under all four scenarios, consumers would have an incentive to return the ULABs to retailers. They would receive a refund on the purchase of a new battery when they returned the ULABs. The major problem with the success of the Indian ERP-DRS is the coexistence of a very active informal sector. The informal sector is responsible for recycling a major share of ULABs, therefore the present study describes three alternative scenarios taking into consideration the informal sector. A comparison of the roles of different stakeholders in the four scenarios is presented in Table 1.

Under Scenario I and IV, manufacturers are responsible for collecting ULABs from retailers. In Scenario I, the collection system is very weak, providing

Aspects of the EPR-DRS System in India	Scenario I	Scenario II	Scenario III	Scenario IV
Role of Manufacturers	Collect the ULABs from retailers. Recycle them in their own smelters or have them recycled at registered recyclers.	Pay a recycling fee to the government recycling funds. Fee used to fund (subsidize) collection agencies.	Pay a recycling fee to government recycling funds. Fee used to fund (subsidize) collection agencies. Option to buy recycled lead from informal smelters (only from those using pollution control measures).	Collect the ULABs from retailers. Recycle them in their own smelters or have them recycled at registered recyclers. Pay a 'green tax' on each battery produced. Tax refunded when the UALBs have been disposed/ recycled in a clean manner. Refund also to compensate additional expenses towards ULAB collection.
Role of Separate Collection Agency	Not present	Collect used batteries from retailers and scrap dealers (informal collection system). Subsidy received used to pay higher price to scrap dealers.	Collect used batteries from retailers and scrap dealers (informal collection system). Subsidy received used to pay higher price to the scrap dealers. Portion of the subsidy used for upgradation and pollution control in the informal smelting units. Complete all paper work for informal smelters.	Not present
Role of Retailers	Formal Recycling—Sell the ULABs collected from consumers to the manufacturer's representative. Informal Recycling—Sell the ULABs to the itinerant collectors or 'kabadiwalas'.	Sell the ULABs collected from the consumers to the itinerant collectors or 'kabadiwalas' Sell the ULABs collected from consumers directly to the collection agency.	Sell the ULABs collected from consumers to the itinerant collectors or 'kabadiwalas' Sell the ULABs collected from consumers directly to the collection agency.	Formal Recycling—Sell the ULABs collected from consumers to the manufacturer's representative only.
Role of Informal Recycling	Itinerant collectors or 'kabadiwalas' sell the ULABs to the scrap dealer. Scrap dealers sell it to informal smelters. Informal smelters sell the recycled lead to local battery manufacturers, assemblers, and reconditioners.	Only the informal collection system is a part of the scheme. Itinerant collectors or 'kabadiwalas' collect the ULABs from retailers and sell them to the collection agency through scrap dealers.	Both the informal collection system and the smelters are part of this scheme. Itinerant collectors or 'kabadiwalas' collect the ULABs from retailers and sell to the collection agency through scrap dealers. Informal smelters sell recycled lead to local battery manufacturers, assemblers, reconditioners, and branded battery manufacturers.	
Role of Consumers	Return the ULABs to retailers and avail the discount.	Return the ULABs to retailers and avail the discount.	Return the ULABs to retailers and avail the discount.	Return the ULABs to retailers and avail the discount.

Table 1 — Role of Different Stakeholders Under the Four Scenarios

Upstream Downstream

opportunities for informal recyclers to take away ULABs from the retailers by offering a slightly higher price. The rules further require manufacturers to have ULABs recycled only by registered smelters. The costs of installation and maintenance of pollution control equipment (other than bag filters) and taxes on purchase of battery scrap and transportation costs incurred by these registered smelters significantly increase the cost of recycling. This acts as a major obstacle in the smooth functioning and profitability of the formal recycling sector.⁷

Under Scenarios II and III, manufacturers have no physical responsibility, and they would be required to pay a recycling fee to the government recycling fund. In Scenario II, the fund would be used to subsidize a separate collection agency, whereas in Scenario III, a portion of it goes towards the installation and maintenance of pollution control equipment in informal smelters.

In Scenario IV, the 'green tax' paid by manufacturers is refunded if the ULABs have been collected and recycled by registered smelters. This type of revenue-neutral upstream DRS has been suggested by Calcott and Walls¹⁶ and Fullerton and Wolverton.¹⁷ The upstream DRS would force the manufacturers to enhance their collection system, offering very little opportunity for retailers to divert ULABs toward informal recycling. The informal recycling sector is absent from this scenario.

The role of a separate collection agency can be very crucial for a successful EPR-DRS. In most of the successful EPR-DRSs across the world, a separate agency for collection and recycling on behalf of producers plays a prominent role.^{21-23,25} In Scenario II, the competitive price offered by the separate agency enables maximum collection of ULABs. Retailers find

both the option of selling ULABs to *kabadiwalas* and the collection agency equally attractive. This scenario also envisages that even the *kabadiwalas* would sell the collected ULABs back to the collection agencies, as there are no informal smelters in operation. The importance of a separate agency is further increased in Scenario III, as in addition to ensuring collection, it is entrusted with the responsibility of managing the informal smelters.

In Scenario I, retailers act as the main leakage point from which lead is diverted for informal recycling. Gupt⁷ found that retailers preferred to sell the ULABs to itinerant collectors or '*kabadiwalas*', as the price offered by them is about rupees (Rs.) 4 per battery higher than the price offered by the manufacturer's representative. This small price difference, together with the taxes and storage costs avoided (as manufacturer representatives visit less frequently as compared to the '*kabadiwalas*'), influence retailers' decisions to sell the ULABs to the informal recyclers. The total amount that prevents the retailers from compliance resulting in the sustaining of informal recycling works out to approximately Rs. 0.50 per kilogram or Rs. 500 per ton of recycled lead.⁷ The problem of this price differential is eliminated in Scenarios II and III, as the separate collection agency offers prices similar to or higher than the *kabadiwalas*. A retailer's decision to sell the ULABs to *kabadiwalas* also channelizes the lead for formal recycling in the absence of informal smelters in Scenario II and to the informal smelters who take pollution control measures in Scenario III.

Both Scenarios II and III integrate the informal recycling pathways into the mainstream in a manner in which their activities do not harm the environment. This is achieved by the introduction of separate collection

agencies. Scenario II utilizes the service of the *kabadiwalas* for the collection of ULABs from the retailers, keeping them in business and takes advantage of their extensive and more efficient collection network. Scenario III takes care of the interests of all of the stakeholders of the existing EPR-DRS in India. The manufacturer's responsibility is restricted to paying the recycling fee to the fund, which is then used to pay a separate agency. *Kabadiwalas* would continue to be in business collecting and selling ULABs to the separate collection agency in Scenario II and to the informal smelters in Scenario III. The informal smelters would continue to operate in Scenario III, as maintenance of pollution control measures and all paper work is taken care of by the separate agency. Increased supply of ULABs to the registered smelters enabling them to enhance their capacity utilization is ensured by the separate collection agency. The collection agency would enjoy a high collection rate, as it would receive the ULABs from the retailers, as well as from the informal collection systems.

In all of the four scenarios, the downstream stakeholders of the EPR-DRS are major beneficiaries (Table 2). Retailers receive a higher price for the ULABs in all of the scenarios. In Scenario I, they receive higher prices from the *kabadiwalas*, and in II and III, from the separate collection agency. In Scenario IV, they receive higher prices from the manufacturer's representative.

Registered smelters would receive more raw materials, enabling them to increase their capacity utilization in Scenarios II, III and IV. Manufacturers would be able to get increased supply of secondary lead in Scenarios II, III, and IV. They would fulfil their obligations without any physical responsibility for collecting and

Gain to Stakeholders — Formal Recycling

Stakeholders	Scenario I	Scenario II	Scenario III	Scenario IV
Consumers	Receive the discount upon returning the ULABs.	Receive the discount upon returning the ULABs.	Receive the discount upon returning the ULABs.	Receive the discount upon returning the ULABs.
Retailers	Have profit margin of 0.9% by selling ULABs to the informal recyclers. ⁷	Receive a higher price for ULABs from the collection agency than from 'kabadiwalas'. Only incentive—High frequency of visits by 'kabadiwalas' reduces storage costs significantly.	Receive a higher price for ULABs from the collection agency than the 'kabadiwalas'. Only incentive—High frequency of visit by 'kabadiwalas' reduces storage costs significantly.	Receive a higher price for ULABs from the manufacturer's representative.
Registered Smelters		Enhanced collection provides more raw materials enabling them to increase their capacity utilization.	Enhanced collection provides more raw materials enabling them to increase their capacity utilization. Fiscal incentives -lower taxes, permission to buy ULABs both from bulk consumers and collection agencies and relaxed terms and conditions for importing ULABs.	Enhanced collection by the manufacturers provides more raw materials, enabling them to increase their capacity utilization.
Manufacturers		Increased supply of secondary lead. No physical responsibility for collecting ULABs. Fulfil their obligation for green recycling by paying a fee.	Increased supply of secondary lead. No physical responsibility for collecting ULABs. Fulfil their obligation for green recycling by paying a fee.	Increased supply of secondary lead. Pay green tax/battery produced. Get refund on green disposal/recycling of battery.
Gain to Stakeholders — Informal Recycling				
Collection System (Itinerant collectors or 'kabadiwalas' and scrap dealers)	Do brisk business in the absence or low frequency of visits by the manufacturer's representative. ⁷	Continue to remain in their usual business and receive benefits from the higher price received from collection agencies.	Continue to remain in their usual business and receive benefits from the higher price received from collection agencies.	
Informal Smelters	No compliance cost and consistent supply of ULABs keep them in business. ⁷		Collection agency invests in pollution control and carries out paper work. Consistent supply of ULABs keeps them in business. Sell ULABs to the manufacturers.	

Loss to Stakeholders — Formal Recycling

Stakeholders	Scenario I	Scenario II	Scenario III	Scenario IV
Consumers	No Loss	No Loss	No Loss	No Loss
Retailers	No Loss	No Loss	No Loss	No Loss
Registered Smelters	Low availability of raw material results in low capacity utilization and compliance cost reduces profitability	No Loss	No Loss	No Loss
Manufacturers	Lower recycling rate Non-compliance	No Loss	No Loss	No Loss
Loss to Stakeholders — Informal Recycling				
Collection System (Itinerant collectors or 'kabadiwalas' and scrap dealers)	No Loss	No Loss	No Loss	Out of business
Informal Smelters	No Loss	Out of business—Job loss	No Loss	Out of business—Job loss

Table 2 — Gain and Loss Under the Four Scenarios

recycling in Scenarios II and III. Scenario IV completely eliminates informal recycling, which is very prominent in the base-case scenario. Scenarios II and III make arrangement for the integration of informal recycling in a way that is in accordance with the spirit of green recycling.

Policy Recommendations

Based on the analysis of the scenarios developed, we propose the following changes in the existing EPR-DRS for recycling of ULABs in India.

Separate Collection Agency

In both Scenarios II and III, a separate collection agency plays a major role in the recycling of ULABs. The introduction of this agency into the existing recycling system or the base case scenario leads to almost all of the major stakeholders benefiting from the system. Thus, we recommend setting up separate collection agencies to improve the current recycling system. Collection agencies could be in the form of a registered society, designated agency, company, association, or an NGO registered with the SPCB/PCC. An adequate number of such agencies with wide collection and distribution networks should be allowed to operate, as this would increase the reach of the formal recycling system of ULABs.

The separate collection agency would be responsible for collecting used batteries from retailers and scrap dealers (informal collection system) and passing them on to registered smelters. It would be accountable for all transactions and undergo regular third party audit, the report of which would be submitted to the concerned SPCB/PCC on a regular basis. In Scenario III, which integrates the informal smelters with the formal recycling system, these agencies would have the additional responsibility of investing, monitoring, and keeping account of all pollution control

activities in these informal smelters. The agency would also be responsible for all paper work and providing monitoring reports on pollution control in these units to the concerned SPCB/PCC on a regular basis. The recycling fee paid to the government recycling funds by the manufacturers would be used to fund (subsidize) these collection agencies.

The major advantage of setting up separate collection agencies is that both the upstream and downstream stakeholders would benefit from the system. The formal sector benefits by an increased supply of battery scrap, while the collection chain of the informal sector still operates and remains in business as usual. Manufacturers would only be left with the financial responsibility of paying a recycling fee to the government recycling funds which would be used to fund (subsidize) these collection agencies. The organized smelters (and registered reconditioners) would have sufficient raw material, increasing their capacity utilization. The retailers would benefit from avoiding storage costs due to the low frequency of visits by manufacturers' representatives at present. Furthermore, entrusting these agencies with major responsibilities would make compliance monitoring administratively easier and more effective for regulators.

Green Tax

Manufacturers could be made to pay a green tax on each battery produced subject to a refund on producing evidence that the battery has been disposed of or recycled in a clean manner. As the refund includes the additional expenditure incurred upon collection and recycling of ULABs, manufacturers would have an incentive to collect ULABs by offering prices higher than *kabadiwalas* and disclosing correct information on the number of batteries produced. This would help in

monitoring and tracking the recycling carried out by registered smelters. To receive a refund, manufacturers would have to ensure that registered recyclers who are engaged in recycling on their behalf have filed regular returns with correct information on the number of ULABs recycled and report that the pollution levels are below the prescribed standards to the SPCB/PCC. In cases of non-compliance by these smelters, their registration would be cancelled and the manufacturer would not be entitled to a refund. This would compel manufacturers to ensure formal recycling and have better coordination with registered smelters. In the case of any kind of non-compliance on part of the manufacturer, the tax collected could be used to subsidize the upgradation and use of cleaner technology in the informal sector.

Strengthening Organized Smelters

As of September 2010, 353 lead recyclers were registered with the Central Pollution Control Board (CPCB). Of these, only 24 have a capacity greater than 10,000 tons/year (the minimum size required for a similar recycler in China). In 2011, only 40% were operating and at an average capacity utilization of 50% (Indian Bureau of Mines study 2011).²⁴ Low capacity utilization is mainly due to the limited supply of battery scrap and the additional compliance cost for organized smelters.⁷ The registered smelters could be motivated to continue with green recycling by offering fiscal incentives like lower taxes on purchase of battery scrap, green certification if they meet the specified pollution control requirements, and increasing the span during which they remain registered. This would reduce the problem of yearly paper work. Furthermore, easing the eligibility criteria for smelters and allowing them to import lead scrap could solve the problem of under-capacity performance of registered smelters. Increased import

of lead scrap would drive down its price and reduce the cost of the finished product. This would prevent registered smelters from outsourcing lead smelting to unorganized (polluting) smelters.

Compliance Monitoring

As per the BMHR Amendment 2010, battery dealers are required to be registered and file returns for the ULABs received to the respective state pollution control board. It is very difficult to monitor battery dealers because of their large numbers. Policy measures implemented upstream (for instance involving the top 10 manufacturers) are easier to implement and could result in greater compliance. Manufacturers could be made more accountable if they were mandatorily required to declare all aspects of BMHR (2001) compliance in their balance sheet/annual report.

In cases where a separate collecting agency is created as recommended in Scenarios II and III, there should also be a provision for penalties in cases where manufacturers fail to comply with regulation, such as when there is a continued failure to pay recycling fees or submission of false or inaccurate reporting of battery production. Such incidences could be referred to the courts for legal action. If collection agencies fail to submit audited reports of all of the transactions they make (number of ULABs collected and sent to registered recyclers, subsidy received, investments and running cost of pollution control equipment in the informal smelters and transportation costs) or pollution monitoring in informal units within the stipulated time (monthly or quarterly), their registration would be cancelled with immediate effect and they would then be barred from re-registration for the next five years.

Registered smelters would also need to submit an audited report of their

transactions along with monitoring reports of pollution control. An online system should be introduced for managing the inventory of battery scrap so that it can be tracked. All filing of returns should be online, so that the CPCB can monitor the data centrally. Smelters would receive incentives such as tax exemptions and permission to import lead only if they provided pollution control monitoring reports as approved by the concerned SPCB/PCC to the proper departments. In the case of non-compliance, their registration would be cancelled with immediate effect and they would then be barred from re-registration for the next five years.

Conclusions

India has a well-defined EPR-based DRS for the recycling of ULABs guided by a set of rules laid down by the MoEF as BMHR (2001). As per these rules, consumers get a discount on the purchase of a new battery upon return of the old one to retailers. It also makes producers responsible for the post-consumer stage of a product's life cycle, including its final disposal. The existing mechanism has failed to achieve the desired goal. This is mainly due to the existence of a very active informal sector involved in the collection and recycling of ULABs. Retailers continue to serve as an interface between the formal and informal recycling sectors. The higher price offered by the *kabadiwalas* who visit retailers more frequently than manufacturer representatives is one of the major factors that influence retailers' decisions to sell ULABs to *kabadiwalas* to be recycled by informal smelters.

This study compares the base case and three alternate scenarios. Scenario I is the base case or the existing EPR—DRS in India. Scenarios II and III make an effort to integrate informal recycling with the mainstream recycling pathway. This is achieved by the introduction

of a separate collection agency which could be a registered society, designated agency, company, association, or an NGO registered with the SPCB/PCC. Scenario II limits the role of the informal sector to collection of ULABs only. It utilizes the already existing extensive informal collection system, while Scenario III also includes the informal smelters, provided they take up pollution control measures. Scenario IV creates an arrangement where informal recycling is completely eliminated. The manufacturers are made far more responsible for their products and are required to pay a green tax which is refunded upon recycling the ULABs in an environmentally friendly manner.

A comparison of the scenarios shows that a successful EPR-DRS for ULABs in India could be achieved by integrating informal recycling as in Scenario II, which takes care of the existing stakeholders from the formal and informal sectors, excluding the informal smelters. In this scenario, the service of the *kabadiwalas* is utilized for collecting ULABs for formal recycling, which enables registered smelters to enhance their capacity utilization. The other option is to strengthen the upstream DRS and completely eliminate informal recycling as in Scenario IV, which involves imposing a green tax on manufacturers. Monitoring of compliance is also crucial to ensure an effective EPR-DRS for the green recycling of ULABs.

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