Chapter 6

Industrial Standards and Roles of Stakeholders in 3R Implementation in Vietnam

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CHAPTER 6

INDUSTRIAL STANDARDS AND ROLES OF STAKEHOLDERS IN 3R IMPLEMENTATION IN VIETNAM

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1. Introduction

Socio-economic achievements in the past decades have caused environmental problems especially in most developing countries like Vietnam, including waste management. Improvement of living standards and the rapid urbanization have resulted in the increase of domestic wastes that consist of hazardous wastes such as electronic wastes. In addition, the economic growth has also led to the rise of industrial, agricultural, constructional and medical wastes. To deal with this problem, the 3R policy (Reduce, Reuse and Recycle) has been applied in many countries all over the world, in order to reduce pollution and the negative impacts on the environment. It also helps to enhance economic development through increasing efficiency in the use of natural resources, decreasing the amount of solid wastes to be landfilled and disposed, creating more jobs and improving income. In this report, the roles of stakeholders related to waste management are studied and analyzed. This paper recommends the application of the Extended Producer Responsibility (EPR) as an initial stage for implementing 3R in the waste management in Vietnam.

2. Situation of Solid Waste Management in Vietnam

Up to now, there has been no updated statistics of waste types in Vietnam. According to the estimation by Ministry of Construction [1], the country's solid wastes generation is about 28 million tons per year, of which urban solid wastes account for about 50%, rural wastes 30%, and the remaining percentconsists of industrial, medical and craft village wastes. This number excludes agricultural wastes, which is estimated at approximately 65 million tons per year. It is calculated that by 2015, Vietnam's solid waste generation will reach 43.6 million tons per year, with 22.1 million tons of domestic waste and 9.6 million tons of industrial waste. By 2025, these will be 91 million tons, 51.7 million tons and 27.7 million tons, respectively. The average growth rate of solid wastes is 0.7-1.0 kg/person/day and may even increase up to 10-16% per year. It would be a considerable challenge for the management of solid wastes in Vietnam in the coming years.

2.1. Wastes Reduction

The reduction in industrial, commercial and domestic wastes have not been paid due attention. There has been no policy to encourage, as well as no regulations to force people to reduce the solid waste generation. Furthermore, there are not many programs to protect and conserve the natural resources. The results of recent programs such as the project "3R implementation in Hanoi", which was implemented in 4 ward in Hanoi including Thanh Cong ward, Nguyen Du ward, Phan Chu Trinh ward and Lang Ha ward, or other similar projects has been done in Ho Chi Minh City (9 out of 14 wards in 6 District), Bien Hoa (Hoa Binh ward), Da Nang City (Nam Duong ward, Hai Chau district) in the period 2006-2008, are inconsiderable. Cleaner Production, an advanced initiative for environmental protection was introduced in Vietnam from 1998, was expected to reduce the waste generation from industrial enterprises. However, up to the year 2008, there are only 300 out of 400,000 enterprises, making up for below 0.01%, applying cleaner production, an efficient method to reduce wastes during manufacturing [2].

2.2. Collection

At the moment, collected solid wastes account for only 50-60% on average nationwide with 80-82% in large cities and 40-55% in rural areas. The collected rate increases following the class of cities (the classification of cities is as defined in the Decree 42/2009/ND-CP dated 2 Jul, 2009 by the Prime Minister, based mostly on the function of city, the number of living, infrastructure). For example, the IV-class cities (that have more than 50,000 people, density of population is more than 6000 capita/km^2) get the lowest rate with about 65% on average; and the highest rate is Hanoi (special urban class), which reaches out of 98%, acording to the Ministry of Construction [1].

The segregation of solid wastes at source is still unpopular in Vietnam or it is just applied in some few pilot projects in some individual big cities as listed in the previous part. Nevertheless, it is essential to make adjustments and provide time and financial support to implement these kinds of initiatives in other cities throughout the country. On the other hand, these are just preliminary practices of solid waste management besides the application and deployment of a comprehensive management system. Hence, the principle of 3R would remain huge challenge to Vietnam in the coming years. At present, in most places, wastes are usually disposed without segregation. This not only raises issues on environment and public health but also causes a waste of natural resources, especially non-

renewable ones. It is assumed that although the collected rate can reach 100%, the treatment of such wastes even by landfill is still a big challenge to Vietnam, not to mention hazardous wastes requiring special measures to collect, transport and treat that can not have full investment within a short period of time.

Recently, some manufacturers of electronic components execute programs on exchange of old devices for new ones at individual scale. The treatment, renewal and recycling of packing now become major activities of many enterprises such as the Ngoc Tan Kien manufacturing and commercial Co., Ltd (operating in the fields of collection and renewal of barrels), Viet Xanh manufacturing, commercial and environmental services Co., Ltd (treating and recycling nearly 300 tons of packing, barrels and bags of all kinds).

Generally, the collection of solid wastes in Vietnam remains unsegregated and unsystematically. For this activity, the related authorities provide much support for the change of social awareness. However, the outcome of this support is not as expected and the participation of the community and economic sectors is still remained less. Besides, the dissemination and communication of this solid waste segregation stays limited, incompliant with Article 67, the Law on Environmental Protection 2005.

2.3. Reuse/Recycling

It is estimated that about 15-20% of total solid wastes generated can be reused or recycled. They are taken with a high rate during the collection stage, transport and treatment thanks to saving habits of people and the private collection system. Most of solid wastes are recycled by craft villages and most of them are popular materials such as metals (iron, bronze, aluminum and lead), paper and plastic. However, the recycling technology is almost obsolete and backward which causes numerous serious problems to the environment and public health, not to mention the poor quality of products. Just a small proportion of organic waste is processed into organic fertilizers with low efficiency due to poor segregation and limited users in some big cities. Some organic fertilizer plants in Vung Tau, Vinh and Viet Tri are operated ineffectively. Several proper technologies of solid waste treatment such as Seraphin, An Sinh – ASC and MBT-CD 08 are well admired domestically, but only on a small scale. Seraphin technology was first applied in Ninh Thuan province in 2001 to treat municipal waste without landfill. After disinfection process, the municipal waste is seperated into organic part and inorganic one. The organic is then used to produce compost and the inorganic is used to produce shaped construction

materials. The ASC technology is composed of segregation activity, composting (for the organic part that is easily to compost), plastic recycling (for the plastic part), pressure curing (for the inorganic) and thermal treatment (for the organic part that is hard to compost). MBT-CD 08 (first applied in 2008) is the technology to produce fuel and construction materials from solid waste. The common disadvantage of these technologies is the quality of the segregation process and the output.

Industrial and medical wastes are managed better than domestic wastes due to availability of proper legislation. Industrial wastes are mainly materials or waste products arising from production processes, thus, it is easy to classify them for reuse and recycling. Normally, reusable wastes can be diretly used as materials for industrial production. Non-reusable wastes that can be useful for other manufacturing process will be collected, classified and sold to some recyclers. The remaining wastes are transported to store or collectors for further treatments. However, the systematic prevention and reduction of solid wastes in industrial sectors has just started recently by applying cleaner production on a moderate scale. Most medical wastes are categorized in compliance with the regulations by the Ministry of Health in all central hospitals. Medical and industrial wastes are normally concentrated and thus can be managed due to inconsiderable amount and strict regulations.

2.4. Final Treatment

Almost all solid wastes in Vietnam are landfilled. In most cities, there is at least one landfill and in big cities like Hanoi and Ho Chi Minh City, there are 2-3 landfills. However, landfill method remains unhygienic with about 82 out of 98 landfills nationwide [1]. Other treatment technologies such as composting or controlled burning are applied in some individual cities such as Ho Chi Minh City, Hanoi, Nam Dinh, Thai Binh, Vinh, Hue, Phan Rang and Vung Tau cities. The treatment of industrial solid wastes is taken cared by the manufacturers or urban environment companies and other lisenced enterprises. The most common treatment measures are: (1) landfill with domestic wastes; (2) burning or using as fuel; (3) selling to recycling units; (4) storing or landfilling in the plant area; and (5) dumping. There is still lack of specific treatment zones in the country for industrial solid wastes, especially hazardous wastes. In 2008, The Prime Minister has approved Project 07– Regional treatment zone of solid wastes in key economic regions under Decision No. 1440/2008/QD-TTg to deal with this problem. However, the effect of this initiative is still unclear.

In rural areas, domestic solid wastes are mostly collected to dumping areas without holes and banks to bury. Chemical packs used as containers for pesticides are not regularly collected into tanks. Other agricultural wastes are disposed in open field or just being burned. In the health care field, treatment process remains incomplete. Air and water pollutions from treatment process are not treated properly. Almost all hospitals burn these wastes in simple incinerators without air treatment systems. Some hospitals are equipped with modern incinerators; however, they are not put in use due to a near distance from residential area.

The recovery of methane and other gases from normal landfill is remained unpopular, except some modern landfills. This leads to waste of resources and increase greenhouse effect gases that is the main cause for the climate change.

2.5. Legislation

In terms of legislation, Vietnam has not yet launched any policy and regulation on reduction in domestic and service wastes. This remains a great challenge to Vietnam as many countries have applied already the integrated waste management system measures such as prevention, reduction, segregation, recycling, reuse, collection, transport and treatment. Out of these measures, most of them prefer an increased prevention, reduction and reuse to minimize wastes rather than landfill.

This report aims to further analyze responsibilities of stakeholders concerned to wastes in order to identify a base for an adequate waste management system in Vietnam and to enhance the launch of specific policies relating to the application of 3R in the management of solid wastes in the country.

3. Recycled Wastes and Products in Vietnam

3.1. Recycled Wastes and Products

With rapid socio-economic growth and the development of industry and service sectors in terms of quantity and proportion in national economic structure, the demand for materials is tremendously growing. In addition to domestic and imported materials, it is essential to mention a special kind of materials that comes from recycled wastes, domestic or imported, mostly consists of metals (bronze, lead, aluminum, iron and steel), paper and plastic. Domestic materials are usually more expensive than imported and recycled ones. There are many reasons for that, including the use of backward technology, low efficiency and highly-priced raw material processing. Therefore, while million tons of wastes pollute the environment, Vietnam also fails to make use of a remarkable amount of scrap that can be recovered with the proper application of the 3R system.

In Vietnam, legally, scrap material is defined in the item 1, Article 3 Decision No. 03/2004/QD-BTNMT dated 2 April 2004 by the Minister of Natural Resources and Environment. On the introduction of regulations on environmental protection for imported wastes used for input materials, it stipulates that "scrap materials are materials and output of manufacturing or consumption, compliant with demand for materials". The concept of wastes is also stated in the item 13, Article 3, Law on Environmental Protection, "scrap materials refer to all products and materials that are discarded from a specific process of production or consumption but are collected as input materials for other productions". Thus, scrap or recycled scrap materials can be: (1) output or materials to create themselves; (2) discarded from manufacturing (wastes) or consumption (products); and (3) recovery to be used as input materials (to create the original or the other products).

The difference between scrap materials and recycled products are not legally defined in Vietnam. However, it is possible to define recycled products as outputs produced from discarded products or scrap materials. The quality of recycled products is poorer than those of new ones, nevertheless, the economic efficiency of the former is higher than that of the latter thanks to the so-called unlimited source of wastes (scrap materials), which helps to reduce either directly and or indirectly the production costs, the treatment expenses and the end-product price. Aside from these, it has also other benefits like those from the economic priorities and policy to promote environmental protection. For example, according to the Institute for Scrap Recycling Industries (ISRI), the use of

steel scrap helps to save 74% energy, 90% minerals, 40% water, can reduce air pollution by 86% and water pollution by 76% in comparison with that of exploited steel. Recycling of one ton of paper scrap helps to save 2,200 kWh of electricity [3].

Like other countries, Vietnam has to import materials including standard, secondary and scrap materials to meet the demand for production materials, in addition to domestic materials. The importation of scrap materials complies with the production demand of some industriy sectors dealing with the material scarce and formed the activeness for some major industrial sectors such as steel ingot, plastic and paper production. These industry sectors have huge demand for materials while being difficult to mobilize input materials. Besides, the supply fails to meet the demand and costs of domestic materials are higher than those of imports.

The importation of scrap materials (steel, plastic and paper) does not only help to solve the shortage of input materials but it also reduces product price and increase competitiveness of products. For example, imported plastic scrap reduces price of input material by 25% and reduces price of products by over 15%, thus enhances the competitiveness of Vietnamese products compared to Chinese and Indian [4] ones. Moreover, consumers in Europe, USA and Japan demand that Vietnamese products should use at least 10% of recycled plastic to reduce price and make it environment friendly.

Nevertheless, the other side of importing scrap materials is that if they are not paid attention or tightly controlled, they may cause negative impacts on the ecological environment or make Vietnam to become a big dumping area of the other countries. That is such an extremely serious consequence which requires huge costs to deal with.

Steel Recycling Market

In 2006, total steel production output reached 3.6 million tons, meeting over 80% of demand for round steel [3]. To meet the growing demand for steel, in 2007, Vietnam increased yield up to 4.3 million tons of end-products, out of which 250,000 tons of strip steel. With such growth rate, in the future, Vietnam's steel industry is able to fulfill domestic demand and tendentious to export round construction steel (in 2006, 160,000 tons of long, rolled and corner steel were exported).

In Vietnam, there are about 10 steel plants with capacity of 1.7 million tons per year by using mainly steel scrap. To limit steel ingot importation, between 2007 and 2010, Vietnam's steel plants focus on the use of steel scrap with capacity of 4.5 million tons per year. However, domestic steel scrap satisfies only 30% of demand and the remaining must

be imported overseas (it is estimated 1.5 - 2 million tons steel-wastes per year and about 1 million ton of steel arising from old ship destruction). Steel scraps imported in 2006 were 536,000 tons, up to 1.05 million tons in 2007, and over 1.1 million tons in 2008. In fact, since 2000, with a view to meet demand for input materials, steel enterprises have found foreign sources of steel scrap (mainly from Russia, Japan and USA) with high price to add to domestic steel scrap of lower value to ensure that steel price is equal to that of imported steel [5].

Before 2007, there appeared some enterprises in the field of old ship destruction, importing overseas or domestic old ships for dismount, collecting plate steel and accessories of ships and selling the remaining to steel plants as materials. Nevertheless, the disassembling of old ships caused environmental pollution. In the recent years, the Government has banned importing old ships that contain pollutants. Therefore, this activity is reduced remarkably, failing to meet 30 % of market demand.

Plastic recycling market

In 2007, Vietnam's plastic sector produced and consumed nearly 3 million tons products. Plastic products per capita in 1990 reached 3.8 kg/year, up to 32.1 kg/year in 2007. In terms of intensive investment, in 2007, costs for importing plastic production machinery increased over 80% from a year earlier and first ever exceeded the benchmark 300 million USD [4].

Vietnamese plastic products now appear on markets of 48 nations and turnover 750 million USD in 2007 only (USA market is the biggest one with turnover of more than 95.2 million USD). In 2008, exports and export-oriented products of the sector were marketed in EU, America, Japan and ASEAN countries with turnover of nearly 1 billion USD, an increase of over 30 % from a year earlier. Export turnover in 2009 was an estimated increase of 39.8 % from a year earlier and by 2010 total turnover of the sector is predicted to rise up to 7 billion USD compared to 1.6 billion USD of 2002 [4]. Forecast about output and growth rate of each group of plastic products by 2010 is described in Table 1.

The forecast growth rate shown that the plastic industry is affected and trend to reduce due to the swing of world oil price. This impact would be minimized by the use of plastic scrap as a major input.

Table 1. Forecast on Output and Growth Rate of Plastic Product Groups by 2010 [4]

Field	Output (ton/year)	Growth in 2010
Packing	1,400,000	15%
Construction materials	600,000	15%
Household appliances	1,400,000	13%
Technical plastic	450,000	20%
Total amount:	3,850,000	

Nevertheless, at present the material demand of plastic sector is difficult to solve. In terms of material supply, just to satisfy 30% demand for domestic materials for an average output in recent years of the sector, it is vital to provide a supply of about 1 million ton materials. If the average import price is 1.800 USD/ton (clean materials like PE - polyethylene, PP - polypropylene, PS - polystyrene, PVC - polyvinylchloride, etc.), to meet 50 % of plastic demand nationwide, on the yearly basis, Vietnam has to spend over 2.5 billion USD to import materials. Another challenge is that almost all plastic materials are by-products from oil refinery process, so the material price is very sensitive to changes or it depends on the prices of these fuels, while plastic product price almost remains stable. For example, the price of 1 ton PVC in 2006 was 830 USD, in 2007 was up to 960 USD and now is 1,020 USD [3].

If plastic scrap is imported, this will meet 35 %-50 % of material demand, equal to over 1 million tons wastes of good quality (at the current price of 600 USD/ton); Vietnam can save about 1 billion USD each year from material import. However, up to now, there are only 2 PVC semi-product plants in Vietnam including TPC Vina with total capacity of approximately 250,000 tons PVC and LG Vina 150,000 tons DOP. Such domestic material is able to meet only 10 % of market demand; therefore, it is crucial to import 2–2.5 million tons other materials. Table 2 below described the value of plastic imports, finished and semi - products in recent years.

Table 2. Imported Plastic Materials of Vietnam [4]

(Unit: Million USD)

	2005	**2006**	**2007**
Plastic materials	1,357	1,669	2,471
Semi - products	336	361	453
End-products	243	278	330
Total	**1,936**	**2,308**	**3,254**

Paper wastes market

Vietnam's demand for import of paper scrap seems to remain at a high rate. According to statistic figures in 2008, scrap papers account for 70% of materials for paper sector and act as main source of materials in Vietnam whereas domestically collected papers make up 50% and overseas imports 50%. At present, the collecting rate of scrap papers in Vietnam remains low (15-25%) compared to 60-70% in developed countries. In recent years, the collection rate of scrap papers has decreased to 16-17% from 20-25% in the previous years. This trend has shown that the collection and recycling of wastes is discouraged in common [4].

Currently, five newly-invested production lines to manufacture pulp from paper wastes with designed capacity of 190,000 tons /year are put into operation.

3.2. Standards for Recycled Wastes and Products

In terms of Vietnam's legal regulations on management of wastes, the Law on Environmental Protection 2005 is a supreme law on issues relating to scrap material as well as import of scrap material.

Regarding the imported scrap, in the item 2, Article 43 of the Law on Environmental Protection, it is stipulated that organizations and individuals have to comply with the following conditions to import or delegate import wastes: (1) having warehouses and yards intended for wastes collection in accordance with environmental standards during storage; (2) be able to treat impurities accompanied with imported wastes; (3) having technology and equipment to recycle and reuse scrap in accordance with environmental standards.

Together with the Law on Environmental Protection, Vietnam issued regulations on criteria and conditions for wastes and importers, as follows:

- Regulations on forbidden businesses and banned imports as stipulated in Decree No. 59/2006/ND-CP dated 12 June, 2006 and Decree No. 12/2006/ND-CP dated 23 Jan, 2006 concretizing Article 25 of Commercial Law 2005.
- Decision No.12/2006/QĐ-BTNMT launching list of wastes imports, out of which 20 are imported to act as input materials as follows:
  - Group 1: iron or steel scrap;
  - Group 2, 3, 4, and 5: bronze, nickel, aluminum, zinc scrap;
  - Group 6-15: lead, tin, wolfram, molybdenum, Maggie, titan, zircon, antimony, manganese and chrome scrap;
  - Group 16: glass shatter and scrap;
  - Group 17: papers or carton of all kinds, including (a.) margin papers, unused carton scrap, (b.) papers and cartons collected from used or unused products;
  - Group 18: Plastic scrap;
  - Group 19: Gypsum;
  - Group 20: Small-sized slag (sand slag) of iron or steel processing

  Now, this Decision and Article 43 of the Law on Environmental Protection 2005 is major legal bases to permit or ban imported materials.
- Interministerial circular No.002/2007/TTLT-BCT-BTNMT by the Ministry of Industry and Trade, Ministry of Natural Resources and Environment (MONRE) on the implementation of Article 43 of the Law on Environmental Protection in terms of criteria and conditions of organization and individual to import scrap.

In addition, Vietnam is admitted to the WTO; therefore, in years to come, under WTO's regulations, Vietnam has to open its market to clean scrap. However, technical requirements and barriers to prevent importation of material scrap into Vietnam are not paid attention. This makes Vietnam at high risk of wastes. Although policy and legal framework have been formed, the importation of material scrap is discouraged. It is because imported scraps are diverse and difficult to control as well as the transport of wastes remains unsafe. For benefit, many enterprises have imported poor quality scrap, or even banned wastes [6]. In many circumstances, imported wastes are detained in customs warehouses for a long time to conduct verification procedure, and even re-export. The investigation of impurities contained in scrap by experts seems limited as the scrap is

collected from different sources, resulting in difference in components and quality as well as different verification results among authorities and importers. Additionally, those scrap issue terrible threats to the environment. Despite of increased control and limitation of wastes spread by concerned authorities, it is impossible to absolutely overcome consequences. Furthermore, treatment measures taken by concerned authorities do not gain approval by enterprises, resulting in disapproval among enterprise circle and the society.

For recycling or manufacturing materials from recycled scrap, the quality and requirements for recycled materials (domestically collected or imported) and products are not governed by any legal documents. Table 3 listed some specific legislation issued for some kinds of products.

Table 3. Some of specific legislation for recyclable materials and products

No.	Type of documents	Title	Type of material/products	Issued under
1.	National Standard	Vietnamese Standards 7342:2004 – Steel scrap used for common carbon steel – Classification and technical requirements	Steel scrap	Decision No.35/2004/QĐ-BKHCN dated October 29, 2004 by Minister of Science and Technology
2.	National Standard	Vietnamese Standards 24 TCN 81-2000: for pulp and papers	Paper scrap	Decision No. 07/2000/QĐ-BCN dated 16 February 2000 by Minister of Industry
3	National Standard	TCVN 5946:2007-Paper scrap standards	Paper scrap	Decision No. 851/QĐ-BKHCN dated 24 May, 2007 by Minister of Science and Technology
4	National Standard	Vietnamese Standard TCVN 4315:2007	Arc-furnace cinder for the use in cement production	Decision No. 834/QĐ-BKHCN dated 23 May, 2007 by Minister of

No.	Type of documents	Title	Type of material/products	Issued under
				Science and Technology
5	National Standard	Vietnamese Standard TCVN 4316:2007	Portland blast furnace slag cement	Decision No. 834/QĐ-BKHCN dated 23 May, 2007 by Minister of Science and Technology
6	National Standard	Vietnamese standard TCVN 6069:2007	Low heat portland cement	Decision No. 3245/QĐ-BKHCN dated 31 Dec, 2007 by Minister of Science and Technology

Vietnam also issued Vietnamese standard TCVN 3164-1979 applicable to hazardous substances included in materials, products, semi finished products and wastes for production process and general requirements for safety, use and storage, hygiene and investigation of hazardous content at workplace. However, these standards are not specifically enough, compliant with some certain requirements for wastes used for production.

Thus, standards for recycled wastes are not only lacking but also scattered. Depending on sector and specific requirements, it is essential to refer to standards applied in such countries and regions as Canada, USA and EU. However, these foreign standards are not officially applied, but required by foreign importers for Vietnamese exports. There are no standards applied to recycled products.

This situation leads to various and serious difficulties for entities participating in recycling activity. Another problem is that recycling is performed mainly by medium and small-sized private companies using low technologies and often without environmental protection equipment. To balance demand for economic development and environmental protection, companies of this kind are acceptable at local government. Nevertheless, it is essential to launch standards and requirements for recycled wastes and products in order to form proper waste management system in compliance with 3R principle. In this system,

recycling units are required to invest in new and high-efficiency technologies to protect the environment.

Therefore, MONRE prepared regulations on importation to adjust related activities and create consensus in the society (Regulations on the management of imported materials). Draft regulations were submitted by MONRE to Prime Minister for consideration and approval. Moreover, MONRE also prepared regulations on specialty management to improve and complete legal framework and control specific problems, such as the technical specification for imported wastes (steel, plastic and paper); list of importable wastes and instructions to pollution control for imported wastes. These are management instruments necessary for establishing a sustainable wastes management system in the principle of 3R.

Although legal regulations encourage the importation and recycling of wastes in Vietnam, it is nessessary to pay attention to hazardous components as described in Table 3. It is noted that iron and steel wastes may contain many pollutants, including metal and non-metal substances depending on collection sources. These pollutants exert serious impacts on the environment and public health during storage, transport and recycling depending on applied recycling technologies. The surveyed statistic has shown that the use of scrap as materials always causes environmental pollution at different levels. Causes of environmental pollution as analyzed are (i) hazardous nature of wastes and (ii) application of backward and outdated technologies incompliant with requirements for the treatment of impurities included Table 4 and 5 shows the collection sources and corresponding pollutants in the producing steel by arc-furnace.

Table 4. Iron and Steel Collection Sources and Corresponding Pollutants [3]

Source	METAL INCLUSIONS:											
	Al	Bi	B	Cd	Cr	Co	Cu	Pb	Ni	Sn	Zn	Brass/ Bronze
Foreign materials (often solid pieces)	✓						✓	✓		✓		✓
Electrical components				✓			✓				✓	
Bearings		✓					✓	✓		✓		✓
Galvanising	✓										✓	
Plating				✓	✓				✓	✓		
Paints, coatings & glazes				✓	✓	✓	✓	✓	✓	✓		
Solder								✓		✓		
Vehicle scrap								✓				
Vitreous enamels		✓	✓	✓				✓				

	NON-METAL INCLUSIONS:					
Source	Oil	PAH	PCBs	Cutting fluids *	Plastics	Dirt
Vehicle scrap	✓	✓			✓	
Combustion engines, cylinder blocks	✓	✓				
Capacitors from electrical & lighting fixtures			✓			
Scrap from sources involving oil use	✓					
Turnings from machining	✓			✓		
Any type stored on soil						✓

** May be chlorinated*

Table 5. Pollution Sources and Pollutants Arising from Arc [3]

Source	Metals/Metalloids & their Oxides	Persistent Organics			Other
		PAH	PCDD/F	PCBs	
Non-ferrous Alloy Constituents	***Alloy dependent:*** Al, Cr, Co, Cu, Pb, Mg, Ni, Sn, Ti, Zn ***Trace elements (Alloy dependent):*** Sb, Mn, Mo, Si, Th, V, Zr	N/a	N/a	N/a	N/a
Ferrous Alloy Constituents	***Primary:*** Fe, Mn ***Alloy dependent:*** Cr, Co, Cu, Pb,[1] Mo, Ni, V ***Trace elements (Alloy dependent):*** Sb, As, Bi, B, Ca, Mg, Nb, Si, Ti	N/a	N/a	N/a	N/a
Contaminants from scrap	***Common:*** Cd, Pb, Zn ***Possible:*** Al, Bi, B, Cr, Co, Cu, Ni, Ti	***Common:*** from incomplete combustion of organics, e.g., oil & plastics	***Possible:*** from chlorinated contaminants, e.g., Cl-cutting fluids & PVC plastics	***Possible:*** from capacitors	N/a
Furnace fuels: coal, coke, oil	Al, Sb, As, Ba, Be, Bi, B, Cd, Cr, Co, Cu, Pb, Mn, Hg, Mo, Ni, Ti, V, Zn[2]	Certain	Likely	N/a	***Certain:*** Sulphates
Refractories, fluxing agents	***Common:*** alumino-silicates	N/a	N/a	N/a	***Possible:*** Fluorides, chlorides

Hence, for regulations and rules on imported material scrap, it needs to formulate standard system for recycled material scrap and products and develop adequate technology standards.

4. Current Roles and Responsibilities of Stakeholders

4.1. Legal Documents Relating to 3R

At the present time, the Government has recognized the need of 3R strategy as an important basis for an effectiveness management of waste in the future. The thought of 3R shown in some directional legislation described as the followings:

Resolution No. 41/NQ-CT by Politburo on environmental protection in the period of enhanced industrialization and modernization legalized by decision No.34/2005/QĐ-TTg dated February 22, 2005 by Prime Minister highlights environmental protection policy in combination with socio-economic development, including Reduce, Reuse and Recycle wastes.

Particularly, *Resolution No.41/NQ-CT* launched a policy to allocate 1% of total Government budget for environmental protection activities since 2006.

Vietnam's sustainable development program (Agenda 21) sets goals of sustainable development by properly exploiting and saving natural resources. Agenda 21 issues principle that environmental protection and improvement in environment quality are an integral part of development process. In the fields to be prioritized, Agenda 21 gives priority to change in production model and technologies. Consumption model is environment-friendly and green by saving non-renewable resources and minimizing hazardous and difficult-to-disintegrate wastes.

National strategy for environmental protection by 2010, orientation towards 2020 sets goals of and measures for environmental protection, including reducing, reusing and recycling wastes.

Of *Vietnam's Law on Environmental Protection*, Articles 66, 67 specify that "Organizations and individuals engaged in activities that generate wastes, shall have the responsibility to reduce, recycle and reuse wastes so as to minimize the volumes of wastes required to be discharged and disposed of".

Neverthelss, up to present, there is not any specific guideline document for the application of the responsibility of the disposer, which is an important part of the 3R principle. Besides, from the oriented legislations, it is needed an appropriate legislation system to concretize the basis thought, that is still lacking in Vietnam. Without this system, the 3R policy would not be implemented harmoniously with stakeholder responsibility and economic benefit.

At the present time, Ministry of Construction coordinates with MONRE to build a draft of national strategy for the management of solid wastes by 2025, oriented towards 2050. This draft was presented by Mr. Nguyen The Dong, deputy director of General Environmental Office in 3R Forum held in November in Tokyo, Japan. It is under construction to submit Prime Minister for approval.

In addition to those legal documents and strategies, there are sub-law documents on the management of solid wastes as listed in Table 6.

Table 6. Some of major legislation related to the management of waste

No	Type of document	Title	Date of issue	Issued by
1	Decision	Decision No.1140/QĐ-TTg on the approval for 7 solid wastes treatment zones by 2020	6, Oct, 2008	Prime Minister
2	Decision	Decision No.155/1999/ QĐ-TTg on the management of hazardous pollutants	16, Jul, 1999	Prime Minister
3	Decision	Decision No. 2575/1999/QĐ-BYT on the management of medical wastes	27, Aug, 1999	Minister of Health
4	Decision	Decision No. 03/2004/QĐ-BTNMT on the issuance of Regulations on environmental protection for imported wastes used as input materials	2 Apr, 2004	Minister of Natural Resources and Environment
5	Decree	Decree No.59/2007/NĐ-CP on the management of solid wastes	9, Apr, 2007	Prime Minister
6	Decree	Decree No.174/NĐ-CP on charge of environmental protection for solid wastes,	29, Nov, 2007	Prime Minister

No	Type of document	Title	Date of issue	Issued by
7	Decree	Decree No.152/1999/ QĐ-TTg on the approval for solid wastes management strategy in urban and industrial zones	10, Jul, 1997	Prime Minister
8	Circular	Circular No.1590/1997/ TTLT-BKHCNMT-BXD on urgent measures to manage solid wastes in urban and industrial zones	3, Apr, 1997	Minister of Science, Technology and Environment and Minister of Construction

In terms of priority policies for the management of solid wastes: although the government has just issued Decree No. 04/2009/NĐ-CP supporting and prioritizing environmental protection activities, there are no concrete instructions for implementation.

Nevertheless, it remains shortages of specific instructions to the management of solid wastes and hazardous wastes. Almost all legal documents focus on the management of wastes in urban and industrial zones. Policies on wastes prevention, reduce, reuse and recycle are absent. Regulations on the expansion of responsibilities of manufacturer in collecting and treating some discarded products in order to minimize solid wastes are planned to be constructed in the coming time. Economic instruments such as tax reduction, environmental charge, take-back and re-fund system to encourage reduce, reuse and recycle of solid wastes are also lacking. Besides, it is impossible to implement these regulations as there are no regulations on product life cycle.

4.2. Roles and Responsibilities of Stakeholders in Execution of 3R in Vietnam

The summarized product life cycle and stakeholders relating to it, from the manufacturing to distribution, consumption and rejection is shown in Figure 1.Products or imported ones are supplied to consumers through distributors. In the life cycle of product, the service shop provider may be related to the repairing process of product through direct relationship with consumers. For consumers, end-of-life products may be discarded directly or indirectly (storage) or resold to collectors if they still have value. This relation is

same with service shops. Valuable discarded products collected from consumers, service shops or landfill areas may be dismantled to classify into specific groups of material scrap to increase the value of waste and provided to the recycler. There may be a part of materials, components or accessories returned to service shop to be used in other activities such as in refurbishing or producing fake-new appliances, especially the electronic devices. Recyclers reproduce discarded products or wastes into new products or materials to be sold to other manufacturers.

The stakeholders relating to product life cycle are as follows:

- Administrators;
- Suppliers (including manufacturers, importers and distributors);
- Consumers;
- Service providers;
- Recyclers and final treatment units (including collectors).

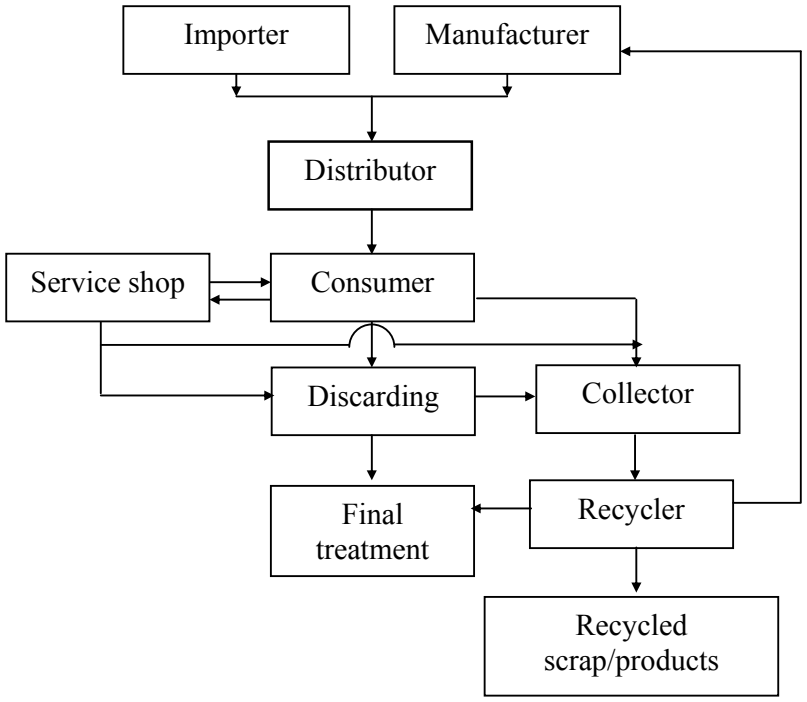

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Figure 1. Summarized Life Cycle of Products

Generally, the consumer creates demand for products and supplier creates supply. These are main stakeholders of product life cycle. The other stakeholders take part in the product flow at different levels. With regards to economic benefits, manufacturer (in addition to importer and all-level distributors) gains benefit from consumer, who may get

interests by selling discarded products. However, a bigger benefit of consumer is immaterial value that the consumer pays for their entertainment demand. Discarded products shall be handled by collector and recycler through collection network at all levels. Essentially, collector is in charge of transshipment between consumer and final treatment or recycler or manufacturer (in case of collecting delegation), or illegal manufacturer (for fake products). Economic benefits gained by collector are dependent on value of wastes or collected materials, and based on the differences between purchase and selling price of recycler, final treatment unit or manufacturer. In Vietnam, collector's benefits are dependent on level (retail or agent) and type of collected materials. Benefits are gained by the final treating units through existed differences between input costs and profit from processing (including expenses on wastes, normally financed by the state budget, profit of products and by-products, if any). Similarly, benefits are gained by recycler through differences between cost of collection and profit from recycling process.

The financial flow of stakeholders in product life cycle is shown in Figure 2.

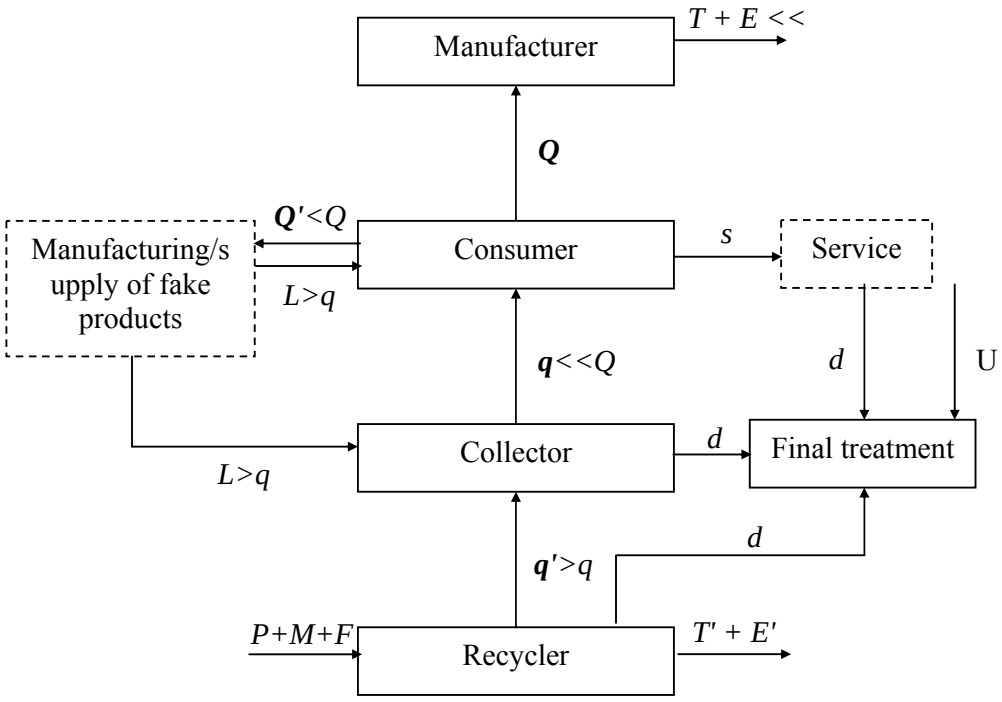

Figure 2. Financial Flow of Stakeholders in Product Life Cycle

Q and Q': prices of products supplied to consumers; q and q': collection costs for discarded product and collector; L: collection costs of illegal manufacturer paid to collector and consumers; T and T' tax-related costs; E and E': costs of environmental protection; P priorities under applicable laws for recycling/treating units; M: benefits gained from recycled materials/products and F: cost of recycling covered by the state budget or manufacturer. d: fee for domestic waste and U : the goverment financial fund for end-of-life treatment of solid waste. In this diagram, production costs (operation, investment and advertising) are excluded.

Legally, responsibilities of stakeholders are stipulated in Vietnam's Law on Environmental Protection. Specifically, Article 66, item 1 stipulates that organizations and individuals causing pollutants are responsible for reducing, recycling and reusing to minimize wastes to be destroyed. Item 1 of Article 67 specifies that manufacturer and services provided are responsible for collecting end-of-life or discarded products as follows: (a) radioactive sources used in production, business and service activities; (b) batteries and accumulators; (c) home and industrial electronic and electric equipment; (d) greases, lubricants and packaging materials that are naturally persistent degradable; (e) medicine products and chemicals used in industry, agriculture, fisheries, and medicines for disease treatment in humans; (f) means of transport; (g) tubes and tires; and (h) other products in accordance with the regulations of the Prime Minister of the Government.

As a result, the Law on Environmental Protection stipulates specific responsibilities of manufacturer for discarded products. The Law on Environmental Protection and the other related legal documents (Decree 174, Decree 59 and other legal documents) stipulate responsibilities of organizations and individuals releasing pollutants. In reality, responsibilities of manufacturer remain ambiguous. It is impossible to require implementation of these responsibilities as they are not specified in sub-law documents.

The Law on Environmental Protection also specifies responsibilities of People's committee at all levels, Ministry of Construction, MONRE and environment management units at all levels for wastes in articles 69, 70, 74, 75, 76 and 80. Under this Law, People's committee at all levels have responsibility for arranging space for treatment units, building waste management works within their scopes of work, investigating and verifying these works before putting them into operation, issuing and deploying priority as well as supporting policies on the management of wastes. Ministry of Construction is responsible for introducing regulations on technical standards in partnership with MONRE, guiding the investigation and recognizing units treating hazardous wastes and areas to bury dangerous

pollutants and normal solid wastes, setting up national projects on collection, treatment and burying of hazardous pollutants and normal solid wastes in cooperation with People's committee at all levels. Hence, concerned authorities are responsible for just encouraging, financially prioritizing the management of wastes, planning, construction, investigation and verification of treating units (including burying of wastes). Their responsibilities for the collection, collection and recycling are not mentioned.

According to the law, the waste disposer has responsibility for implementing 3R for discarded products and sharing costs for public domesic wastes only. Therefore, consumers take no responsibility for discarded products under laws and regulations. This is a huge challenge to the application and deployment of 3R relating to discarded products.

The responsibilities of stakeholders, their behaviors relating to product life cycle are analyzed in the succeeding paragraphs.

4.2.1. Authorities

Responsibilities of authority are stipulated in the Law on Environmental Protection and other relevant regulations. However, for wastes, the law only specifies responsibilities of the Prime Minister for issueing legal documents related to collection and treatment the above products in Article 67. In addition, the Government has not issued any clear policy stipulating responsibilities for collecting wastes. In many cases, there is an overlap of competent authorities' responsibilities, so it is difficult for defining responsibility of agencies. Moreover, resources (financial and human resources) for solid waste management are still limited and funded ineffectively annually. It causes difficulties in management of wastes under 3R rules leading to irresponsibility of managers in many fields of waste management, such as withdrawing discarded products, and preparing related legal, financial and technical policies. Governmental plannings and programs prepared and issued in a long time do not follow up with changes of the market. They are also adjusted by legal elements, so difficulties happen when deploying. Therefore, expenses for scientific and technological researches on recycling and treatment of discarded products are not considered and they do not encourage units to invest in this field. As a result, technology for recycling and treating wastes in Vietnam has been old and backward. Advanced technologies in Vietnam are not popular because they are mostly invested under the names of foreign aids.

Moreover, there are many shortcomings with regulations on waste in the Law on Environmental Protection 2005. In clause 9, Article 7, the Law on Environmental

Protection, it is forbidden to import, export and transit wastes by any form. According to clause 1, Article 43, the Law on Environmental Protection, "scarp materials to be imported must comply with the following requirements for environmental protection, that having been segregated, cleansed and unmixed with materials, products and goods that are banned from import in accordance with the provisions of the law of Vietnam or international treaties to which the Socialist Republic of Vietnam is a Contracting Party". However, when implementing the Law, competent authorities meet many difficulties because there is no stipulation on "clean" level for imported refused materials and it is not suitable to stipulating that imported refused materials should not contain impurities. The Law also stipulates refused materials "without containing hazardous wastes and impurities, except non-hazardous impurities mixed during loading, unloading and transport operations". However, it is difficult to comply with this regulation because in facts, wastes shall not be considered hazardous waste if contents of hazardous impurities do not exceed hazard level. Currently, there is no scientific and practical proof to define the content of impurities (hazardous and unhazardous impurities) in imported refused materials.

At present, the Vietnamese Government has assessed and acknowledged that the take-back, treatment and elimination of end-of-life products are necessary to protect the environment. A directorial Decision for this problem then is prepared to issue by the Government.

4.2.2. Manufacturer

As mentioned, according to the Law on Environmental Protection, manufacturer has responsibility for collecting and treating discarded products as required. However, there is no administrator agency in charge of supervising the performance of this responsibility and no specific instructions to its implementation and no policy relating to this responsibility (support and fine). In fact, the collection of discarded products is not conducted seriously by manufacturers. Economically, manufacturer has poor awareness of environmental protection. Almost all enterprises pursue goal of making profit and pay little attention to the application of environmental protection measures. This results in seriously polluted environment in many localities.

The diagram in figure 2 shows that at the moment, major costs of manufacturer are production fees, taxes and costs relating to environmental protection. Among these costs, production costs are the majority. The application of responsibilities for discarded products may cause extra costs in the context of which manufacturers pursue the maximum profit.

Therefore, manufacturers have no intention and ability to take their responsibilities for discarded products when they are not forced under legal regulations and laws, except some special circumstances where the collection of products is closely related to their economic interestes as analyzed in the case study later.

A pressing problem that Vietnam has to face with is used products from developed and other ASEAN countries that entered into Vietnamese markets illegally. These products have advantages over new products thanks to low price and acceptable quality. They meet a considerable demand of people in lower class urban and rural areas. However, it is difficult to require manufacturer and consumer to perform their responsibilities for discarded products since they are illegally imported. Now, in Vietnam, some enterprises have collected used products on small scale. Products such as empty bottles of beer, alcohol and beverage shall be collected by manufacturer or by delegation agents to reuse and reduce production costs (accounting for 50% product price).

Another type of product collection is the exchange of old products for new ones. For example, Sao Nam Stationery Co., Ltd. (in Ho Chi Minh City) is one of authorized distributors of photocopy machine branded Brother, Sanyo and Konica Minolta. Since the end of September this year, the company has deployed the program "exchange of analogue for digital" by purchasing old equipment from the customer on the condition that customer has to buy the company's new products.

In Vietnam, examples of product collection of used or end-of-life products show that manufacturer aims to: (i) gain economic interests (in case of empty bottles of beer and alcohol); (ii) respond to requirements by concerned authorities, (iii) and satisfy customer's claim in case of problem relating to quality or other parameters, not taking responsibility as stipulated under the Law on Environmental Protection. This is the same with foreign or joint-venture companies although they have done environmental protection measures well and actively participated in environmental programs.

Difficulties and shortcomings for collection of products for enterprises:

- In addition to benefits from the collection of used and out-of-date products, enterprises have to confront with difficulties in ensuring high efficiency in collection and minimizing damages and risks. It is so unpopular that showrooms and distributors withdraw old products;
- Manufacturer has to invest a big capital and workforce in establishing a network to collect discarded or used products. Furthermore, it is essential to invest in equipment,

technology and human resource to resuse and recycle the collected products. If these are not done, manufacturer will have to spend much money to complete their responsibilities through competent delegated recycling agents and units;

- In addition, units that purchase discarded or used products are unable to select and classify them to pick out components for recycling and reuse as well as bring them back to the manufacturer;
- Illegal manufacturers and fake product manufacturers have a great demand for discarded products. This leads to decrease in private units' capability to collect as manufacturer wants to take back their products. The prices of collected products sold to legal manufacturers are cheaper than that to illegal units;
- Furthermore, consumers have poor awareness of their responsibilities for products. This is a challenge to the collection of enterprises. To gether with that, the national management system on the conducting of collection system is still problematic.

4.2.3. Consumer

Obviously, consumers are responsible for 3R to minimize wastes. However, there are no legal documents or sub-law documents stipulating the performance of that responsibility. Now, consumers have to pay a general cost monthly while no responsibility is required for discarded products including battery. This discourages people to limit wastes. Besides, people have a habit of puting hazardous wastes together with domestic wastes. That causes various difficulties in treatment. A numerous pilot programs on segregation of wastes at the source have been run; however, no long - term positive results have been achieved. These programs are also difficult to be deployed on the large scale although consumers are responsible for minizing wastes.

Unlike consumers at anywhere, Vietnamese consumers are not only irresponsible for discarded products but also entitled to economic benefits when transferring discarded products to collector as described in figure 2. Therefore, it is hard to change traditional behaviours and improve awareness of people so that consumers have to hold their responsibilities for 3R principle.

These negative behaviours of consumers are mainly due to their lack of awareness about proper waste management. It is difficult to change conventional awareness among people. In addition, almost all people are unaware of the impact on the environment exerted by consumer and discarded products during and after use. They think that products

are just for consumption. When products are end of life, they have a right to choose their own behaviours to treat them, including storage, reselling or disposing.

Many people do not realize the benefits of the segregation of wastes at source, as well as the reduction, reuse and recycling of wastes. Or they only only know the benefits of proper waste management for the community but they do not want to practice it since there is no private benefit that can be gained from this activity. Also, the private benefit even much smaller, is always put at a higher priority than the general benefit.

Certain proportion of discarded products is reused by households in Vietnam for many different purposes. In one aspect, this is a good behaviour of consumers to minimize wastes and make use for different purposes of discarded products. For instance, plastic boxes and packs are used as containers and tires are used as buffers. In another aspect, when products are used for different purposes from their designs, they may also be harmful to other family members or to themselves. It is because they do not know the safety benchmarks of products, especially used products and they just focus on their features.

Difficulties and shortcomings for collection of products for consumers

- Firstly, consumers are unaware of dimissing end-of-life products and they are not provided adequate information about the impact of waste dumping;
- Secondly, when disposing products, consumers can gain economic benefit and have no responsibility for discarded ones; and

  Finally, during collection of products, it is essential to pay attention to convenience for consumers (collection method and distance) as they care both their materials and entertainment interests.

4.2.4. Recycler

Like manufacturer and consumer, recycler (in addition to collecting and finally treating units) has no responsibility according to the Law on Environmental Protection. However, Article 68 of the Law on Environmental Protection stipulates that recycler as mentioned in Article 67 will be given priorities such as tax incentives, capital and land support to construct their facilities. Actually, recycler has to hold responsibility for their activities in compliance with regulations on environmental protection.

If there are no legal regulations and laws on responsibilities of manufacturer, it is hard to give the recycler priorities when they recycle and finally treat discarded products. This is a bottleneck. Although they may gain profit from recycled materials and products

(in case of recycling), or receive treatment costs from the national agencies or manufacturer (in case of treatment). This benefit is so little compared to costs for collecting when manufacture has no responsibility for collection and recycling. Another problem is that almost all recycling activities causing environmental issues are privately owned. Most of these units pollute the environment and public health as they lack resources or even they prefer economic development. If these units comply with regulations on environmental protection, they cannot exist. Recycling enterprises face difficulties in collecting input due to intensive capital and compliance with legal regulations on environmental protection. Furthermore, poor management capacity of the authorities makes competitiveness of these enterprises limited.

Difficulties and shortcomings for collection of products for recycler

- Receiving favourite conditions from priority policies, recycler and treatment units have to ensure efficiency in technology, product quality and the environment. This leads to decrease in small-sized recycler and treatment units that have backward and outdate technology and increase in large-sized ones that have proper technology and comply with requirements for environmental protection. This makes a big change in the current recycling/treating system, especially to the informal sector;
- Recycler/treatment units should be financially and legally supported by the Government to change the current collecting system, otherwise it is hard to find input for production.

5. Proposed Responsibilities of Stakeholders

5.1 Major Viewpoints

In order to successfully apply and deploy system of solid waste management under 3R principle, at first, it is necessary to define and stipulate all responsibilities of stakeholders in the life cycle of products. The following opinions have been researched and proposed as a main foundation for the stipulation of responsibilities of the stakeholders:

1. 3R principle considers wastes as valued resources. This opinion must be affirmed and shared between stakeholders and community;

2. Solid wastes management system in general and recycling should meet international standards or at least regional standards;
3. In the system, responsibilities for discarded products should be shared between the two stakeholders including manufacturer and consumer.

   As analyzed, manufacturer and consumer are the most important factors relating to the life of a product. One creates demands and the other supplies to that demands. Therefore, responsibilities of the two stakeholders must be defined with the same importance in spite of the fact that the economic benefits of manufacturer seem to be more significant than of consumer;
4. Responsibilities of consumers should be considered to form 4R rule (Reduce, Reuse, Recycle and Responsibility) based on 3R rule, and Responsibility factor should be emphasized as a decisive factor for a success of the system;
5. Take back – refund should be considered as a main economic tool of the system, and each product shall have its own code of paying a security representing defined rate of expense for the collection, transportation, recycle and treatment of products when discarding. A fund of pay a security for recycle process should be established with the participation and control of Ministry of Finance, Ministry of Industry and Trade and MONRE. This fund should be separated from existing Fund of Environmental Protection;
6. The system should be connected closely to the changes of informal recyclers, from small scale and old technologies into new, modern and friendly-environmental technologies, because responsibilities of recyclers are to recycle safely;
7. Economic tool shall be the most important tool to impose responsibilities upon stakeholders and to change informal recycler into formal recycler;
8. There should be researches on a system of policy frame so that stakeholders can implement their responsibilities. Also in that system, the establishment of standards for recycled wastes and recycled products should be re-standardized and environmental standards for imported and exported wastes should be established;
9. The system should eliminate illegal manufacturers and smuggled goods by technical tools (standards and registration), economics (punishment) and control (controlling of goods origin);
10. The system should also be connected to an international fund for recycling with the participation of international and national manufacturers. This fund shall be connected to international functional centers for recycling focusing on small products and difficult

to collect in terms of physics such as: battery, hi-tech products: digital camera, iPod, etc;

11. In the first period of deployment, there should be an assistance of capital by the Government. The Government shall support both manufacturers and consumers in terms of sharing responsibilities for discarded products.

Based on these rules, the diagram of economic line is proposed as Figure 3.

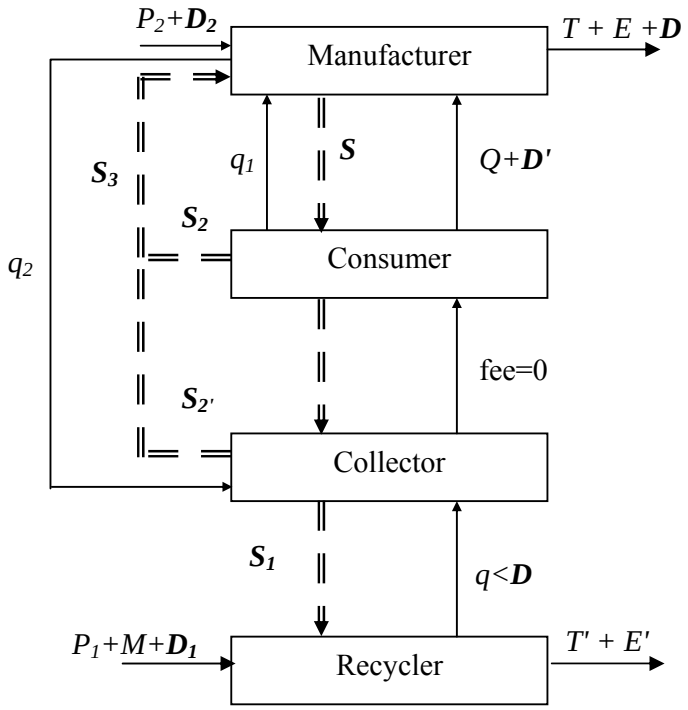

Figure 3. Estimated Material and Financial Flow in the New Management System

In the figure, S is the quantity of products which is provided for consumers and featured by particular recycled label for each type of product; S_1 is the quantity of products which is discarded to recycling enterprise; S_2 is the quantity of discarded products which is rendered to the manufacturer and therefore, received transport expenditure q_1, $S_{2'}$ is the quantity of discarded products which is rendered to the manufacturer by the system of collection with the condition that the manufacturer has the system of discarded product recycling and therefore, received the expenditure of transport and collection q_2 ($q_2 > q_1$), S_3 is the total quantity of discarded products which are collected from the consumers and the system of collection, accordingly $S > S_1 + S_3$ ($S_3 = S_2 + S_{2'}$). Q is the cost price of products provided for consumers, q is the collection expenditure of discarded products from the system of collection, T and T' are the expenditures related to tax, E and E' are the

expenditures related to the environmental protection, P_1, P_2 are favors as per the current laws for recycling/processing factories and manufacturers (in case the manufactures have the system of discarded product recycling), M is the profit gained from recycled products/materials. D and D' is the responsibility contribution of manufacturers and consumers, and $D + D' \sim q + g + t$, of which g is the transport expenditure and t is the expenditure of recycling and processing activities. D_1 is the part of expenditure from recycling fund received by the recycling/processing factories in accordance with the quantity of discarded products which are recycled by such recycling/processing factories, D_2 is the rendered expenditure of the manufacturer if the manufacturer has the collection and directly recycling system of their discarded products, $D_1 + D_2 = \boldsymbol{D}$.

In the proposed system, the flow of products can be from the manufacturers to consumers and from the consumers to the manufacturers or recycling enterprises through the system of collection. The current flow related to manufacture of imitated or fake products must be terminated through the strict inspection and supervision and serious application of standards with respect to the recycled products. In the economic sector, the recycling expenditure of discarded products, including the expenditure of collection and transport of discarded products to the recycling center/enterprise, shall be shared by the manufacturers and consumers. The whole of such expenditure of the manufacture shall be collected immediately by the National agency (the consumers shall refund the manufacturer when purchasing products) under the form of exchanging recycled labels which each product is forced to have. Such expenditure shall be mainly used for the recycling enterprise as per the registered quantity of recycling, and determined by the number of collected recycled labels. Besides, the recycling enterprise shall be supported by the Government in terms of technology, policies and taxes through the relevant management agencies. In the initial phase of the system, the Government shall spend a part of recycling expenditure as a form of supporting the manufacturers and consumers to stabilize operation, avoid disorders during the application of lengthened responsibility.

Together with the strict application of standards of recycled materials and products, as well as the environmental standards, as forecasted, the informal recycler must transit their manufacturing line in the direction of investing new technology and expanding the manufacture in stead of remaining the state of small and backward technology as currently because the line of discarded and collected products shall belong to registered recycling enterprise or formal enterprise, that has ensured technology and capacity.(too long sentence, kindly paraphrase) The reason is that, here, the formal recycler which is

supported financially from the recycling fund, and to increase the competitive level, shall increase the collection expenditure of products to the level that the informal cannot compete.

Based on the operation of the system, it is proposed the detailed responsibility of related stakeholders for discarded products as discussed in the next section.

5.2. Responsibility Proposal of Stakeholders

5.2.1. Authorities

Responsibility of authority agencies, in addition to specified matters in the Law of environmental protection and related legal documents, shall be as follows:

a. Establishing, issuing and adjusting the framework of policies and institution:

- Issuing and adjusting legal documents, stipulating the implementation and guiding the implementation of the new management system of wastes, of which classifying clearly responsibility of stakeholders as proposed, particularly the authority agencies;
- Investing in researching and issuing standards of recycled materials and products; focusing on common and particular materials such as metals (black and colored metals), paper, plastic (including rubber);
- Establishing the recycling fund with full functions and legal foundations, with the participation of related authority agencies in order to support and supervise financially the lengthening of responsibility of the manufacturers and consumers;
- Establishing and applying regulations of "greenization" of the supply chain of international materials as well as policies of "green" moral in the society;
- Increasing the capacity and establishing the human resources serving the system of waste management.

b. Executing activities from the management agencies in the system of waste management

- Controlling and supervising strictly the activities, including import declaration, manufacture declaration, manufacture registration, distribution registration, recycling registration as well as the implementation of standards of recycled materials and products by the manufacturer and recycler;
- Executing the green purchase, particularly, the application for public purchase as a part of 3R activities;

- Participating in supervision of input and output of discarded product cycle, of which imported products/refused materials and environmental protection in the recycling, processing as well as the inspection and supervision are focused in order to eliminate illegal activities harming the system of lengthened responsibility with respect to discarded products;
- Presiding programs and activities of information publication, increasing public knowledge and management capacity.

c. Investment in improving technological capacity in the system of waste management

- Presiding, financing and supporting domestic units to research on technology and deploy technology;
- Improving capacity and establishing research and traning system at universities and institutes;
- Establishing communications system and propagating information in order to meet the demands of community's information query.

d. Presiding and act as intermediary for international cooperation

- Acting as intermediary for international cooperation in the field of international recycleing, dialogue and share of policy, especially in the Southeast Asia and other countries;

  Participating in establishment and activities of investment of International funds for recycling, researching and transferring technology to countries in the region and establishing international functionally center for recycling (for special products).

5.2.2. Manufacturer

Manufacturer having the following responsibilities:

- Admiting and holding legal liabilities as required for products from manufacturing to recycling/final treatment processes;
- Actively forming recycling system for discarded products (entire or partial) to collect a part of materials for the production line or assigning this work to a competent recycling unit;
- Actively establishing collection system of discarded products in compliance with its production capability or legally authorizing a competent collector system;
- Cooperating with related national agencies and construction consultancy units to identify responsibilities (expenses on security payment to recycle discarded products) in costs for safe recycling of discarded products;

- Representing the Government to collect responsibility cost from consumers, (including product price);
- Co-ordinating with concerned national agencies in security payment to recycle;
- Directly participating in technology study and transfer to serve 3R activities for related products;
- Willing to provide information about products and other related information.

5.2.3. Consumer

- Admiting and holding legal liabilities as required for discarded products;
- Taking partially financial responsibilities for recycling of discarded products by incuring a part of cost included in product price;
- Being responsible for taking discarded products to collectors such as manufacturer's agents or authorized collectors and holding full responsibility for the pollution of discarded products;
- Actively receiving and studying related media information.

5.2.4. Recycler

- Registering capability and recycling processes with concerned agencies;
- Having responsiblity for complying with all standards for recycled wastes and products and other regulations relating to recycling of discarded products, especially environmental protection regulations;
- Cooperating with concerned national agencies, manufacturers in registration, report, investigation of discarded products to be recycled and participating in security payment – return relating to recycling funds;
- Actively co-ordinating with concerned national agencies in related overseas and domestic cooperation activities, proactively taking part in recycling technology study and transfer;
- Providing full information to stakeholders.

Based on these major responsibilities, it is possible to form and deploy an adequate management system of solid wastes in the principle of 4R as mentioned above to construct a sustainable developing society with less pollution.

6. Case Study

6.1. Case Study of the Use of a Thermo-power Plant Ash

Since 1954, Vietnam has operated power plants in small scale and capacity of 6-12 megawatt (MW) like: Hon Gai, Hai Phong, Nam Dinh, Yen Phu, Viet Tri, Thai Nguyen, Dam Ha Bac, Vinh, Lang Son, Uong Bi, Ninh Binh (25MW). In 1994, the electricity system in Vietnam was unified country-wide and the electricity production increased continuously from 8.7 billion kWh in 1990 to 80.7 billion in 2009 [7]. order to satisfy the demand, some plants have expanded their capacities for example, Uong Bi (expanded 1 - 50 MW), Pha Lai expanded 1 (110 MW), Pha Lai expanded 2 (300 MW), Uong Bi (expanded 2 - 300 MW), etc.

To meet the demand of electricity, the planning of National electricity development in the period of 2006 – 2015 with refers to 2025, thermo-power plant projects are expected to be built in the period shown in Table 7.

Table 7. Designed Thermo-power Plant Projects in 2006-2015 [8]

No.	Projects	Location	Designed capacity (MW)	Operation time
1	Duyen Hai 1	Tra Vinh	2 x 600	Assembly 1: year 2013
2	Duyen Hai 2	Tra Vinh	2 x 600	2014-2015
3	Long Phu	Soc Trang	2 x 600	year 2013
4	Vinh Tan 1	Binh Thuan	2 x 600	2011-2012
5	Vinh Tan 2	Binh Thuan	2 x 600	Assembly 1: year 2013
6	Vinh Tan 3	Binh Thuan	2 x 1.000	Year 2013
7	Vung Ang 1	Ha Tinh	2 x 600	Assembly 1: year 2013
8	Vung Ang 2	Ha Tinh	2 x 600	Assembly 1: year 2013
9	Hai Phong 3	Hai Phong	4 x 600	Assembly 1: year 2014
Total capacity			**12,800**	

Yearly, million tons of ash is generated from thermo-power plants causing serious impacts to the environment and community heath [9]. Counting out thermo-power plants belonging to EVN (Vietnam Electricity) in the North of Vietnam, emitted ash reaches nearly 1 million tons per year (Table 8).

Table 8. Amount of Coal Ashes From Thermo-power Plants in the North of Viet Nam

Plants	Capacity (MW)	Amount of ash (ton/year)
Pha Lai 1 [10]	400	188000
Pha Lai 2	600	249000
Ninh Binh	100	37000
Uong Bi	100	39000
Expanded Uong Bi plant	300	124600
Cao Ngan (2008) [11]	115	180000

Ash from thermo-power plants can be divided into two types: bottom ash and fine ash (chemical compositions are similar to clay). The bottom ash term is used for the heavy ash and slag found in the bottom of thermo-power furnace and the fine ash term is used for the ash accompanied with the exhausted gas. The ratio of bottom and fine ash (also called invert) is shown in Table 9.

Table 9. Ash Component [9]

Plants	Bottom ash	Fine ash (invert)
Pha Lai 1	27%	73%
Pha Lai 2	27%	73%
Ninh Binh	27%	73%
Uong Bi	29%	71%

Becaue the combustion efficiency in thermo-power plants is not high so untreated fine ash reaches only class F (1-12 % calcium and lower alkalis compared to Class C)

according to ASTM International (American Society for Testing and Materials). Besides, they are lost remarkablely when igniting. That is the main reason for limiting the use of fine ash in Vietnam in the previous time.

Nevertheless, in the recent year, the fly ash from thermo-power plants has found its application in the cement production thank to the technology transfer from Japan. The use of fine ash, which was considered waste before, can change the conventional view on waste and it should trend the waste management in the future. The use of fly ash is discussed on detail in the next part.

Reusing ashslag of thermo-power industry in Vietnam

Previously, the ash slag of thermal power plants as Ninh Binh, Pha Lai was often given or sold at very cheap prices. Then, it was mixed with peat coal as a fuel for domestic appliances or for brick kilns. Late 1990s, some local thermo-power plants had started to salvage ash slag to produce non-baked bricks. However, salvaged ash slag is much less than generated ash.

Since 2000s, when Japanese technology on applications of ash from thermo-power plants was introduced, a lot of researches to develop these application in Vietnam have been carrying out in two ways: (1) puzzolan, contains components as same as clay (silicat oxide SiO_2, aluminum oxide Al_2O_3 and ferrous oxide Fe_2O_3), and (2) remaining coal (approximately 20%).

Ratio between these two components has a significant impact on objects that can use this type of ash. Brick manufacturing plants prefer to use ash with a high content of coal, while this content is too high can reduce the chemical properties leading to a limition in applications fine ash to produce cement and concrete. Vietnamese scientists, research institutions and enterprises have recognized that and quickly implemented researches to develop technology of separating two components into finished products.

Main applications of ash generated from thermo-power plants in Vietnam are:

- To use as a mineral additive for cement production or partial replacement of cement in concrete and mortar production to take advantage of cheap raw materials and constraint of cracking of concrete structures when using fly ash in concrete;
- To concrete in big blocks or roller-compacted concrete (RCC method) because it can help to improve the concrete quality, easier to executing the work, reduce breaking down, reduce the invasion of water, cut down the cost of concrete;

- To manufacture brick in tunnel kilns (use unburned coal and puzzolan in slag); and
- To manufacture unfired-brick, AAC brick, panel, asbestos-free cement, etc..

Due to the limited supply while the demand is increasing, at the beginning (2005-2006), the price of raw fine ash (unclassified fine ash) was only 3 USD per ton at Pha Lai thermal power plant. In 2009, the price of raw fine ash was about 11USD/ton in the North, and about 32 USD/ton in the South. In 2007, classified fine ash (to make unburned coal content to less than 6% of going down in accordance with technical requirements for cement additive) was sold at price of 25 USD per ton [12]. In order to improve economic effect and environmental pollution, thermo-power plants have equipped with particle collection systems.

The success in research and implementation of using fine ash in construction works increase the need of that waste (Table 10).

Table 10. Fine Ash Consumption in Vietnam [12]

Industries	Using purpose	Amount
Cement	active admixture with the minimum level of 5%	0.9 million ton/year
Concrete	to replace cement with the minimum level of 20%	342,000 ton/year
Hydro power industry	Admixture	1.8 million ton
— Son La Hydro power Plant		600,000 ton
— Hoi Quang Hydro power Plant		200,000 ton
— Nam Chien Hydro power Plant		200,000 ton
— Ban Ve Hydro power Plant		200,000 ton
— Cua Dat Hydro power Plant		180,000 ton
— A Vuong Hydro power Plant		150,000 ton
— C Ka Mang Hydro power Plant		300,000 ton

The standards related to the fine ash

Currently, Vietnam has not issued any legal documents on product standards or the use of thermo-power ash. The use of fine ash is currently based on the standards for active additive Puzzolan such as TCVN 6260: 1997; TCVN 6882 2001; TCVN 4033: 1995;

TCVN 7712: 2007 TCVN 7711: 2007 ; TCXDVN 395:2007; T4 BC 114: 2001. The Government is interested in reusing thermo-power ash. That is displayed in the investment of the Government for researches on the possibility of application of fine ash in the construction industry in recent years. A draft of TCVN 2682-2008 [9] specifying on analysis of fine ash composition is being seting up and this is the base for the other criteria for that kind of high demanded waste.

Although fine ash is not included in the list of waste imported into Vietnam, but when implementating commitments to WTO of which Vietnam is a member, Vietnam will be unable to prevent the import of wastes including fine ash from other countries. Therefore, the promulgation of the technical standards for this type of waste not only control the import of waste, but also promote the reuse of fine ash in the economic fields, reduce pollution, improve economic efficiency as well as promote regional and international integration.

The remarkable benefits and wide application scale of fine ash along with the self control capacity of technical factors in domestic establishments have led the reuse of thermo-power ash to be widely applied. Consumers also respond enthusiastically the use of these products. Economic benefit from the use of fine ash has promoted the implementation of the responsibilities of producers and consumers in implementing 3R effectively for this type of waste.

6.2. Case Study of Lead Battery Recycling

Batteries using in Vietnam mainly are open typed and close typed acid batteries for transportation means. Batteries not causing negative impacts to the environment when being deposed are expensive and unusual, so they are used mostly in specialized equipment with limited quantities. At present, collection and treatment for expired and out of work batteries are often done by private owned companies, craft-households. Treatment and recycling technologies added poor awareness on environmental protection lead to serious impacts to the environment and human health. Meanwhile, the legal system in Vietnam is still incomprehensive with lacking of policies, economic tools that specify clearly responsibilities of battery consumers, manufacturers, and importers as well as responsibilities of agencies for treatment and taking back out-of-work batteries.

Different from the fly ash case, even lead battery is recycled for a long time in Vietnam, however, there is still no specific regulation or standard for the application of this

type of materials. The next part will discussed on detail this difference and try to find the cause.

Manufacturing and import acid batteries in Vietnam

Until the end of 2009, Vietnam had only five acid battery manufacturers (Table 11) and 20 companies importing that kind of battery.

Table 11. List of Acid Battery Manufacturers in Vietnam [13]

No	Name of Companies	Unit	Production	Export
1	Dry Cell and Storage Battery JS. Company PINACO (2008)	kwh/year	1,000,000	162,324
2	Vinh Phu Storage Batteries & Dry Cells JS. Company (2007)	kwh/year	60,000	none
3	Tia Sang Battery JS. Company	kwh/year	250,000 (2007) 207,329 (first 8 months of 2008)	25,899
4	GS Battery Vietnam Co. Ltd. (2008)	kwh/year	431,329	60,386
5	Le Long Vietnam Co. Ltd. (2007)	box	6,000	1,800

Import of used batteries and scraps are complicated in the recent years. Thousands tons of used battery are imported into Vietnam as scraps or brand new products. In the 3-year period of 2005-2008, Environmental Police (C36) had forced nearly 6,200 tons out-of-works acid batteries which were illegally imported to re-export [14]. In fact, most of imported scraps contain impurities, hazardous components although in customs declarations, they are “materials” or “cleaned matters”. For example, Vu Hai Co. Ltd., (Quang Ninh) imported 63.040 tons acid battery electrodes; Hoang Phat Co. Ltd., (Hai Phong) imported 44 tons acid battery electrodes while they declared to the Customs those were lead ores; Long Giang Co.Ltd., (Quang Ninh) imported 257 tons used batteries with the declaration of brand new ones and Hai Thien international Carriage Service and Trading Co. Ltd transported 20 tons wasted acid batteries at Tan Thuan Port [15].

Status of using acid batteries in Vietnam

- Batteries for automobile and motorcycle

According to the report on National environmental status in 2007 – there were approximately 800,000 automobiles and 23 million motorcycles in Vietnam. The longevity of a 15 kilogram battery for automobile is two years and of 2.5 kilogram battery for motorcycle is five years on average. It is estimated that in 2007, about 19,600 tons acid batteries including 8,200 tons for automobile and 11,400 tons for motorcycle were used.

In 2008-2009, the number of automobile increased approximately 20% per year, of motorcycle increased approximately 15% per year. In total, used acid batteries were about 27,000 tones in 2009 [16].

- Batteries for other purposes

Specialised batteries are mainly used in mine, telecommunications and electronic sectors. Previously, in Mine sector, many Fe-Ni batteries imported from China were used however, at the current time, big equipment trends to run by acid batteries because they are easy to be replaced by domestic products.

Since the supply of electricity in rural and mountainous areas does not satisfy the demands, people often buy cheap acid batteries or used automobile batteries that had been repaired for domestic use purposes or for production activities. Up to now, a number of those batteries have not been counted yet but it is found that all of those batteries after use are bought to the collection system, not discarded.

Status of wasted and end-of-life battery collection and recycling

- Collection

According to the survey results in some garages in Hanoi, Ho Chi Minh city, Viet Tri, Nam Dinh and Hai Phong, almost transportation mean batteries are replaced in garages. Those batteries after being replaced are collected at garages then sold to scavengers. That kind of collection shows its high effect because few batteries are discarded into the environment.

Besides, manufacturers and importers only have responsibilities for replacing (taking back) under provisions of warranty for their batteries. However, the rate of that activity is low because usual technical errors only reduce productivities and longevities of equipment while consumers do not have enough knowledge and tools to check on exactly product quality whether it matches technical characteristics declared by manufacturers.

- Recycling in craft villages or craft households

A big amount of lead batteries is recycled in craft villages, typically lead recycling craft village Dong Mai (Hung Yen). That used to be a traditional bronzing village, since 1985-1986, hundreds of craft households in Dong Mai village have changed to recycling activities due to high benefits, cheap materials (wasted batteries) and simple techniques.

Lead recycling craft households in Dong Mai order materials to scavenger nets in provinces. Those scavenger nets collect end-of-life batteries from garages or buy from smaller scavenger groups or buy batteries failed to finished conditions from battery manufacturers. Materials even come by illegal import activities of lead batteries through national borders.

On monthly average, hundreds of tons of discarded batteries are collected to come to Dong Mai where recycling organizations use backward and manual technologies causing serious environmental problems. In 2008-2009, environmental management authority in Hung Yen had monitored environmental impacts and suspended many households in the area, so recycling activities had decreased significantly. However, some organizations in the village still carry out recycling activities as Ngoc Thien Co.Ltd., with capacity of 15-20 tons raw lead/day; Minh Quang Co.Ltd., with capacity of 2.5 tons recycled lead/day, etc.,

In the southern areas, some organizations recycle lead with out registrations such as: Kim Thang Long Co.Ltd., (a professional waste treatment) in Le Minh Xuan small scale industrial area, Village No.1, Tan Nhut Commune, Binh Chanh District (Ho Chi Minh City), households in Quang Trung road (Go Vap District), Hung Vuong road (District 5), Lac Long Quan road (Tan Binh District) etc.

Due to backward technologies and equipment, recycled lead quality does not satisfy domestic production demands. Most of them are exported to refine while Vietnamese manufacturers have to import lead as a material for their processes.

Recycling at industrial scale

With high economic effect of lead battery recycling in Vietnam, since the end of 2007, in the South of Vietnam, some private establishments have invested to lead recycling activities. These establishments have bigger scale and more advanced technology than craft villages although they are scattered (Dung Ngoc Co.Ltd., in Tan Thanh district, Ba Ria – Vung Tau province with a scale of 2,000 tons/month). Most of recycled leads from these establishments are exported because they do not meet the requirements for materials of

domestic battery production. In the near future, a factory belonged to Thye Ming Vietnam Company in Binh Duong is going to operate with main function of lead battery treatment and recycling.

Lead battery collection and recycling system in Vietnam is summarized on Figure 4.

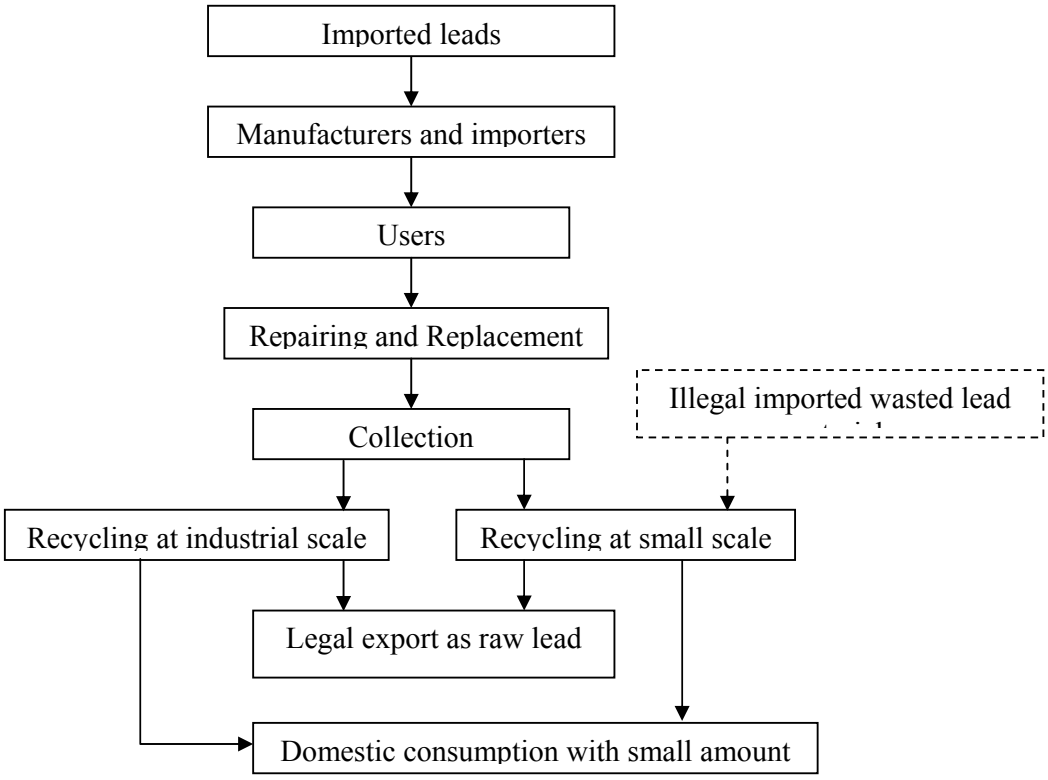

Figure 4. Diagram of Lead Battery Collection and Recycling System in Vietnam

In summary**,** according to the Law on Environmental Protection 2005, Article 67, battery is one of products that manufacturers have responsibilities for taking back after use however there are no detailed regulations about these responsibilities of manufacturers as well as importers and distributors in Vietnam. The management only conforms to regulations on hazardous wastes such as Basel Convention, Circular 12/2006/TT-BTNMT dated 26 December 2006 by MONRE providing guidance of professional conditions and procedure for documenting, registering, licensing, coding of practice and hazardous waste management. There are no detailed regulations on responsibilities of manufacturers as well as importers and distributors of battery products in Vietnam.

Import wasted lead batteries into Vietnam faces many difficulties due to incomprehensiveness of legal system as well as lack of detailed standards relating to wasted lead batteries in spite of that illegal import of wasted lead batteries is existing due to economic profits.

Collection of lead batteries is done by recycling establishments through scavenger net with a high effect (approximately 100%). Environmental protection aspect is not concerned in lead recycling activities in particular and recycling acitivities in general so economic effects of these activities are high. That is a main factor to make the collection system operate effectively.

Because standards for recycled lead are lacked so lead recycling establishments still remain backward and limited technologies and equipment, small sizes leading to poor quality of recycled lead and environmental pollution. National management authorities monitor ineffectively so recycling establishments do not have to pay much for pollution treatment. People‘s awareness on that field is not high, and often focus only for economic profits. Neither environmental protection nor human health is underestimated. That is why even recyling lead batteries can bring high benefits,recycling rate is still low.

Beside preferences regulated in the Law on Environmental Protection, detailed responsibilities of relevant partners to lead battery (manufacturers, importers, distributors, consumers, recycler/final treatment) as well as detailed standards on that kind of scrap promote informal recycling acitivities to become formal activities and create a good condition for the performance of 3R to that kind of such hazardous waste.

From this two different case studies, it is found that economic benefit should be closely tied with the responsibility, in order to successfully apply 3R strategy. In the first cases, all of the stakeholders are big enterprises and their benefit is secured (and controlled) by the standard and legislation. In the second case, the stakeholders (all of them are small and medium private enterprises) found that their benefit is opposited with the standard and legislation. They would be suffered when the industrial standard for recycled lead is applied, unless they improve themself in both of the scale and technology immediately. Of course, the view point on their responsibility to the environment also should be changed. This is a very important point for the application of 3R strategy in Vietnam.

7. Conclusion

The increading waste generation, as the result of the economic development, has become one of the most important environmental issues in Vietnam. Due to many reasons, the amount of wastes has tremendously increased within the past few years and thus, has caused much difficulty for Vietnam to address this problem. Until this time, Vietnam does not have a proper system to manage it.

The waste collection system is not organized and still scattered over the country. For the valuable waste such as metal, plastic or paper, the system can collect most of them with a very high efficiency. But for the other type of waste, the efficiency is still low, not only due to the lack of economic benefits but also due to the lack of awareness of its negative environmental impacts to the community.

At the present time, Vietnam does not have proper recycling and treating system for the waste. A lot of waste is landfilled without proper environmental protection solution. There is a large amount of waste being dumped or disposed yearly without control. It leads to great harmful effects to the environment and public health that can also reduce the economic achievement through the increase of environmental cost. Furthermore, when disposing wastes, Vietnam has lost a remarkable amount of secondary material sources that can be reused or recycled in many production sectors, and thus, lost an important benefit source for the development.

There are not much industrial recycled materials and products standards, and the existing ones are still scattered that can not encourage the 3R implementation. Due to this reason, Vietnam also does not have the proper technology and the market using recycled materials, especially plastic, glass and precious metals. They are a very important factor to drive the stakeholder's trend from the existing waste management system into the proper system for the development in future. Besides, for the improvement of the small private enterprises on the material recycling sector, standards for recyclable waste as well as recycled products are needed. As mentioned before, one common dilemma for waste management system in Vietnam is the existence of the private recycling enterprises. This sector can bring benefit to the poor agricultural areas without much investment cost; create more direct and indirect jobs to the peasant at free time of cultivation. Nevertheless, it also causes serious problems to the environment and public health as evident in many craft villages that need to prevent for the sustainable development. The standards for recyclable waste and recycled products then must be a key factor to restrict the operation of small

recycler, and force them to change technology and equipment and enter in the new stage. Besides, the standards for recycled products also can limit the development of the fake-new appliance at the acceptable level, to avoid the uncontroled expanding of this sector. In the near future, due to the integration into the world economy, the waste management system in Vietnam should meet the international or at least, the regional standards.

The role of stakeholders is still unclearly defined to promote 3R policies and activities. Therefore, it reduces the effectiveness of the waste management system, and creates unclear conditions to define the responsibilities for stakeholders. Thus, for an improved waste management system, it needs to draw clearly the role of stakeholders, with a proper framework of regulated and guideline policies. More importantly, responsibilities of the society (including manufacturer, consumer and recycler) should be considered to form 4R rule (Reduce, Reuse, Recycle and Response) based on the 3R principle, and should be emphasized as a decisive factor for the success of the system.

Based on the experiences of case studies discussed, it is shown that the provision of economic benefits is one of the most important tools to impose responsibilities upon related parties and to change informal recycler into formal recycler. In which, take back–refund should also be considered as a main economic tool to form the appropriate waste management system, along with the legislation tool.

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