Chapter 9

Waste Management and Waste Information Exchange in Thailand

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Introduction

The world is currently faced with economic crisis, as well as increasing natural resources and environmental degradation. Global attempts with some measures have been done to deal with environmental problems. However, sometimes complying with existing required procedures have become trade barriers and have burden to industrial operators. Both the government and industrial sector therefore have to adjust themselves by applying the concept of resource maximization under the principles of 3Rs – reduce, reuse and recycle.

According to the studies and researches in Thailand, various types of wastes generated in the country have great potentials to be recovered. The database of the Pollution Control Department (PCD) and the Department of Industrial Works (DIW) in 2007 indicated that in Thailand, domestic wastes in particular, totaled to 14.7 million tonnes a year, out of which only 22% had been recovered. Also, out of 18 million tonnes of industrial wastes generated a year, only 60% had been recovered. More of these have had large potentials to be recovered. Therefore, different sectors have encouraged the government, industries and households to optimize and initiate means for waste exchange so that the matching between those producing wastes and those needing to use them could be enhanced, and the resource utilization within the country could also be maximized.

I. Situation of Wastes in Thailand

I-1. Domestic Wastes

The amount of solid wastes in Thailand continues to rise. Currently, solid wastes generated nationwide are accounted for 14.47 million tonnes or 39,630 tonnes a day (excluding the amount prior to being dumped to waste containers). In Bangkok Metropolitan Area (BMA), 8,897 tonnes of solid wastes a day are collected while 12,433 tonnes a day are collected in other municipal areas. Pattaya city, (the special Administrative in Chonburi Province) accounted 31% of waste generated. Solid waste generated outside the municipal areas, including Tambon Administrative Organizations (TAO) accounted for 18,300 tonnes a day or 46% of the total solid wastes generated nationwide. Compared to the previous year, a decrease of only 0.25 million tonnes (or approximately 1.7%) is reported. The amount of solid wastes within the municipal areas decreased 9% while those outside the municipal areas increased more than 1%. This

could possibly be due to the promotion of recycling within the scope of integrated waste management (see Table 1 and Figure 1). However, the overall rate of solid wastes generation nationwide has remained the same, 0.65 kg. per person per day, as detailed in Table 1.

Table 1: Quantity of Municipal Waste, Classified by Area

Area	Quantity of municipal waste (ton/day)				
	2003	2005	2006	2007	2008
Bangkok	9,356	8,291	8379 (21% - 1.5 kg/person-day)	8,532	8,897
Municipalities and City of Pattaya	12,500	12,635	12,912 (32% - 1 kg/person-day)	13,600	12,433
- Center and East		5,499	5,619		5,859
- North		2,148	2,195		1,745
- North East		2,906	2,970		2,838
- South		2,082	2,128		1,991
Other	18,100	18,295	18,697 (47% - 0.4 kg/person-day)	18,200	18,300
Total	39,956	39,221	39,988 (0.6 person-day)	40,332	39,630

Source: www.pcd.go.th, 2008. and www.timpse.or.th, 2009

Domestic wastes composed of organic wastes (46%), recyclable wastes (42%), toxic wastes (3%) and others (9%).

I-2. Toxic Wastes

The total amount of toxic wastes were generated in Thailand in 2007 accounted for 1.82 million tonnes a year, of which 1.40 million tonnes came from industrial sector, 0.40 million tonnes from households and 0.02 million tonnes from hospitals. Those mostly generated within BMA amounted for 1.191 million tonnes a year or approximately 65% of the total toxic wastes generated nationwide, as detailed in Table 2.

Table 2: Quantity of Hazardous Waste, Classified by Area

Area	Quantity (million tons)			
	Municipal	Industrial	Total	%
Bangkok	0.266	0.926	1.191	65
North	0.020	0.071	0.092	5
East	0.053	0.185	0.238	13

Area	Quantity (million tons)			
	Municipal	Industrial	Total	%
North East	0.018	0.064	0.082	4.5
North	0.029	0.100	0.128	7
South	0.022	0.078	0.101	5.5
Total	0.409	1.424	1.833	100

Source: www.pcd.go.th, 2008

I-3. Industrial Wastes

Industrial wastes are defined as those not being used or the total wastes generated from the entire operation within the working places, including wastes from raw materials generated from the production process of deteriorating products and effluents with toxic components or compositions.

According to DIW, in 2007, industrial wastes with permits to be taken out of the factories accounted for 18 million tonnes, comprising 16 million tonnes of non-toxic wastes and approximately 2 million tonnes of toxic wastes. The main composition of non-toxic wastes was iron, accounting for 31.01% of the total non-toxic wastes generated; the rest were plastics (24.54%) and papers (25.06%).

Table 3: Component and Percentage of Non-Hazardous Waste

No.	Detail	Percentage
1	Paper	25.06%
2	Glass	12.36%
3	Plastics	24.54%
4	Steel	31.03%
5	Aluminium	4.03%
6	Rubber	2.98%

Source: Department of Industrial Works, 2007.

Sources of Industrial Wastes

According to the statistics of DIW, Ministry of Industry, currently there are 126,658 industrial establishments in Thailand. Most of them are located in the Northeast, accounting for 33% of the total establishments, 30% located in BMA and its vicinities, while the least number of industrial establishments is reported in the East, as detailed in Table 4.

Table 4: Distribution of Industry, Classified by Region

No.	Region	Number of Industry
1	North East (33%)	41,705
2	Bangkok and Boundary (30%)	38,345
3	North (12%)	15,288
4	Center (10%)	12,573
5	South (8%)	10,427
6	East (7%)	8,320
Total		126,658

Source: Department of Industrial Works, 2009

Taking a particular focus on industries, Type 3 –polluting industries required to have a permit to operate from DIW. (Type 3 industry is that of which the site location, capacities and construction must obtain a permit before the operation) It was reported that in 2007, there were a total of 65,523 industries under this type; mostly located in BMA and its vicinities, as shown in Table 5.

Table 5: Distribution of Industry Type 3, Classified by Region

Region	Number of Industry
Bangkok and vicinities	27,639
Center	9,274
North East	8,111
North	7,512
East	6,805
South	6,182
Total	65,523

Source: Department of Industrial Works, 2007

In addition, there were approximately 60,000 industrial establishments nationwide generating wastes, out of which 9,780 establishments requested permits to take wastes out of the premises. The highest volume of wastes requested for the permit are reported is Samutprakarn Province, approximately 1.0 million tonnes a year, then followed by Samutsakorn and Bangkok Province, respectively.

Table 6: Quantity of Waste Which Asked Permission to Move Out From the Factory Between 2007 – 2008, Classified by Province

No.	Province	Quantity of Waste (tons)
1	Samutprakarn	1,020,289
2	Samutsakorn	796,187
3	Bangkok	750,131
4	Pathumthani	429,473
6	Rayong	372,960

Source: Department of Industrial Works, 2009.

II. Waste Management in Thailand

II-1. Domestic Wastes

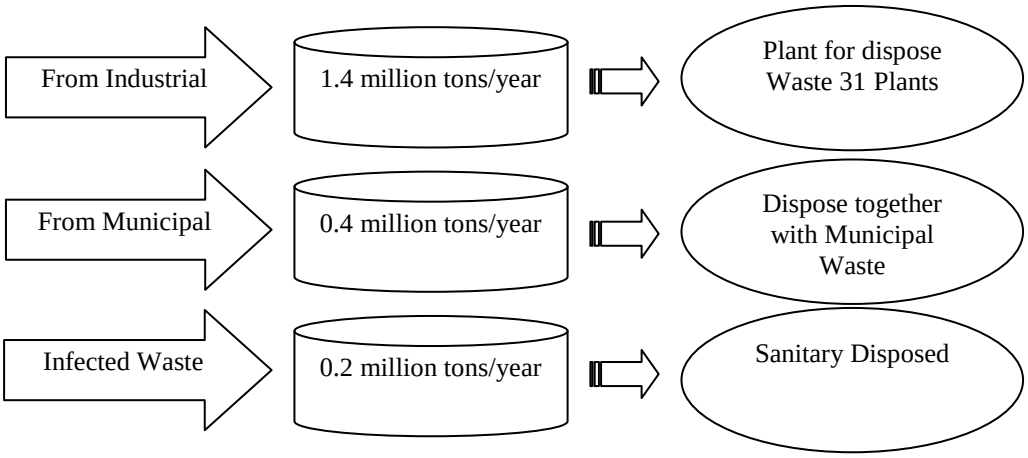
Domestic wastes in Thailand accounted for 14.6 million tonnes a year, of which only 12.3 million tonnes a year was collected (approximately 84% of the total domestic wastes generated). Currently, only 36% of domestic wastes has been technically and hygienically managed and treated through sanitary landfill, incineration or integrated waste management system. And 64% of domestic waste has been open dump site or burning. There are 96 domestic waste treatment plants in Thailand, which include 90 sanitary landfills, 3 incinerations and 3 sites of integrated waste management system (Pollution Control Department, 2007).

In 2007, 3.19 million tonnes of wastes or 22% (the total waste generated in that year are 14.5 million tonnes of wastes) were recovered, out of which approximately 94% was recovered through sorting and trading of recyclable wastes (glasses, papers, plastics, iron and aluminum). These were undertaken through the purchase of old used products, recyclable waste collection project (Pha Paa Recycle Project), Waste Bank in Schools, Recyclable Materials Weekend Market, Community Recyclable Materials Centre, wastes in exchange for rice, among others. The remaining 6% was through the use of organic wastes for the production of organic and biological liquid fertilizer.

II-2. Toxic Wastes

The management of toxic wastes, totaling to two million tonnes a year (0.4 million tonnes of domestic wastes, 1.4 million tonnes of industrial wastes and 0.2 million tonnes of infectious wastes) involved three main stakeholders, which include the waste generators, waste transporters and waste processors. Each of them had the responsibility to ensure that wastes had been managed and treated with no negative impacts on public health and safety, and with least damage on the environment.

Figure 1: The Current Disposal of Hazardous Waste



II-3. Industrial Wastes

II-3-1. Status of Industrial Waste Management Undertaken by Waste Generating Industries

In 2007, there was a small number of waste generating industries who had requested for permits to take wastes out of their operating premises (8.2% of the total registered industries) and who had notified the transport of wastes out of the operating premises (8.2% of the total industries). Only a few proportions of waste generating industries had managed their wastes according to the legislation.

Although the proportion of waste generating industries requesting for the permits has remained low, that of the wastes requested for the permits has been huge, reaching 61.1% and 58.2% of the total toxic wastes generated and non-toxic wastes expected to be generated, respectively. The proportion of notified waste transport was 14.7% and 10.4% of the total toxic and non-toxic wastes generated, respectively. This has indicated that those who has legally requested for the permits for waste treatment and waste transport notification, have been large industries with large volume of wastes generated.

Supposedly, all wastes under the permits would be appropriately treated, approximately 60% of the total toxic and non-toxic wastes currently generated. Therefore, the remaining 40% of the total generated would possibly been inappropriately managed. It is assumed that the small sized industries have generated low volume of wastes.

Industrial wastes with permits for treatment outside the operating premises have mostly been recovered rather than treated. About 61.4% of toxic wastes have been recovered and use as fuel mix or substitutes and others, while approximately 78.4% of non-toxic wastes have been recovered. As for the treatment, non-toxic wastes were taken for landfill and toxic ones for incineration.

II-3.2. Status of Industrial Waste Management Undertaken by Industrial Waste Processors

Currently, there are 427 factories operating as waste processors (excluding those not located at the notified addresses, those terminating their business and those solely sorting their industrial wastes). These factories can be categorized into three according to their types of operation.

Table 7: Number of the Industrial Waste Treatment/Disposal Plant

Type of Management	Hazardous Waste		Non-Hazardous Waste	
	Number (plant)	Capacity (million tons/year)	Amount (plant)	Capacity (million tons/year)
Burn in incinerator	10	8.82	5	8.85
Bury in the landfill	4	0.92	8	0.51
Recycle	196	0.61	204	0.44

According to DIW, the proportion of toxic waste processing factories that notify the transport and receive wastes for treatment has increased from approximately 39.0% of the total number of factories in this category in 2006 to 80.0% in 2007. However, the non-toxic waste processing factories have been quite small, accounting for approximately 15.7% of the total number of factories in this category in 2006.

There have been a total of 14 toxic waste processing factories using incineration and landfill. All of them have notified waste transports and receipts. As for the industrial waste recycling factories, the proportion of those notifying waste transports and receiving wastes for treatment has increased from 38.3% in 2006 to 78.6% in 2007 of all the recycling factories in operation (from a total of 196 factories).

Utilization of Industrial Wastes

In 2007, industrial wastes composed of glasses, papers, plastic, irons, aluminum and rubbers generated were about 13.46 million tonnes, out of which approximately 8.04 million tonnes or 60% were recycled, reused and used as fuel. Compared to 2006, it was found that the proportion of industrial waste recovery decreased by 4%, of which the recovery of papers and irons only was 6% and 7% declined. The proportion of others was quite similar to that of the previous year.

For the utilization of industrial wastes, about three million tonnes (37%) was traded within households and about five million tonnes (63%) were through waste exchange system by producers, importers or distributors and under deposit-refund system. Irons and aluminum have remained the industries of highest recovery with 87% and 71% of the total production, respectively. As Thailand does not have the primary production of irons and aluminum, their wastes are therefore collected as raw materials for product

manufacturing. The lowest waste recovery was found in plastic industry, of which only 21% of the total production was recovered. Rubber industry has 30% recovery, of which the recovery was through the burning of tyre wastes as fuels for cement kilns, totaling 7,223 tonnes or approximately 2% of the total produced.

III. Wastes Related Laws and Legislation in Thailand

There have been a number of laws and legislation related to waste management. The key one is the Factory Act A.E. 1992 (This law provides a legal basis of establishment and control of industrial operation including setting and enforcement of industrial standards.). Other related laws include the Hazardous Substance Act A.E. 1992, controlling wastes containing chemical substances; the Public Health Act A.E. 1992, controlling wastes from all types of activities but currently with enforcement over domestic and infectious wastes; and the Enhancement and Conservation of National Environmental Quality Act A.E. 1992.

The main content of those laws and legislations involves the control and supervision over waste management and treatment, particularly waste collection and transport. Different measures are introduced according to each type of wastes and their origins. The scope of laws and legislations based on types and origins of wastes is summarized in Table 8.

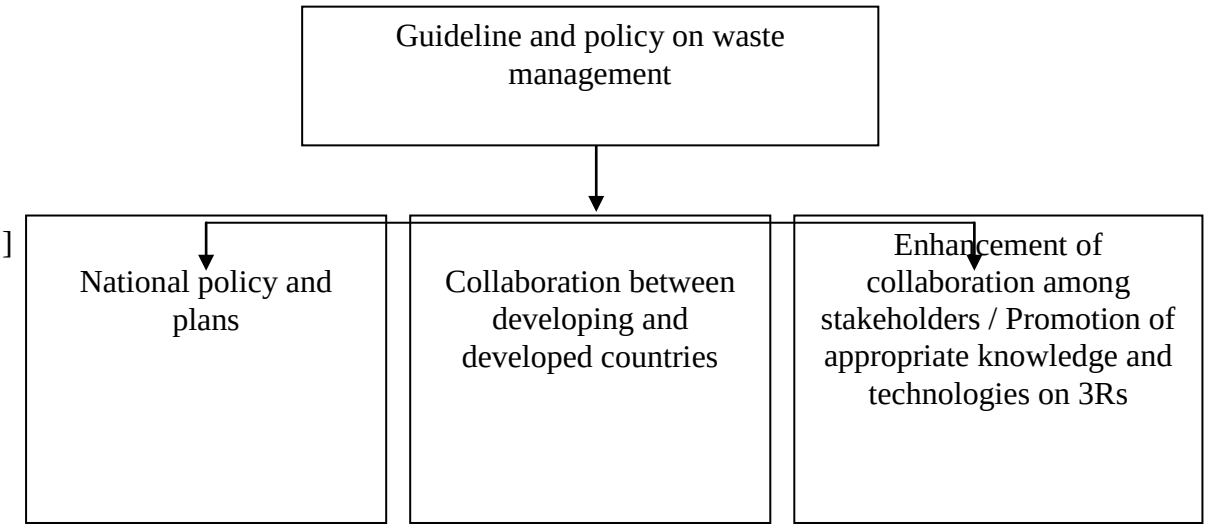
Table 8: Boundary of the Control for Source and Type of Waste

Source / Regulation	Industrial	Hospital	House	Educated Institute
The Factory Act A.E.1992	- Hazardous waste - Non-hazardous waste			
Public Health Act A.E.1992	- Infected waste - Waste (not occur from the process of the production of the factory)	- Hazardous waste - Waste - Infected waste	- Hazardous waste - Waste - Infected waste	- Hazardous waste - Waste - Infected waste
Atomic Energy for Peace Act.	- Radioactive waste	- Radioactive waste	- Radioactive waste	- Radioactive waste
Hazardous Substance Act A.E.1992	- Hazardous waste (only to occupy for chemical waste and transportation)			

IV. Guideline and Policy on Waste Management for Thailand

The guideline and policy for Thailand aims to enhance waste management through the efficient implementation of mechanisms and technologies. This can be summarized as shown in Figure 2.

Figure 2. Guideline and Policy on Waste Management for Thailand



IV-1. National Policy and Plans

Thailand government policies aim to establish efficient waste management system, to enhance waste management in local areas, and to encourage private sector to recycle waste within the organizations so that wastes could be minimized. The government should also ensure that Thailand would not be a waste dumping destination as this would increase pollution to the country.

The national integrated waste management plan has been formulated to encourage the maximum use of resources in an efficient manner, to control wastes at the sources, and to maximize the use of wastes prior to final treatment.

The national master plan on the cleaner production and cleaner technology has been created to enhance the application of cleaner production and cleaner technology so that wastes could be minimized e.g. in pulp and paper industry where cleaner technology has currently been promoted.

The Strategic plan on e-wastes has been formulated as a framework for e-waste management through appropriate waste sorting and management, emphasizing on the Polluter Pay Principle (PPP) that would apply to both manufacturers and consumers, and on the principle of 3Rs in the management of e-wastes.

The strategic plan on packaging and packaging waste management to minimize the volume of wastes has been also drafted. The government has drafted this plan covering four main groups, which includes the following: 1. designers and manufacturers, 2.

product transporters and distributors, 3. consumers, and 4. waste collectors and processors.

The government green procurement policy project has been implemented to minimize pollution and enhance awareness among manufacturers and service providers on all aspects of environmental impacts, including waste minimization.

IV-2. Collaboration between Developing and Developed Countries

Thai government has conducted 3R related projects with developed countries.

Green Manufacturing Technical Assistance Program to encourage cleaner technology, life cycle assessment (LCA) and eco-design have been implemented so that the industrial sector becomes green. In addition, a network of product LCA and eco-design has been established. This is collaboration between the National Metal and Materials Technology Centre (MTEC), Thailand and the Government of Japan under Green Partnership Plan.

Fluorescent Lamp Partnership Program is a collaboration program between the governments of Thailand and Japan for the management of fluorescent wastes, under which waste recycle and the establishment of waste exchange network has been emphasized.

Construction and Demolition Waste Management System, a partnership between GTZ (Thai-German Programme for Enterprise Competitiveness) and Pollution Control Department (PCD) for appropriate management of construction and demolition wastes has been also implemented so that inappropriate waste management could be prevented.

Packaging Waste Project with GTZ's technical support as the preparation for plan and policy on packaging waste management would require further knowledge and various technologies.

IV-3. Enhancement of Collaboration among Stakeholders/ Promotion of Appropriate Knowledge and Technologies on 3Rs

Thai government also have enhanced collaboration among stakeholders on 3R,.Initiation of the recycling-oriented society is started from the eco-town project, which is collaboration program among stakeholders in the national and local governments and private sector to encourage a recycling-oriented society that includes waste sorting, waste recovery, knowledge enhancement and people's participation.

Technical and financial support provision to enhance local capacity to develop appropriate and efficient waste management system are also important.

Capacity building on the 3Rs for local communities should be encouraged, by organizing seminars and workshops on waste management, and including implementation of activities in the pilot sites e.g. waste sorting, waste recycling.

Community participation in the 3Rs under a community 3Rs project has, involved the use of wastes for agricultural purposes, e.g. as fertilizers, and the establishment of recyclable waste bank. All these activities have contributed to 30% of waste reduction.

Guideline, measure, and standard related to the 3Rs should be established, such as, involving the preparation for a guideline on waste management and minimization for communities, standards for different types of packages, measures to control products using recycled materials, to ensure better quality and consumers' satisfaction. The use of

those products could therefore be promoted, including the sorting of packaging wastes and the return of packaging wastes to producers.

1. Industrial Waste Exchange Program encourages the exchanges of information of wastes and waste recycling. Wastes from one factory could possibly be a raw material for another. The information on waste exchange and matching could be done through database calculation. It could reduce wastes and at the same time it could save energy that would otherwise be required to acquire raw materials. This has already been implemented by the Ministry of Industry who would continue for further development in the future.

Green Label Scheme provides a green label to products with least impacts on the environment with comparison with products of the same category. Criteria include the use of raw materials, energy and waste minimization.

2. Under used lead-acid batteries recycling program, 84% of the batteries has been recycled currently.

Promotion of material recovery encourages energy recovery and replacement of raw material in cement kiln under the government support to conserve energy and reduce the use of coal.

Take-Back Program on end-of-life products under which the Ministry of Natural Resources and Environment has initiated projects on the recycling of mobile phones, batteries, other associated accessories and used packages. These wastes would then be collected at the specified waste take-back points or places by those involved.

Pilot program on plastic and foam waste management tries to reduce the amount of plastic and foam wastes as well as the use of these materials in department stores, convenience stores in BMA and its vicinities, including the promotion of recycling.

Thailand Green Purchasing Network was established as a centre for information on the trade of environmental friendly products.

V. Examples of Waste Exchanges in Thailand

V-1. Waste Information Exchange in Thailand

In Thailand, three waste exchange centres are established with clear operation procedures. The objectives are as follows:

1. Encouraging the maximization of resource use in an efficient manner through the application of 3Rs to minimize environmental impacts and costs of industrial waste management;
2. Enhancing waste trading and exchanges as well as waste recovery among industries. These centres have acted as clearing houses for the dissemination of industrial waste recovery related information. In addition, they have been considered the main mechanism connecting factories or business generating wastes

with those in need of wastes for their raw materials or fuels in the production process;

3. Being a source of information dissemination as related to waste management technologies and waste recovery, with various databases involved in order to systematically support waste utilization process;

4. Being a centre where research and development related to waste utilization could be enhanced and where pilot guidelines promoted by the government, private sector and others could be tested and multiplied so that practical implementation could be successfully achieved; and

5. Establishing information network database through websites on the recovery of wastes or residues for industrial production process.

With the establishment of a systematic waste database, the services have therefore not been limited to industries only. The services have additionally been provided to a variety of groups, including the following:

a) Different types of industries e.g. glass industry, chemical industry, etc.;

b) Related government agencies, independent organizations and state enterprises;

c) Academic and research institutions;

d) Private organizations with related business and those who are interested in business operation related to industrial waste management; and

e) The general public who are interested in environmental information and knowledge on the overall waste management.

The three waste exchange centres are composed of 1. Eco-Town program coordinated by DPIM, 2. Material Exchange Center (MEC), and 3. Waste Utilization Data Center (WUDC). The details about the name of the centre, source of support, the start of the operation and current operation are summarized in Table 9.

Table 9: List and Situation of The Centre of Waste Information Exchange in Thailand

Name	Responsible Organization (Website)	Year Started	Situation	Number of visitors (person)
Eco-Town	Department of Primary Industries and Mines (DPIM) (http://eco-town.dpim.go.th)	2007	operating	332,500
MEC	Thailand Environment Institute (TEI) (http://www.tei.or.th/mec/) (supported by Ministry of Energy)	2000	operating	5,377
WUDC	Department of Industrial Works (DIW) (Supported by JICA, Japan)	2001	Stopped operating	15,621

Source : 1) http://eco-town.dpim.go.th 2) www.tei.or.th/mec/ and 3) www.diw.go.th [cited : Jun 3, 2009]

V-1-1. Eco-Town (http://eco-town.dpim.go.th)

The Eco-town project which originated from the concept of establishing an eco-industry has been implemented under the DPIM. It aims to enhance efficient renewal of mineral and metal resources. Its operations involve public relations and organization of events and activities where industrial operators meet and exchange their experiences and views on waste management. The website was developed to collect database on waste management and to ensure project continuity. Regarding the services, wastes have been categorized into 17 types, including glasses, metals, plastics, papers, organic wastes, used computers, etc.

The website provides industrial related information, including 3R business, social network, sources and prices of used products, as well as academic information. It emphasizes on enhancing the knowledge and understanding about waste recovery, technology and environmental management related information and environmental laws and legislation. It is expected that members and those interested individuals or groups would have maximal benefits upon visiting the website. On June 3rd 2009, there were 332,500 visitors to the website as shown in Table 9.

Table 10: Detail of Usage Service for Waste Exchange in Eco-Town Website

Type of Waste	Number of Seller	Quantity (ton/month)	Number of Buyer	Quantity (ton/month)
Metal	7	80	4	10,100
Paper/ paper board	1	Not specify	3	1,000
Wood	1	500	Not specify	Not specify
Glass	1	3,000	Not specify	Not specify
Plastic	246	4,660	182	Not specify
Metal sludge waste	1	50	1	Not specify
Construction material	3	700	-	Not specify
Other	8	30	4	Not specify
Total	274	14,460	194	11,100

Source: http://eco-town.dpim.go.th, 2009.

The examples of waste exchange are as follows:

- The exchange of gypsum waste generated from air pollution treatment system for use in construction material production industry;
- The exchange of sludge from effluent treatment system of food industry for fertilizer to be used by farmers; and The exchange of metal dust from electronic industry for raw material substitutes in cement production industry, among others.

V-1-2. Material Exchange Center (MEC) (http://www.tei.or.th/mec/)

MEC has been operated by Thailand Environment Institute (TEI), under the support of the Ministry of Energy. The Centre has categorized wastes into 38 types, including foam, used mechanic lubricant, defected tyres, sludge from effluent treatment system, paint wastes, etc. The examples of waste exchange are as follows:

- The exchange of wastes from cattle leather, sheep leather, swine leather and artificial leather generated by leather shoes factories with housewife group who take the wastes and use them to produce shoes cleaning carpets, wallets and key chains;
- The exchange of synthetic tyres and xylene generated by car assembling factories and plastic producing factories for the production of cabinet leg pads, furniture and slippery preventing ground; and
- The exchange of used mechanic lubricant from different industries for fuel used in cement production factories, among others.

The Centre has currently been in operation; however, it lacks regular public relations activities and collaboration in providing technical and academic knowledge on the management of those wastes.

V-1-3. Waste Utilisation Data Centre (WUDC)

WUDC was operated by the DIW, under the JICA support. At present, the Centre is not operating anymore as DIW has focused its missions more upon monitoring waste management of industries through electronic system. This is to facilitate industrial operators' requests for permit to operate, as required by law.

V-2. Municipal Solid Waste Exchange in Thailand

The current volume of municipal wastes in Thailand has become a huge problem that needs the central agency's support in managing those wastes. This has been done through knowledge enhancement, activities and events to raise awareness on the dangers of solid wastes on public health and the environment and the establishment of an integrated management system. Apart from government agencies, Thailand Institution of Packaging Management for Sustainable Environment, a non-profit organization, has played an important role. The Institution has gained support from industrial operators who are the five industry member groups of the Federation of Thai Industries (FTI), including plastic industry, pulp and paper industry, glass industry, iron and aluminum industry and members producing related products. It has provided supports on planning, coordinating and implementing activities to ensure that the number of used packages, ending up in solid waste piles nationwide, has been minimized through appropriate and safe means. The successful CEMPRE (The Brazilian Business Commitment for Recycling (Cempre) is a non-profit association dedicated to the promotion of recycling within the scope of integrated waste management) model of Brazil has been introduced and applied according

to economic, social and environmental circumstances in Thailand. The activities of the Institution are summarized in Table 11.

Table 11: Municipal Solid Waste Management Projects

List of Projects	Starting Year	Number of Participants
1. Establishment of recyclable materials by a group of informal waste collectors	2008	197 persons
2. Recyclable materials management in housing development estate	2008	98 Housing development estates
3. Recyclable materials management in undergraduate institutions	2006	10 Institutions
4. Promotion of recyclable materials sorting by municipalities	2007	8 Municipalities
5. Community recyclable materials bank	2006	287 Communities
6. Collaboration for establishing drop-off points with department stores, for charity purposes	2007	9 Department stores (47 Branches) 2 Convenience stores (75 branches)

The Community Recyclable Materials Bank Project has received positive responses and collaboration from communities as seen from the participation of 287 communities. The activity has generated income to communities and dramatically reduced the volume of waste, as detailed in Table 12.

Table 12: Result of the Operation of Project "Bank of Municipal Recycle Waste"

Type of Waste	Quantity (kg)	Income (Baht)
Paper	353,405.04	2,217,616.632
Glass	645,112.90	645,112.90
Plastic	187,655.55	3,222,045.79
Metal/ Aluminium	236,158.91	20,977,955.98
Beverage carton	6,581,90	26,327.60
Other	65,908.30	329,541.50
Total	1,494,822.60	27,418,640.39

In addition to implementing a number of activities, the Institution has developed its website, http://www.tipmse.or.th, providing package related database, including old products purchasing stores, recycle/transformation business, selling and buying price of recyclable materials, communities or organizations involved in recyclable waste management, the ratio of recyclable package wastes to the total volume of package wastes,

and statistics on the volume of recyclable materials. This is to provide the current situation of solid waste management in Thailand to visitors.

V-3. Examples of Waste Exchange Undertaken by Private Sector

The commercial waste exchange has been operating in Thailand for several years already. Business operators like Recycle Engineering Co., Ltd. and SCI Eco Services, Co., Ltd. have realized the market niche and an increasing trend of waste generation, requiring waste management and maximal use of wastes.

V-3-1. Recycle Engineering Co., Ltd.

Recycle Engineering Co., Ltd. has obtained a permit to operate a business on waste quality adjustment (Factory Type 101), waste recovery through refinery and package washing (Factory Type 106). The company is under a joint venture with German partners who import technology, and applying it to the production process. An environmental learning centre has been established within the factory premise, as a learning ground for the government agencies, private sector, academic institutions and other interested public.

It has performed the business operation by obtaining wastes from targeted industries, including painting, automobile, chemical, textile and others, where wastes that could be recovered through refinery could be derived. As far as the management of waste is concerned, the company has categorized customers into two groups, as follows:

1) Customers who bring in their wastes for recycling, take them back and use them in their own production process; and
2) Customers who deliver their wastes to waste processors who would sell them to other industries.

Recycle Engineering Co., Ltd. has categorized the used chemical substances that could be recycled into the following:

Group 1. Chemical solvents e.g. NMP, acetone, MEK, MIBK, methanol, ethanol, IPA, etc.;

Group 2. Hydrocarbon solutions and mixed solvents e.g. thinner, toluene, xylene, etc.;

Group 3. Halogenic solutions e.g. halogenic hydrocarbon, 1,1,2 trichloroethylene, methylene chloride, bromopropane, etc.;

Group 4. Hydrocarbon oil and liquid;

Group 5. Polymer and monomer; and

Group 6. Laboratory wastes.

In addition, the company has implemented activities related to environmental management under the collaboration with both domestic and international organizations, which include the following:

1) Laboratory Waste Management Project, under the collaboration with Merck (Thailand) Co., Ltd., to provide advice on waste storage and receipt of waste for further appropriate treatment; and

2) Environmental Learning Centre Project, under the collaboration with international organizations, who present environmental products like ground brick made from residues, furniture made from plastic wastes, aerobic composted fertilizer from organic wastes and natural renewable sources of energy, etc. It enhances the opportunities among operators to exchange their knowledge and experiences for further business cooperation. It is also a learning centre for the interested pubic.

V-3-2. SCI Eco Services Co., Ltd.

SCI Eco Services Co., Ltd. is a company of cement industry group, providing integrated waste management services, which includes the following:

1) Waste collection, transport, primary treatment, sorting and treatment;

2) Waste burning using cement kiln;

3) Waste recovery as substituting fuel or raw materials for cement production process;

4) Environmental impact monitoring; and

5) Waste analysis service.

Based on the principle of waste exchange, the company acquires wastes from the system, taking into consideration the composition of wastes. The service is charged according to types of wastes, as categorized into the following:

Group 1. Wastes with heat value would be fed into the process in the form of substituting fuel e.g. used mechanic lubricant, thinner, painting wastes, sulfur, etc.;

Group 2. Wastes containing minerals for cement production would be fed into the system in the form of substituting raw materials e.g. sludge, metal dusts, gypsum, etc.;

Group 3. Wastes not within the above categories Groups 1 and 2 would be fed into high temperature cement kiln for elimination so that environmental impacts could be prevented.

Composition analysis of samples of wastes to be fed to the treatment process would be conducted to ensure proper management. This is considered important for reporting and getting a permit to treat wastes, of which the DIW must be notified through electronic system and would then grant a permit accordingly.

Overall, waste exchange business undertaken by private sector involves the receipt of wastes from specific groups of industry, selection of wastes and application of technology for waste management. All these have been performed by business sector with skills, knowledge and understanding on this field. Key problems and challenges include competition as currently there have been a number of companies in Thailand which are involved in the business, and legal aspects has to be strictly enforced to control negative environmental impacts.

V-4. Benefits of the Establishment of Waste Exchange Centre

The benefits obtained in establishing waste information exchange centres include the following:

1. Database related to volume, type and property of wastes in different industries is collected, easy for future use and reference;
2. It will be an important clearing house in enhancing knowledge on industrial waste exchange and waste recovery;
3. Waste trading and exchange among industries for recovery purposes is encouraged;
4. Awareness is raised among industries on waste exchange and recovery;
5. Industrial productivity increases, leading to competitiveness in the global market;
6. Income generation and job opportunities are generated for both short and long terms. Jobs are created for data investigation, anaysis and synthesis, database establishment, website development, document preparation and dissemination, and events and seminars organization. As for the longer term, the establishment of an industrial waste information exchange centre would encourage service business on industrial waste management and waste recovery, including related business of industrial waste collection and transport; and
7. The volume of industrial wastes, which is currently higher than national management and treatment capacity, is reduced.

V-5. Key Problems and Recommendations on the Performance of Industrial Waste Exchange

Based on the above discussion, this report has identified some key problems in the operation of the industrial waste exchange centres and the corresponding recommendations to improve their performance. These include the following:

Key Problems

First, the quality and quantity of wastes do not meet users' needs and requirements. Occasionally, the volume of wastes is low and inconsistent, unable to conclude the trade or exchange deals or negotiations;

Second Capacity of existing recycling facilities is limited, especially as related to technology. The capacity for chemical recovery, recycling of used mechanic lubricant and extracting precious metal from electronic devices cannot compete with the volume of wastes generated;

Currently some types of wastes have potentials for recovery; however, it would require much advanced technology, resulting in high cost. Therefore, commercially, it is not cost effective;

The overall operation of the centres would require supports from different agencies to ensure continuity. These include public relations activities, dissemination of information, awareness raising, and technical and technological support provided to customers and users to ensure effective application to industries; and

The previous operation of the waste exchange centre in Thailand was under project implementation with short term financial support. The services would no longer be available once the project came to an end.

Recommendations

Events and activities should be regularly organized to disseminate information about the Centre to targeted audiences, including workshops in different geographical regions and industrial zones located outside Bangkok and vicinities where those generating wastes could meet waste processors.

The key agency having a significant role in promoting waste information exchange of the country should be identified, as the previous operations were project based –no further progress once the project was completed. Once the key agency is identified with roles specified in the organization's mission, the operation could therefore be sustained in a long run.

Industrial waste management is a business with conflicts, at a certain level. For example, the promotion of recycling or the target on zero landfill could possibly affect landfill waste processors. Consequently, services provided by the Centre should cover all types of customers and maintain their neutral role. At the same time, the Centre should be a channel for those generating wastes to select technologies for more efficient waste treatment. Likewise, waste treatment processors could benefit from acquiring customers both for waste recovery or landfill.

The government should clearly formulate encouraging policy and measures and provide continuous support, including tax incentives for technologies on recycling.

Some laws and legislation considered as a bottleneck to maximizing use of wastes should be amended. Take for instance, a particular type of industrial wastes that have been academically and technically proved, indicating their recovery potentials in other industries and non toxic components, should therefore be granted a rapid process for taking wastes out of the premises.

Technologies and cases of best practice on commercial waste recovery should be regularly disseminated to industrial operators, academicians and interested public, including the organization of annual forum, so that incentives and innovations could be further developed.

In addition, Research and development on new technologies should be promoted both for operation and business levels. Wastes with low volume would gain high economic value or become costly, e.g. technologies for recycling, oil refinery catalysts or technologies for metal recovery, etc.

International collaboration should be encouraged for technological transfer that should be brought to national agenda.

Eco-town should be enhanced in Thailand, as in Japan, so that it becomes attractive incentive that could encourage more waste recovery process.

VI. Conclusion

Waste exchange in Thailand has been faced with a number of problems, including a lack of collaboration and support among those involved, continuation of services, and waste management related knowledge and technologies. Should these problems be overcome and a waste exchange centre is established in a systematic manner where database is developed, public relations activities are regularly undertaken, and strong network is created, it is therefore believed that the centre would significantly contribute to tangible and practical solutions to natural resources and environmental degradation with sustainable outcome.

The establishment of waste exchange centre in Thailand is one of the keys for an efficient waste management. Its operation should involve the establishment of information system management standard. Relevant agencies and institutions should provide support on academic and technical knowledge of waste management and recovery following the principle of 3Rs. Also, a number of activities related to public relations, events organizations and awareness campaigns should be regularly conducted in order to enhance better understanding and waste management standards, and at the same time, to facilitate opportunities and means for waste exchange among industrial operators. This fundamental performance would significantly increase productivity of the industrial sector. Moreover, the establishment of waste exchange centre would open up a new opportunity for setting up national business that could potentially be expanded globally through networks of international collaboration. In this way, it would help promote a better image of Thailand on environmental management and hence reduce trade barriers and increase competitiveness in the global market.

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