Malaysia

Department of Environment,

Ministry of Natural Resources and Environment

Malaysia

The Project for Model Development for E-waste Collection,

Segregation and Transportation from Households for Recycling

Final Report

March 2013

Japan International Cooperation Agency (JICA)

Sustainable System Design institute (SSDi)
Kokusai Kogyo Co., Ltd.

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Abbreviations

DOE	Department of Environment
EPU	Economic Planning Unit
JCC	Joint Coordinating Committee
JICA	Japan International Cooperation Agency
IT	Information Technology
MHLG	Ministry of Housing and Local Government
MPPP	Majlis Perbandaran Pulau Pinang
	(Municipal Council of Penang Island)
NRE	Ministry of Natural Resources and Environment
NSWMD	National Solid Waste Management Department
SW	Scheduled Waste
SWM	Solid Waste Management
P/P	Pilot Project
e-waste	Electrical and Electronic Equipment Waste

1. OUTLINE OF THE PROJECT

1.1 BACKGROUND AND OBJECTIVE

(1) Background

a) Hazardousness and resource value

Many materials, such as lead, cadmium, and arsenic, contained in different e-wastes can be potentially hazardous, if improperly handled throughout their lifecycle. If the e-wastes are disposed in landfills, these materials have potential to leach in landfills and contaminate surface and ground water, if the leachate containing such materials leaches out from the landfill.

In addition, the resources are lost for future use. Valuable resources can be recovered from e-waste, which contribute towards sustainable development and environmental protection.

b) DOE's responsibility

E-waste is one of the Scheduled Wastes stipulated by the Environmental Quality Regulations 2005 under the Environmental Quality Act, 1974. The code of e-waste is SW110. DOE has a responsibility to control the SWs including e-waste. Among the DOE's responsibilities, especially, DOE is responsible to license e-waste recycling activities including partial and full recycling facility.

c) E-waste generators

E-wastes are generated both in households and factories, while the SWs are mainly generated in factories. DOE has a rich experience to manage e-wastes from factories and SWM companies, but it has little experience to deal with e-waste from households. Therefore, DOE would like to seek a possible e-waste collection system by setting up a pilot project in managing e-waste from households.

(2) Objective

The Project aims at developing an appropriate, effective and efficient e-waste collection system from households by working with DOE. The developed system is expected to be used as a model for expanding it to the nationwide collection system. At the same time, it is expected for DOE to derive policy implications for the future expansion.

1.2 PROJECT TITLE

The official title of the Project is

"The Project for Model Development for e-waste Collection, Segregation and Transportation from Households for Recycling."

and a pilot project for e-waste is scheduled in Penang Island.

The short name can be proposed as "Penang E-waste Project."

1.3 BOUNDARY OF THE PROJECT TARGET

The project scope is shown in Figure 1-1. It includes the e-waste generation stage up till the stage where collected wastes are transported to the full-recovery facilities[1].
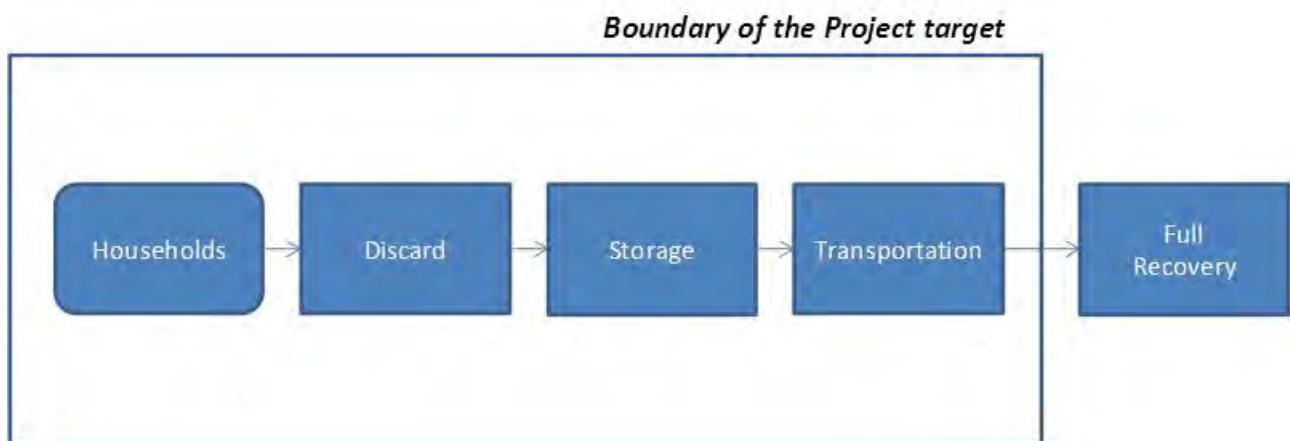

Figure 1-1. Scope of the Project

Note: The Project targets e-wastes from households, but businesses similar to households such as small offices will be also targeted.

1.4 TARGET E-WASTE

(1) DOE's categorization

DOE, in its guideline "Guidelines for the Classification of Used Electrical and Electronic Equipment in Malaysia (second edition, 2010)," categorizes e-waste as follows:

- Used television,
- Used air-conditioner,
- Used computer,
- Used refrigerator,

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[1] E-waste recycling factories are classified to two categories: 1) full recovery facility and 2) partial recovery facility. Full recovery facilities are functioned to recover metals including precious metals. Partial recovery facilities are functioned to dismantle E-wastes and sort the dismantled parts.

- Used washing machine,
- Used video recorder,
- Used telephone,
- Used photostat machine,
- Used facsimile machine,
- Used microwave/ oven,
- Used radio,
- Used printers,
- Used audio amplifier,
- Used cathode ray tube (CRT),
- Used electric cable,
- Used mobile phone,
- Used motherboard,
- Used hard disk drive,
- Used printed circuit board (PCB),
- Used waste metal contaminated with heavy metals such as cadmium, mercury, lead, nickel, chromium, copper, lithium, silver and manganese,
- Used lead frame,
- Used patterned wafer,
- Used or rejected or waste of integrated circuit,
- Used electrical and electronic equipment/ product imported from other countries; and
- Wastes or products processed out of the partial recovery facilities.

(2) Criteria for screening the target e-wastes

As a pilot project, the target e-wastes in the Project are selected by the following criteria.

- The amount of e-wastes generated in households
- Hazardousness
- The amount of valuable materials
- Existence of voluntary collection programs coordinated by industries
- Easiness to be scattered
- Easiness to be mixed in municipal solid waste

(3) Target e-waste screening

The following table shows the result of screening the target e-wastes by using the abovementioned criteria, with the number of "+" shown in the far right column. The target e-wastes were set as the following six items which marked more than four points.

- Used television
- Used air-conditioner

- Used computer (including accessories, peripheral devices and printers)
- Used refrigerator
- Used washing machine
- Used mobile phone

Table 1-1. Screening target e-wastes by screening criteria

	The amount of e-wastes generated in household	Hazardous-ness	The amount of valuable materials	Existence of voluntary collection programs coordinated by industries	Easiness to be scattered	Easiness to be mixed in municipal solid waste	Number of "+"
Used television	++	++	+				5
Used air-conditioner	++	+	++				5
Used computer		+	++	+			4
Used refrigerator	++	+	+				4
Used washing machine	++	+	+				4
Used video recorder		+	+				2
Used telephone		+	+				2
Used facsimile machine		+	+				2
Used microwave/ oven		+	+				2
Used radio		+	+				2
Used printers		+	+				2
Used audio amplifier		+	+				2
Used mobile phone		+	++	+	+	+	6
Used hard disk drive		+	+				2

(Note) The following items were omitted from screening, because they are generated only from industries.

- Used photostat machine, Used cathode ray tube (CRT)

- Used electric cable, Used motherboard, Used printed circuit board (PCB)

- Used waste metal contaminated with heavy metals such as cadmium, mercury, lead, nickel, chromium, copper, lithium, silver and manganese

- Used lead frame

- Used patterned wafer

- Used or rejected or waste of integrated circuit

- Used electrical and electronic equipment/ product imported from other countries

- Wastes or products processed out of the partial recovery facilities

1.5 PROJECT DESIGN MATRIX

The Project Design Matrix (PDM) is shown below.

Project Title: The Project for Model Development for E-waste Collection, Segregation and Transportation from Households for Recycling
Project Period: September 2011 - March 2013
Project Site: Penang Island
Target Group: DOE, MPPP

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
Overall Goal: A proper collection, segregation and transportation programs / system for recycling e-waste generated from households are implemented nationwide.	- E-waste collection, segregation and transportation system is working in two cities and over.	- Documents and/or any materials regarding the system that is to be provided by DOE.	-
Project Purpose: A practical collection, segregation and transportation model for recycling e-waste generated from households is developed through a pilot project in Penang.	- A plan of collection, segregation and transportation for e-waste recycling in Penang is prepared based on lessons and recommendations learned from the implementation of the pilot project.	- Final Report of the Project	- E-waste collection, segregation and transportation system from households in Malaysia is institutionalized.
Outputs: The present conditions regarding e-waste generation, recycling and disposal activities in Penang are studied.	1-1. E-waste generation amount in Penang is estimated. 1-2. E-waste flow diagram in Penang is prepared.	- Report on the current situation of e-waste management in Penang that is to be prepared through the Project. It includes estimation of e-waste generation amount and an e-waste flow diagram.	- A plan of collection, segregation and transportation for e-waste recycling in Penang is approved by DOE and MPPP.
E-waste recycling plan focused on collection, transporation and segregation in the pilot project area(s) is prepared according to the actual conditions in Penang.	2-1. Roles of stakeholders are clarified for implementation of the pilot project. 2-2. An implementation plan of the pilot project is prepared.	- Implementation plan of the pilot project	
The pilot project is implemented in pilot project area(s) according to the proposed e-waste recycling plan.	3-1. Target e-waste items are collected. 3-2. Activities for raising public awareness on e-waste recycling are conducted.	- Records of implementation of the pilot project	
E-waste recycling plans implemented in the pilot project area(s) are reviewed and the lessons learnt and recommendations for the improvement are presented.	4-1. Post-evaluation of the pilot project is conducted. 4-2. Lessons and recommendations from the pilot project are set out.	- Results of the post-evaluation described in Progress report and/or final report of the Project - Lessons and recommendations in Progress report and/or final report of the Project	
Capacity on e-waste management of DOE, local authority and relevant organizations is strengthened.	5-1. E-waste management capacity of 70% of the target persons and over is improved.	- Results of capacity assessment conducted at the beginning and the end of the project	

Activities	Input (Japanese side)	Input (Malaysian side)	
1-1. To survey the present conditions of generation, recycling, disposal and potential amount of e-waste from households in Penang and make an inventory.	Manpower (Experts) - Leader/e-waste management planning - Collection and transportation - E-waste recycling (1) - Public awareness - E-waste recycling (2)	Manpower (Counterpart) - DOE Headquarters - DOE Penang - MPPP	- Stakeholders take the initiative in implementing the pilot project. - No opposition to the pilot Project arises.
1-2. To study the e-waste stream from households in Penang and make a waste stream chart			
2-1. To determine one or two pilot project area(s) and to study the present conditions in the area(s)	Training of Malaysian personnel - in Japan		
2-2. To propose e-waste recycling plans which focus on collection, transportation and segregation considering current situations		Office - A working space in Penang Island	
2-3. To develop the coordination and collaboration mechanism among the stakeholders for the collection, segregation and transportation of e-waste generated from households in the pilot project area(s) to ensure proper management of e-waste			
2-4. To hold a workshop inviting all the stakeholders			
2-5. To formulate the public awareness program in the pilot project area(s) for the smooth implementation of the proposed e-waste recycling plans			
2-6. To develop an information management system of an e-waste collection from households in the pilot project area(s)			
2-7. To develop evaluation indexes and methods of the pilot project			
3-1. To conduct the pre-evaluation of the pilot project using the developed evaluation method			Precondition: - DOE Headquarters, DOE Penang and MPPP are agreed to conduct the Project
3-2. To conduct the pilot project based on the developed e-waste recycling plans and the coordination and collaboration mechanism			
3-3. To conduct the public awareness program			
4-1. To evaluate the pilot project and review the lessons learnt and recommendations			
4-2. To propose a future e-waste recycling plan in Penang			
4-3. To hold a workshop with stakeholders on 4.1 and 4.2			
5-1. To prepare a program to strengthen the capacity of e-waste management of DOE, local authority and relevant organizations			
5-2. To conduct seminars or workshops on the method of survey / planning / implementation / evaluation / public awareness raising on e-waste management			
5-3. To conduct a study tour and/or a training course in Japan or other countries			
5-4. To conduct a training and/or a workshop for officers of DOE, local authority on e-waste management			
5-5. To propose main elements for regulatory control on "Take-Back Scheme (extended producer responsibility)" for electronic and electrical equipment			

1.6 PROJECT IMPLEMENTATION STRUCTURE

The Project was implemented under the following structure.

Figure 1-2. Project implementation structure

(1) Joint Coordinating Committee

a) Function

Joint Coordination Committee (JCC) Meetings were held four (4) times. The main functions of JCC were as follows:

- To approve the annual work plan of the Project,
- To review the overall progress and achievements of the Project,
- To examine major issues arising from or in connection with the Project,
- To work out the modification of activities depending on the necessity; and
- To discuss any other issue(s) pertinent to the smooth implication of the Project.

b) Members

i) Chairperson
- Deputy Director General (Operations) , DOE (Chairperson)

ii) Project Director
- Director, Hazardous Substances Division, DOE Headquarters (Project Director)

iii) Project Manager
- Director, Director of DOE Penang State Office (Project Manager)

iv) Malaysian side
- Representative(s) of NRE, MPPP, NSWMD, MHLG, EPU (International Section & Environmental Section) and any other officials appointed by the Chairperson

v) Japanese side

● JICA Expert(s), JICA Malaysia Office and other personnel concerned to be decided and/or dispatched by JICA, if necessary

vi) Observers

● Representative(s) of the Embassy of Japan in Malaysia

● Other official(s) appointed by the Chairperson

(2) Taskforces

There taskforces were set as shown in the following figure. Each taskforce was composed of a few members from each organization.

The Japanese experts facilitated the taskforce meetings by preparing necessary lectures and specific tasks so that the capacity of the members was to be developed effectively.
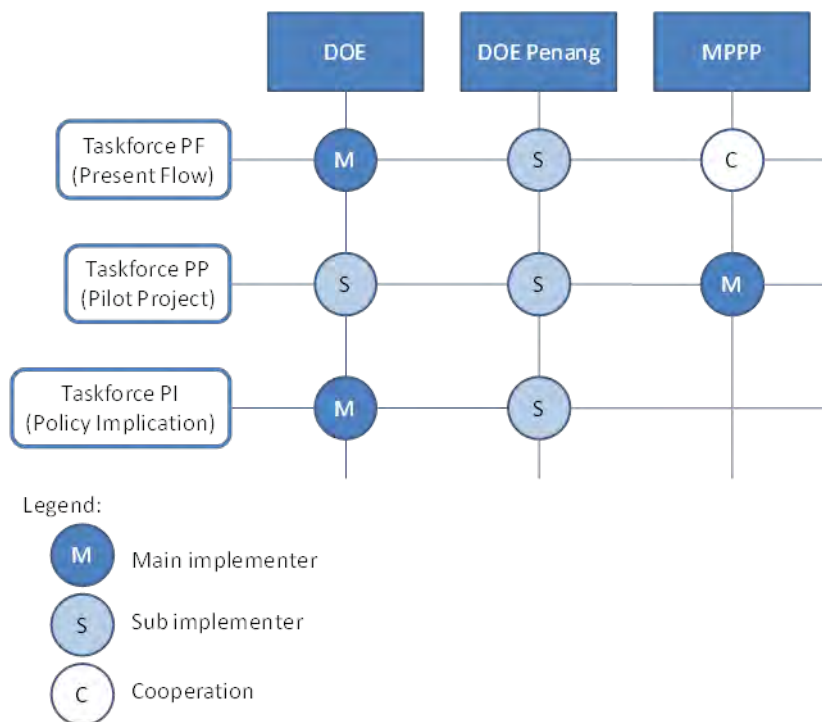
Figure 1-3. Members of Taskforces

The table below shows principle counterparts of this project.

Table 1-2. Counterpart member list

No.	Name	Position
1	Ms. Datin Paduka Che Asmah Ibrahim	Director, Hazardous Waste Substance Division, Department of Environment
2	Mr. Khiruddin Mohamad Idris	Principal Assistant Director, Hazardous Substance Division, Department of Environment
3	Mr. Mohd Zaidi Bin Hassan	Assistant Environmental Control Officer, Hazardous Substance Division, Department of Environment
4	Mr. Badlishah Bin Ahmad	Head, Operation Division, Department of Environment, Penang

No.	Name	Position
5	Mr. Mohd Fitri Mohd Mokhtar	Assistant Director, Operation Division, Department of Environment
6	Mr. Wong Kiong Kok	Senior Principal Assistant Secretary, Policy Division, Ministry of Housing and Local Government
7	Mr. Lim Wei Urn	Assistant Director, Environment and Natural Resources Economic Section, Economic Planning Unit
8	Mr. Junus Mubarak	Director, Urban Services Department, Municipal Council of Penang
9	Mr. Pitchay Sebastian Xavier	Assistant Director, Urban Services Department, Municipal Council of Penang
10	Mr. V Muthu Arul Selven	Senior Health Supervisor, Urban Services Department, Municipal Council of Penang

(3) Other relevant organizations

DOE HQ has formed and taken initiative of the Official Consultative Meeting which is composed of members from manufactures. Meanwhile, a group that consists of local stakeholders such as appliance retailers and full recovery facilities has been formulated. JICA Expert Team functioned as a technical advisor for the both groups.

(4) Other relevant organizations

The table below shows members of the JICA Expert Team.

Table 1-3. JICA Expert Team member list

No.	Name	Position
1	Hideki WADA	Leader / e-waste management planning
2	Ikuo MORI	Collection and transportation
3	Norihisa HIRATA	E-waste recycling
4	Atsushi OTSUKA	Public awareness
5	Noriko OTSUKI	E-waste recycling

2. ACHIEVEMENT OF PROJECT PURPOSE

Achievement of Project Purpose is summarized in the table below.

Table 2-1. Achievement of Project Purpose

Plan		Actual Achievement
Narrative Summary	Objectively Verifiable Indicators	
Project Purpose: A practical collection, segregation and transportation model for recycling e-waste generated from households is developed through a pilot project in Penang.	A plan of collection, segregation and transportation for e-waste recycling in Penang is prepared based on lessons and recommendations learned from the implementation of the pilot project.	- Targets will be set by DOE and MPPP until the final JCC meeting to be held on Feb. 4. - Several documents (Annex)[2] were prepared in the course of this project for achieving the targets.
Outputs: The present conditions regarding e-waste generation, recycling and disposal activities in Penang are studied.	1-1. E-waste generation amount in Penang is estimated. 1-2. E-waste flow diagram in Penang is prepared.	- E-waste generation amount was estimated, which is described in the E-waste Flow Analysis (Annex II). - E-waste flow diagram was prepared, which is described in the E-waste Flow Study (Annex III).
E-waste recycling plan focused on collection, transportation and segregation in the pilot project area(s) is prepared according to the actual conditions in Penang.	2-1. Roles of stakeholders are clarified for implementation of the pilot project. 2-2. An implementation plan of the pilot project is prepared.	- Both outputs were attained. Those are presented in the Pilot Project Plan with Evaluation.
The pilot project is implemented in pilot project area(s) according to the proposed e-waste recycling plan.	3-1. Target e-waste items are collected. 3-2. Activities for raising public awareness on e-waste recycling are conducted.	- Both were conducted. Results were presented in the Pilot Project Plan with Evaluation.
E-waste recycling plans implemented in the pilot project area(s) are reviewed and the lessons learnt and recommendations for the improvement are presented.	4-1. Post-evaluation of the pilot project is conducted. 4-2. Lessons and recommendations from the pilot project are set out.	- Both were conducted. Results were presented in the Pilot Project Plan with Evaluation.
Capacity on e-waste management of DOE, local authority and relevant organizations is strengthened.	5-1. E-waste management capacity of 70% of the target persons and over is improved.	- Capacity may have increased, although the self-evaluation does not show clearly[3].

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[2] Following Documents were prepared. Those are presented in Annex.
- Pilot Project Plan with Evaluation
- Evolutionary System Mechanisms of E-waste Alam Collection System with Planners Notes
- Pilot Project Troubleshooting
- Standard Operating Procedure
- Factor Analysis for an EPR System Based on the EPR Systems in Asian Counties

[3] Self-evaluation was made three times. Many counterparts tended to give high scores on their understanding level at the beginning of the project. The average at the 2nd evaluation recorded the lowest score. Then, the points increased at the 3rd evaluation. This may show that the counterparts realized what the questions are really asking and deepened their understanding on them during the course of the project.

3. RESULTS OF ACTIVITIES

3.1 ACTUAL SCHEDULE OF ACTIVITIES AND EVENTS

(1) Activities

Activities were conducted as shown in the table below

Table 3-1. Actual schedule of activities

Activity	Schedule (year, month)
1) The present conditions regarding e-waste generation, recycling and disposal activities in Penang are studied.	2011/10 – 2012/1
1)-1.To survey the present conditions of generation, recycling, disposal and potential amount of e-waste from households in Penang and make an inventory	2011/10 – 12
1)-2.To study the e-waste stream from households in Penang and make a waste stream chart	2011/11 – 2012/1
2) E-waste recycling plans focused on collection, transportation and segregation in the pilot project area(s) are prepared according to the actual conditions in Penang.	2012/1 – 3
2)-1.To determine one or two pilot project area(s) and to study the present conditions in the area(s)	2012/1 – 2
2)-2.To propose e-waste recycling plans which focus on collection, transportation and segregation considering current situations	2012/1 – 3
2)-3.To develop the coordination and collaboration mechanism among the stakeholders for the collection, segregation and transportation of e-waste generated	2012/1 – 3
2)-4.To hold a workshop inviting all the stakeholders	2012/1 – 2
2)-5.To formulate the public awareness program in the pilot project area(s) for the smooth implementation of the proposed e-waste recycling plans	2012/1 – 3
2)-6.To develop an information management system of an e-waste collection from households in the pilot project area(s)	2012/2
2)-7.To develop evaluation indexes and methods of the pilot project	2012/2
3) The pilot project is implemented in pilot project area(s) according to the proposed e-waste recycling plans.	2012/4 – 2013/2
3)-1.To conduct the pre-evaluation of the pilot project using the developed evaluation method	2012/3 – 4
3)-2.To conduct the pilot project based on the developed e-waste recycling plans and the coordination and collaboration mechanism	2012/4 – 2013/2
3)-3.To conduct the public awareness program	2012/4 – 2013/2
4) E-waste recycling plans implemented in the pilot project area(s) are reviewed and the lessons learnt and recommendations for the improvement are presented.	2012/9 – 2013/3
4)-1.To evaluate the pilot project and review the lessons learnt and recommendations	2012/9 – 2013/2
4)-2.To propose a future e-waste recycling plan in Penang	2013/2 – 3
4)-3.To hold a workshop with stakeholders on 4.1 and 4.2	2012/8–9, 2013/2–3
5) Capacity on e-waste management of DOE, local authority and relevant organizations is strengthened.	2011/10 – 2013/3
5)-1.To prepare a program to strengthen the capacity of e-waste management of DOE, local authority and relevant organizations	2011/10 – 11
5)-2.To conduct seminars or workshops on the method of survey / planning / implementation / evaluation / public awareness raising on e-waste management	2011/11, 2012/1–8, 2013
5)-3.To conduct a study tour and/or a training course in Japan or other countries	2012/5
5)-4.To conduct a training and/or a workshop for officers of DOE, local authority on e-waste management	2012/3, 2012/6, 2013
5)-5.To propose main elements for regulatory control on "Take-Back Scheme (extended producer responsibility)" for electronic and electrical equipment	2013

(2) Major events

Major events were held as the table below shows.

Year	Month	Joint Coordinating Committee	Seminar/Workshop in Kuala Lumpur	Seminar/Workshop in Penang
2011	9	Kick-off meeting in Kuala Lumpur		
	10			1. Kick-off meeting - Explanation of the Project
	11	1. The first JCC - Explanation of the Project		

Year	Month	Joint Coordinating Committee	Seminar/Workshop in Kuala Lumpur	Seminar/Workshop in Penang
	12			
2012	1			2. Seminar on the e-waste flow - Report on the e-waste flow in Penang Island
	2			
	3			
	4			
	5	2. The second JCC - Report on the e-waste flow in Penang Island - Report on the pilot project scheme		
	6			3. Grand opening workshop - Report on the pilot project scheme 4. Grand opening event - Promotion activity for the residents
	7			
	8			
	9			
	10			
	11	3. The third JCC - Report on the pilot project - Evaluation on the pilot project		5. Pilot project review workshop - Report on the result of the pilot project - Discussion on the lessons learnt from the pilot project - Discussion on the pilot project expansion strategy
	12			
2013	1			
	2	4. The fourth JCC - Report on the policy implication - Explanation on the draft final report	1. Policy Implication Workshop - Report on the pilot project - Report on the policy implication	6. Hand over workshop - The pilot project was handed over to the local stakeholders
	3			

3.2 RESULTS OF ACTIVITIES

1-1. To survey the present conditions of generation, recycling, disposal and potential amount of e-waste from households in Penang and make an inventory.

"The Survey on the Current Situation of E-waste" and "The Questionnaire Survey on Public Attitude to E-waste" were carried out by contracting out to local companies from October 2011 and January 2012. Then, the amounts of target e-wastes were estimated based on the aforementioned surveys and macro data such as population and economic growth. The table below shows the result of estimation. Further details are described in Annex II. E-waste Flow Analysis.
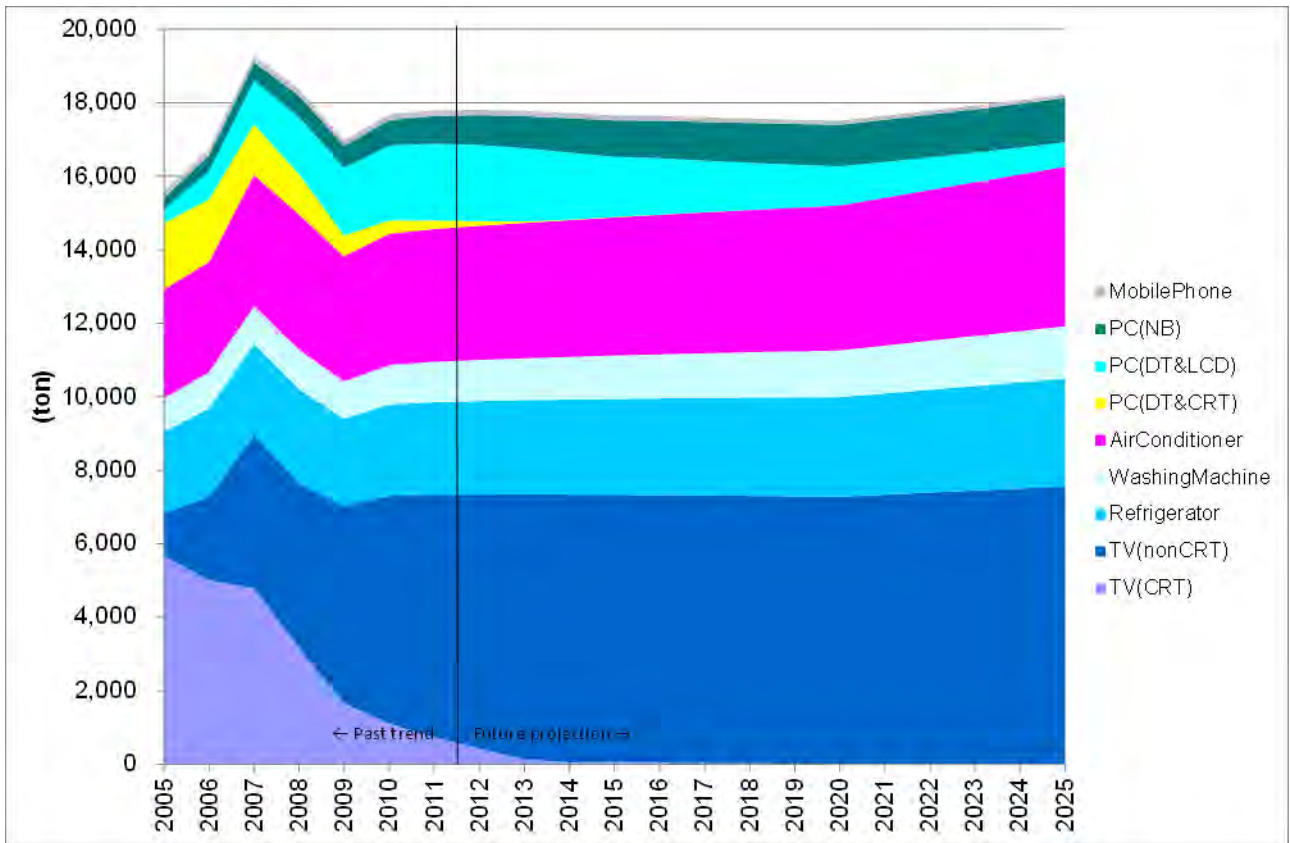
Figure 3-1. Targeted electric and electronic equipment supply in Penang Island
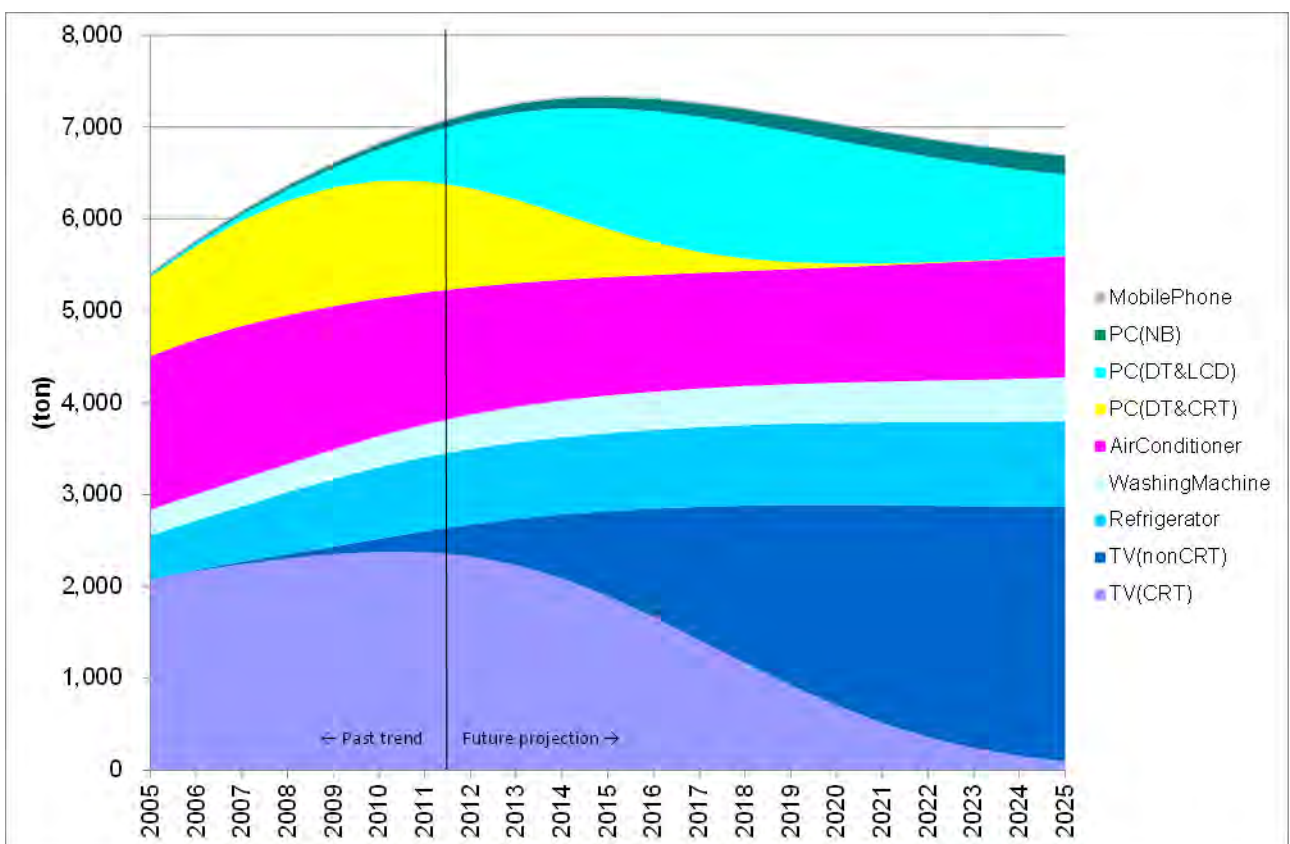
Figure 3-2. Projection of discarded e-waste in Penang Island (excluding repaired e-wastes)

1-2. To study the e-waste stream from households in Penang and make a waste stream chart

The results of "The Survey on the Current Situation of E-waste" and "The Questionnaire Survey on Public Attitude to E-waste" were also utilized for studying out waste streams of the target e-wastes. The following figures show target e-waste streams in 2011. Further details are described in Annex III. E-waste Flow Study.
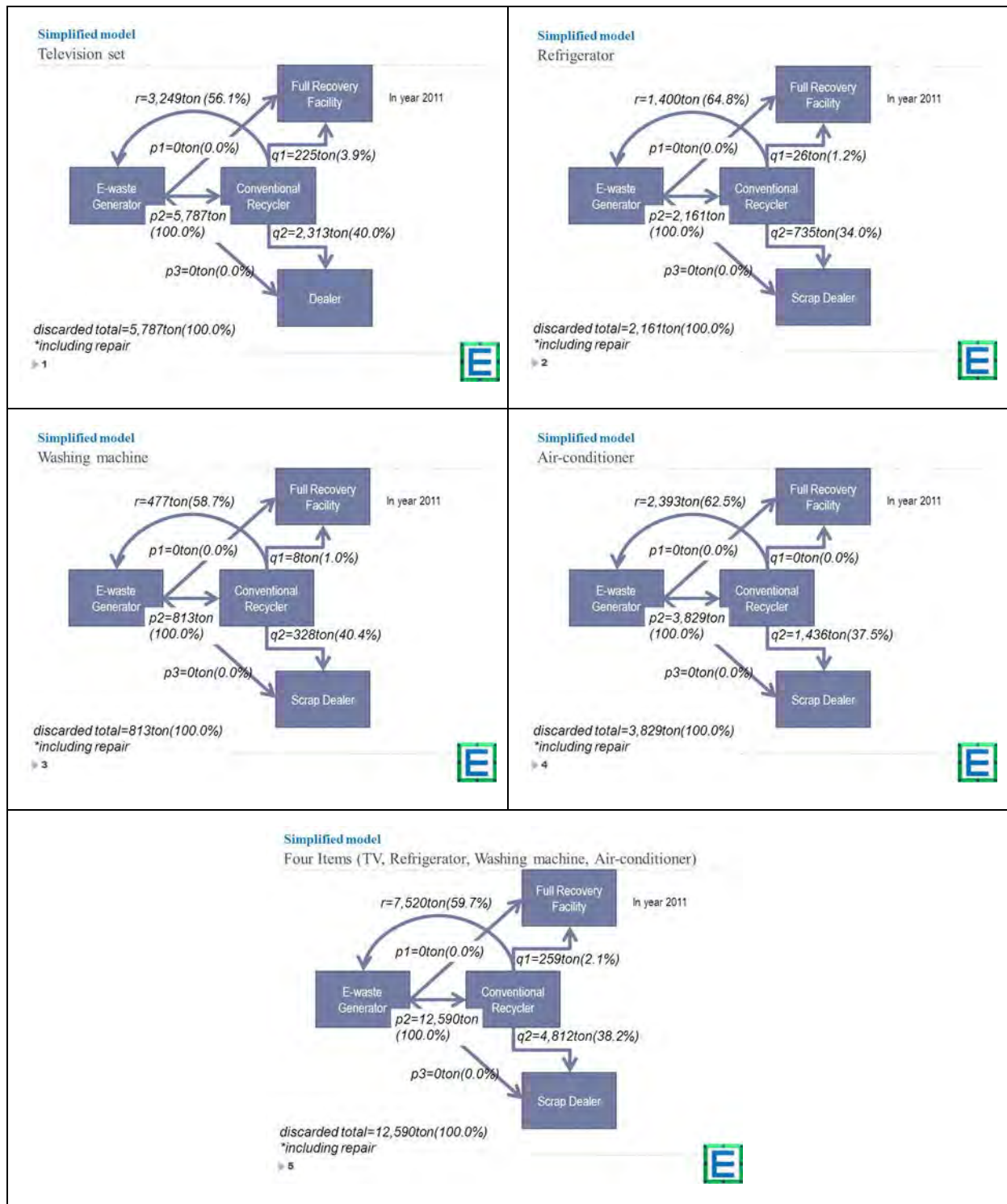
Figure 3-3. E-waste streams of four items (TV, Refrigerator, Washing machine and Air-conditioner) in Year 2011
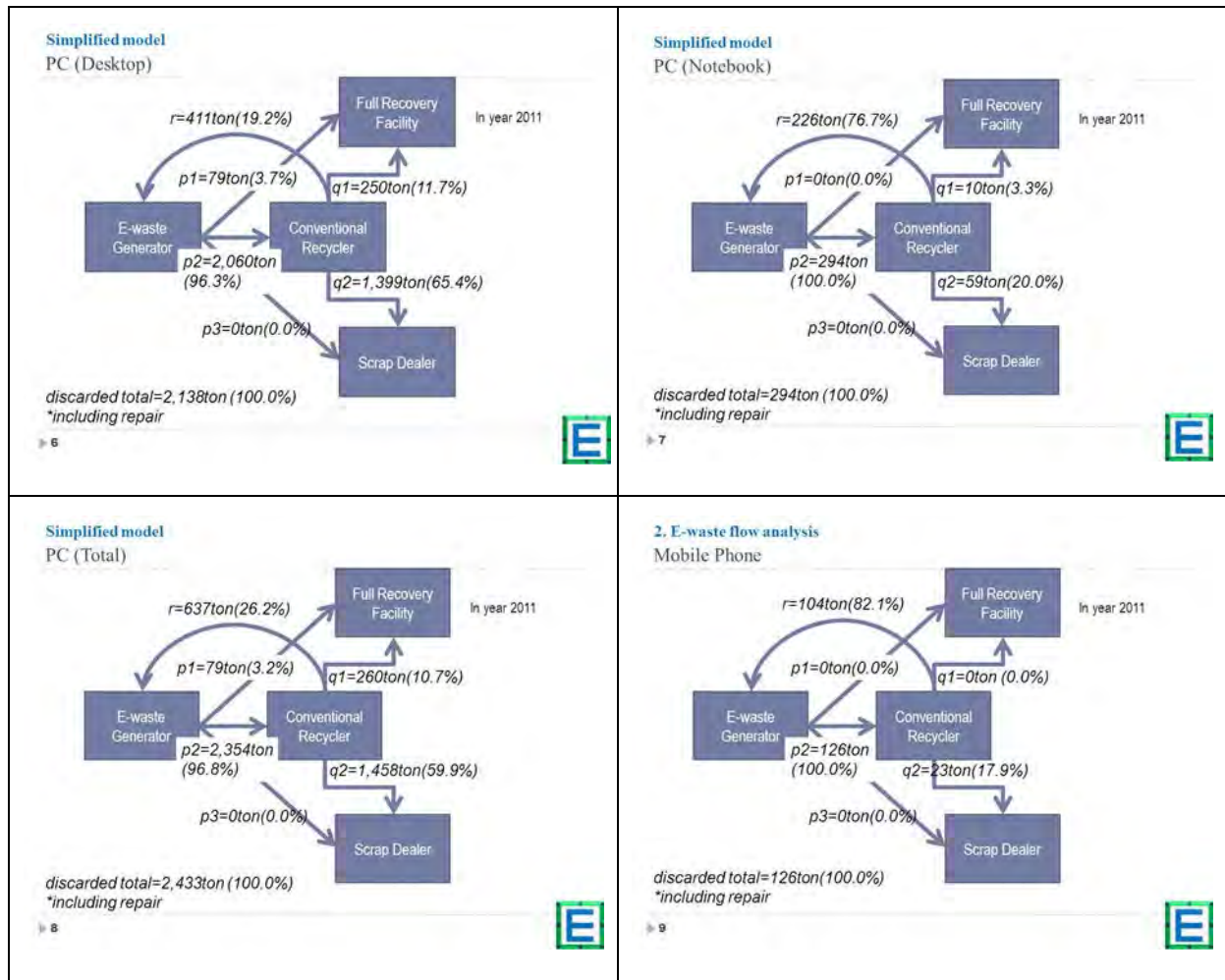
Figure 3-4. E-waste streams of PCs and Mobile Phone in Year 2011

2-1. To determine one or two pilot project area(s) and to study the present conditions in the area(s)

The P/P aimed to involve various stakeholders who are actors in the e-waste streams. Especially, retailers and supermarkets are accounted important in addition to the MPPP collection centers as e-waste collection points. Customers who visit them come from various localities. Therefore, this P/P did not specify certain area(s) as P/P area(s). This issue was discussed in Taskforce Meetings and the members reached to this understanding.

2-2. To propose e-waste recycling plans which focus on collection, transportation and segregation considering current situations

A set of e-waste recycling plans were formulated and compiled as Pilot Project Plan. Outline of the Pilot Project Plan is described below. Full text of the Plan is presented in Annex IV. Pilot Project Plan with Evaluation.

a) Preconditions

i) Objective of the Pilot Project

The Pilot Project aimed at testing an appropriate, effective and efficient e-waste collection

system from households. The tested system supplied the data which were able to be used for discussing a nationwide model for an e-waste collection system as well as a new policy by DOE.

ii) Assumptions and strategies

Some sorts of incentives to the customers were required in order to collect e-wastes from households, where e-wastes are traded as economic goods in the conventional recycling market.

E-waste flow might was controlled by:

- giving incentives to consumers,
- giving a convenient and timely opportunities to customers (collection upon delivery and upon repurchase) and
- giving many opportunities to recycle e-waste (regular buy back services to customers).

iii) Target e-wastes

The target e-wastes were as stated in the Inception Report, but were classified in detail through the discussions with the related full recovery facilities as follows.

- Television set (Brown Tube Type)
- Television set (non-CRT Type)
- Refrigerator
- Washing machine
- Air-conditioner (Full set)
- Personal computer (Desktop)
- Personal computer (Notebook)
- Printer
- Mobile phone
- DVD player, VCD player and etc.
- Others (Battery charger, Mobile phone battery, mouse, keyboard, etc.)

b) Concept of Pilot Project System

i) Current problems

Currently, e-wastes are majorly dealt by the conventional recyclers whose handling practices are unsure and not monitored. The e-wastes collected by conventional recyclers are then going to the scrap dealers, where e-waste flow is again not monitored and unsure.
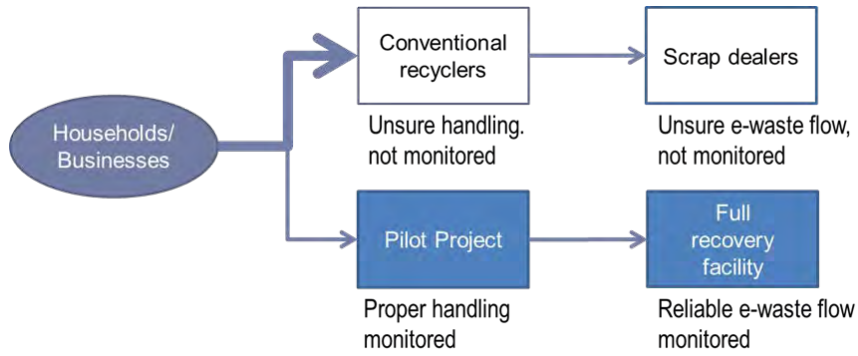
Figure 3-5. Problems of the present major flow of e-waste

ii) Mission of the Pilot Project

For the Pilot Project System to succeed, it is crucial to switch the major e-waste flow to a more reliable channel as shown in the following figure.
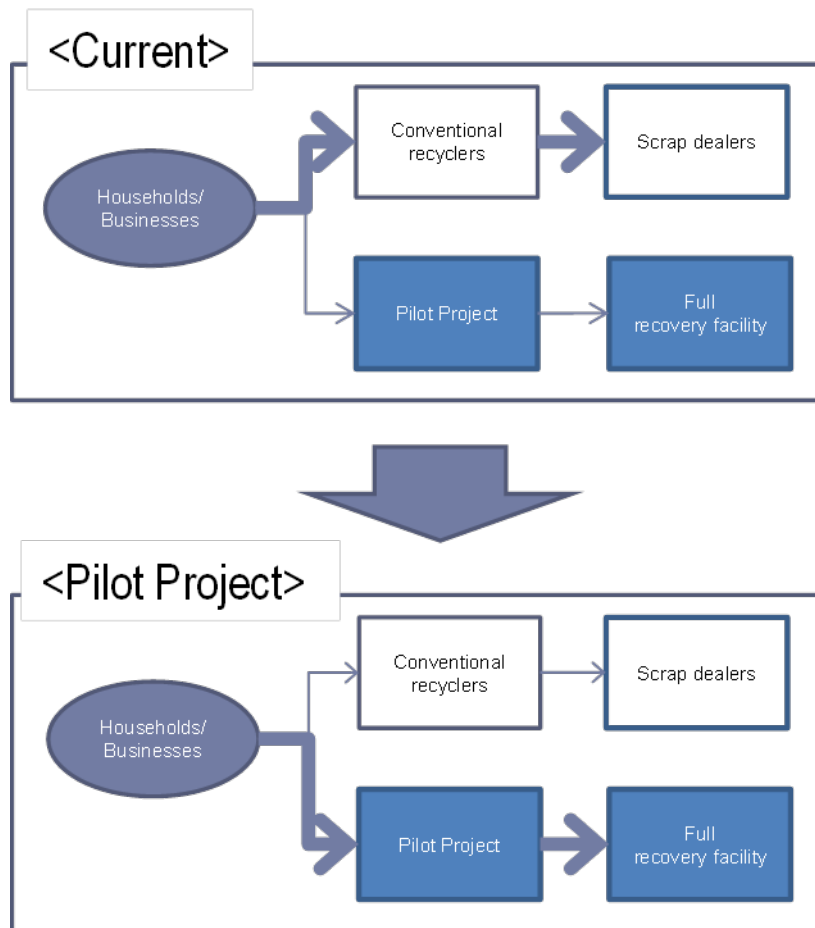
Figure 3-6. Requirement for the Pilot Project System

iii) Strategy to switch the flow

To change the e-waste flow means to change the human behavior. The human behavior can be induced by some ways. One of the most effective ways is to use economic incentives.

The reason why the current e-waste flows to the conventional recyclers is "money". People can get money, if they bring their e-wastes to the nearest conventional recyclers, even the amount is very small. The new system should include certain economic incentives attractive enough to change the discarders' behavior.

In the Pilot Project System, the buying prices set by the full recovery facilities were given to the discarders. The prices set by the full recovery facilities are competitive enough compared to the prices shown by the conventional recyclers, because the prices set by   the full recovery facilities do not include the trade margins which are enjoyed by the conventional recyclers.

In addition, other incentives were considered in the Pilot Project System. They are labor saving and time saving. People can save their labor to bring their e-wastes to the conventional recyclers, if the e-wastes are collected by someone. For this, some home electric appliance shops were invited. They can receive e-wastes from households when they deliver e-products.

Also, as for mobile phones, it is a very good chance to offer end-of-life mobile phones collection upon repurchase. For this, the cooperation from some mobile phone shops was requested.

Supermarkets are perfect places to collect e-wastes. They have large parking lots and the opening hour is very long. The residents can bring their e-wastes when they come for shopping. This may be very convenient for the customer, which could work as an economic incentive.
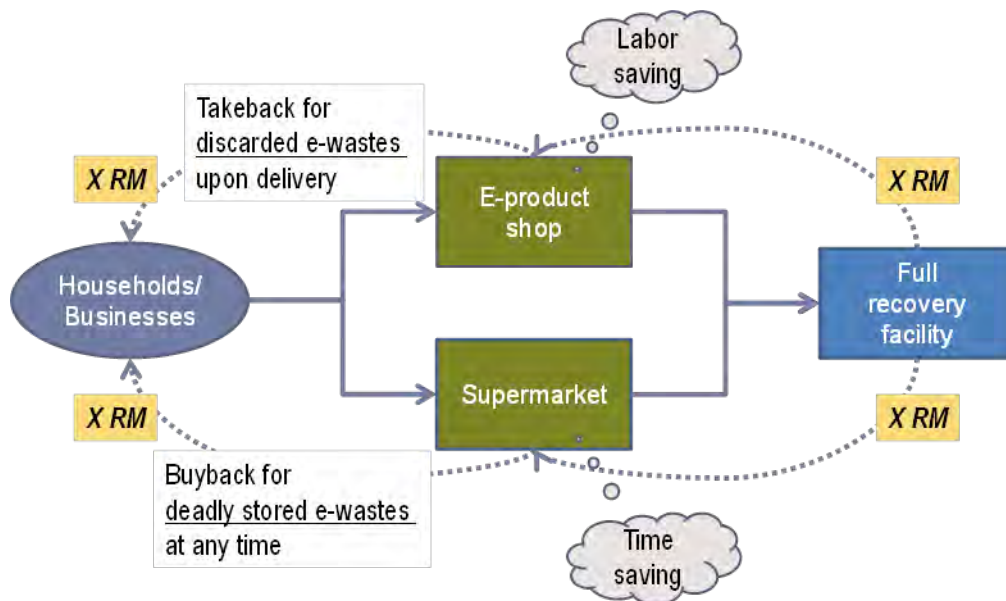
Figure 3-7. Concept of the Pilot Project System

c) Basic system

i) Material flow

● Home electric appliances shops collect the e-wastes from customers' houses upon delivery of purchased products. They also receive the e-wastes carried into their shops by customers.

● Mobile phone shops receive end-of-life mobile phones upon repurchasing. In addition, even in the case of no repurchasing, they also receive the used mobile phones carried into their shops by customers.

● Hypermarkets receive e-wastes brought by the customers.

● Full recovery facilities transport e-wastes collected by the shops upon necessity.
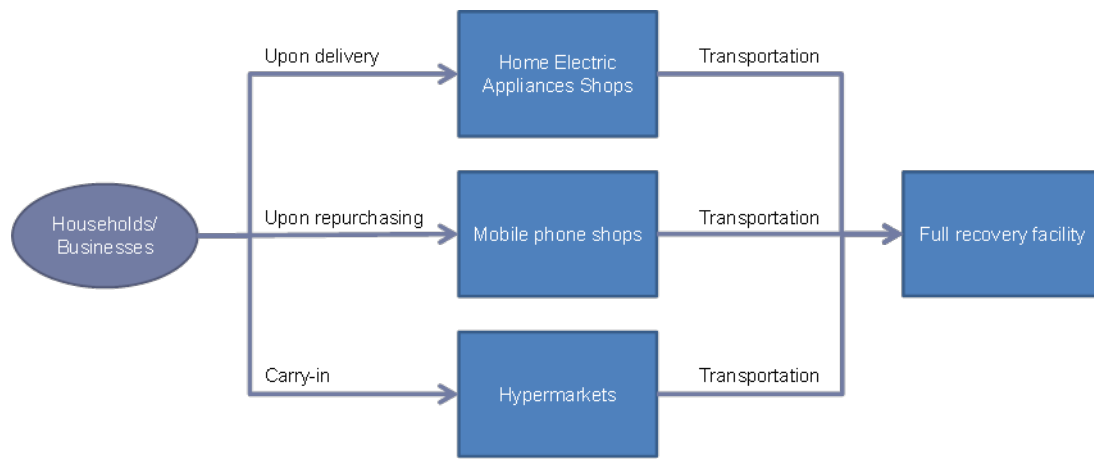
Figure 3-8. Material flow in the Pilot Project

ii) Money flow

● Upon receiving e-wastes from customers, e-waste vouchers are issued and given to the customers.

● The vouchers can be used not only at the shop issued the voucher but also at other shops participating in the Pilot Project.

● Every month, the participating shops can issue the invoices to the full-recovery facility, attached by the vouchers used.
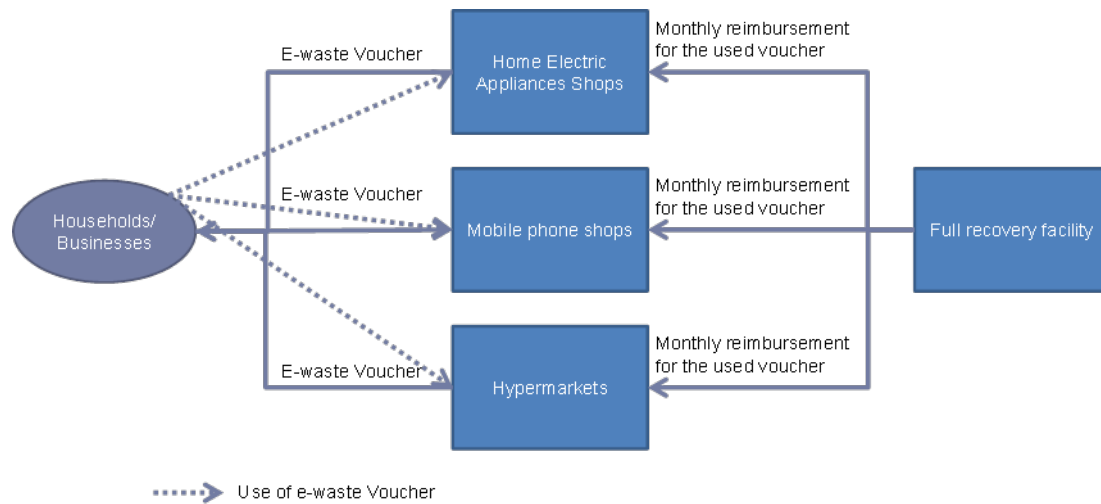
Figure 3-9. Money flow in the Pilot Project

d) Pilot Project Implementation

i) Project period

Although the duration of the Pilot Project was set as follows, MPPP and related organizations are expected to continue the activities even after the end of the Pilot Project.

● June 2, 2012 until November 30, 2012 (six months)

ii) Initial participants

The participants who started to collect e-wastes under the new system of the Pilot Project from June 2 were set as the table below. The autonomy of the participating companies was taken into account most.

"Sunshine" (a supermarket chain nationwide) in Penang Island, SPASTIC (The "Chrebal Palay Children's Association of Penang") and MPPP had started another computer collection systems before the commencement of the Pilot Project (The outline of this system can be referred in Annex I. Current Situation of Waste Management). JICA Expert Team and MPPP discussed that this existing system will be incorporated into the new system in future.

Table 3-2. Participants to start collection of e-waste from June 2

Company name	Business category	Number of shops in Penang Island
Ban Hin Bee (BHB)	Home electric appliance shop	5 (BHB Outlets) 2 (Kitchentech Outlets)
Loo Soon Seng Electrical (LSS)	Home electric appliance shop	3
Channel Communication & Electronics Centre (CCEC)	Mobile phone shop	1
Sun Win Phone Shop	Mobile phone shop	1

iii) Full recovery facility

Shan Poornam Metals and TES-AMM (Malaysia) were selected as the recyclers in charge of the Pilot Project. Also, it was confirmed that Reclaimtek would continue to support the

existing collection system.

Shan Poornam Metals and TES-AMM took turns for the transportation weekly, while the invoices from the local businesses were sent to TES-AMM. The two companies collaborated with each other in the financial arrangement.

e) Initial prices of the common vouchers

i) Price of voucher

The prices of the voucher were set out at what was considered reasonable by the full recovery facilities by considering the assumed metal concentration depending on the types of the e-wastes, as shown in the following table. It was concluded to use the prices as tentative ones, because the data on the metal concentration of the e-wastes collected from households are not well accumulated yet, as well as the prices of the metals are fluctuating according to the metal market. These initial prices will be reconsidered later after the commencement of the Pilot Project.

Table 3-3. Initial prices of e-wastes

E-waste	Price	Remarks
Television set (Brown Tube Type)	RM12/Unit	
Television set (Flat Type)	RM15/Unit	
Refrigerator	RM10/Unit	
Washing machine	RM10/Unit	
Air-conditioner	RM20/Unit	Full set
Personal computer (Desktop)	RM5/Unit	
Personal computer (Notebook)	RM5/Unit	
Printer	RM1/Unit	
Mobile phone	RM40/Unit	By a lucky draw with 10% hits
DVD player, VCD player and etc.	RM2/Unit	
Others	RM0/Unit	Battery charger, Mobile phone battery, mouse, keyboard, etc.

ii) Design of voucher

Vouchers were designed so as not to be forged. Special stickers were used on the voucher for this purpose.

Figure 3-10. Common Voucher (Left: front, Right: rear)

(Note) The dot and the hatched part below the logo are special stickers so as not to be forged.

2-3. <u>To develop the coordination and collaboration mechanism among the stakeholders for the collection, segregation and transportation of e-waste generated from households in the pilot project area(s) to ensure proper management of e-waste</u>

a) Two target groups

There are two target groups having been involved in the Project. One was local businesses by which the Pilot Project was implemented. The other was e-products manufactures with which appropriate EPR was discussed. Thus,

● Official consultative meeting for designing the policies and
● Local working group meeting for designing the pilot project,

were formed involving these stakeholders, as shown in the following figure.
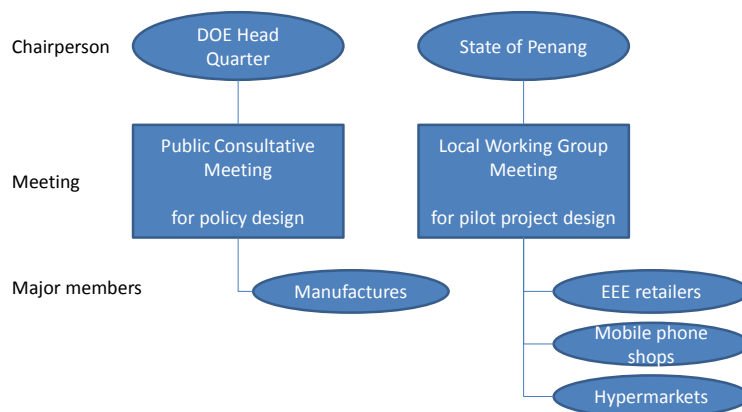
Figure 3-11. Framework of coordination and collaboration mechanism

b) Profiles of the two meetings

The profiles of these two meetings are shown in Table 3-4.

Table 3-4. Profiles of two meetings for designing

	Official consultative meeting	Local working group meeting
Objective	Opinion exchange for designing e-waste recycling	Designing for the pilot project in Penang Island
Chairperson	DOE headquarter	State of Penang
Secretary	DOE headquarter	UPEN
Coordinator	-	- DOE Penang - MPPP
Advisor	JICA Experts	JICA Experts
Place	Kuala Lumpur	Penang Island
The date of the first meeting	26 March 2012	23 March 2012
Category of participants	- Manufactures of home electric appliances - Manufactures of ICT products - Related business associations - Related Ministries	- Retailers of electric and electronic products in Penang - Hypermarkets in Penang - Mobile phone shops in Penang - Mobile phone carriers in Penang (branch in Penang) - Other related business entities

	Official consultative meeting	Local working group meeting
Remarks	FMM coordinated the manufactures of home electric appliances and PIKOM coordinated the ICT manufactures.	-

c) "E-waste Alam Alliance –Penang"

The above mentioned local working group meeting was upgraded to "E-waste Alam [4] Alliance – Penang" in April, 2012 by the same members participated in the working group. This is an intersectoral business group which will be expected to manage the Pilot Project even after the Project.

Figure 3-12. Logo of "E-waste Alam Alliance – Penang"

2-4. To hold a workshop inviting all the stakeholders

a) Kickoff seminar

The kickoff seminar was held on 24 October 2011, in a ballroom of Vistana Hotel, Penang Island. The main objective of the seminar was to announce the commencement of this project and to draw interests into the project from relevant sectors including recyclers and manufacturers.

Presentations were given by the representatives from DOE HQ, MPPP and JICA Expert Team and an external expert invited from a university in Japan.

b) Idea sharing workshop

The idea sharing workshop was held on 17 January 2012, in Cititel Hotel, Penang Island. The objective of this workshop was to share ideas about the pilot projects to be implemented from June 2012 among relevant stakeholders.

It was in fact the first workshop to talk about how the pilot project was to be designed. The presentation from the JICA expert on the current e-waste flow with volumetric figures gave a good momentum to facilitate the attendants to develop their ideas. The presentation of MPPP and DOH helped the attendants to have a common image of the current recycling practices, and DELL and TES-AMM, the supposed key actors of the pilot project, presented their positive response to the pilot project.

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[4] "Alam" means environment in Bahasa Malaysia.

c) Pilot Project launching workshop

A workshop for launching the Pilot Project was held on June 1, 2012 at E&O Hotel. The participating local businesses were introduced after the concept of the Pilot Project was explained. The total number of participants in the workshop was 86 persons.

d) Pilot Project launching event

An outdoor event for celebrating the commencement of the Pilot Project was held on June 2, 2012 at Straits Quay. A "Stamp Rally" and "Lucky Draw" was conducted. More than 500 people came to the event.

2-5. To formulate the public awareness program in the pilot project area(s) for the smooth implementation of the proposed e-waste recycling plans

a) Mass media

Utilization of newspaper articles was planned for announcing the Pilot Project commencement, considering that it was the most effective and cheapest way to advertise the Project.

b) Publicity materials

Some of publicity materials were developed in order that many residents in Penang got familiar with the Project. Those materials were also presented at retail shops which participated in the Project so that main targets who buy electric and electronic equipment were to be aware of it.

2-6. To develop an information management system of an e-waste collection from households in the pilot project area(s)

An information management system was developed as described in this section in order to collect data for appropriate operation, analysis and evaluation of the Pilot Project.

a) Information management system

- Shops issue the receipt with four-ply. The four-ply receipts were given to 1) the customer, 2) shops, 3) full recovery facility and 4) "E-waste Alam Alliance".
- When the collected e-wastes were sent to full recovery facilities, the transportation slip was issued by the shops. The three-ply transportation slips were given to 1) shops, 2) full recovery facilities and 3) "E-waste Alam Alliance".
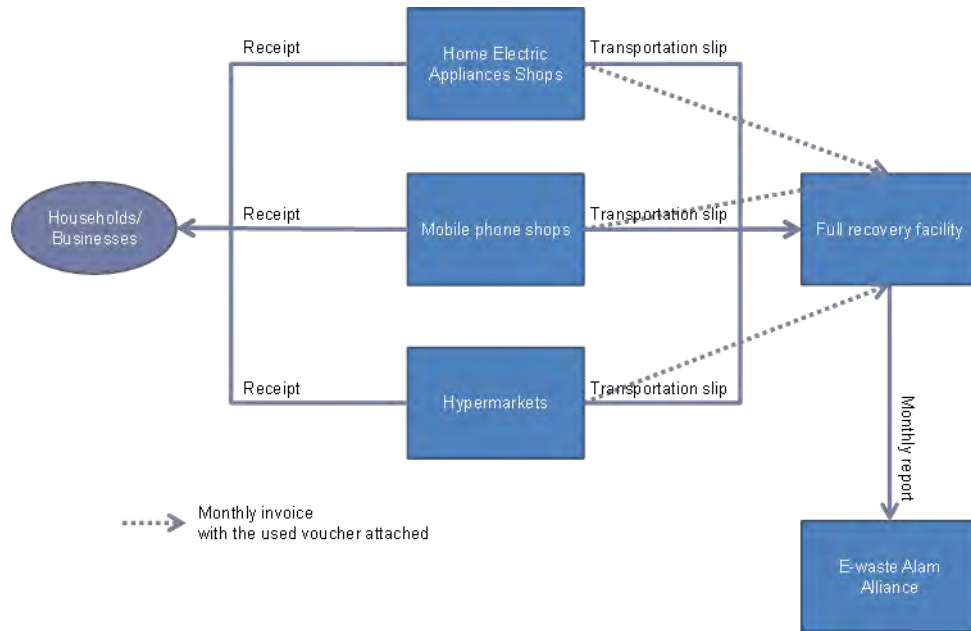
Figure 3-13. Information flow in the Pilot Project

b) Information forms

i) E-waste receipt

There are two kinds of e-waste receipts. One is for home electric appliance shops and supermarkets, and the other is for mobile phone shops which collect only mobile phones.

The e-waste receipts contain 1) purchased units of new products, 2) number of e-wastes applied and 3) brands of the e-wastes. By using the information on brands of e-wastes, the data of amount of e-wastes by brands can be collected.

Figure 3-14. E-waste receipt for home electric appliance shops and supermarkets

Figure 3-15. E-waste receipt for mobile phone shops

ii) Transportation slip

The transportation slip shown in the following figure is commonly used by the different types of shops.

Figure 3-16. E-waste transportation slip

iii) Other data to be collected

In addition to the abovementioned data, the following data were collected.

- Required time and cost for e-waste collection by home electric appliance shops
- Required time and cost for e-waste transportation by full recovery facilities

c) Data compilation

i) The amount of e-waste collected

For the environment, certain amount of e-waste shall be guided to the appropriate recycling routes. Collection percentage of the e-waste supplied in the past was calculated for each brand.

ii) Cost structures of the participants in the Pilot Project

Certain amount of money is needed for collecting e-wastes properly. How much money is required and how it is borne among the participants was calculated[5].

2-7. To develop evaluation indexes and methods of the pilot project

Six aspects of criteria were set for evaluating the Pilot Project as shown in Figure 3-17 and twelve indicators for the evaluation were set as shown in Figure 3-18.

Details are described in the Pilot Project Plan with Evaluation in Annex IV.
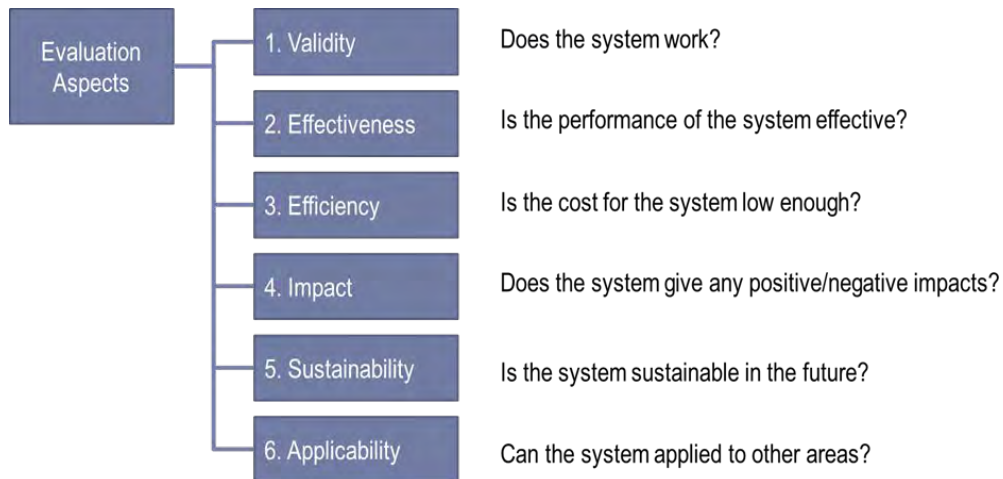
Figure 3-17. Six aspects for evaluating the Pilot Project

Figure 3-18. Evaluation indicators

3-1. To conduct the pre-evaluation of the pilot project using the developed evaluation method

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[5] This does not necessarily mean the direct cost bearing. For example, the home electric appliance retailers can contribute by providing the takeback service to the customers upon delivery of the new products. The labor cost can be converted in terms of money.

The pre-evaluation of the Pilot Project was conducted by applying the above mentioned index system and resulted that the efficiency and effectiveness are fair. The pre-evaluation in detail are presented in Annex IV. Pilot Project Plan with Evaluation. The expected collection rate defined as $\frac{Total\ amount\ of\ e-waste\ collected\ in\ the\ Pilot\ Project}{Total\ amount\ of\ e-waste\ discarded}$ were calculated to be 37%. This figure corresponds to improve the policy indicator as below.

- 1. Hazardousness=$1 - \frac{FR}{W}$ ($in\ terms\ of\ lead$)=42% (Present value=88%)

- 2. Resource recovery=$\frac{FR}{W}$ ($in\ terms\ of\ precious\ metals$)=40% (Present value=19%)

- 3. Traceability=$\frac{FR}{W}$ ($in\ terms\ of\ e-waste$)=43% (Present value=9%)

3-2. To conduct the pilot project based on the developed e-waste recycling plans and the coordination and collaboration mechanism

The Pilot Project was launched on 2 June 2012. Some of the results are presented in this section.

a) Participating retail shops

So far, 25 retail shops have participated in the Pilot Project as shown in the table below.

Table 3-5. Retail shops participating in the Pilot Project

Business type	Company name	Nos. of shops	Launched
E-products retailers (Trade-in and Walk-in) Total 15 shops	LSS (Loo Soon Seng Electrical)	3	June
	BHB (Ban Hin Bee)	7	June
	TC Electrical Centre	1	Aug.
	Wah Lee Chain	1	Oct.
	Chop Seng Hock Electrical (CSH)	3	Oct.
Mobile phone shop (Walk-in) Total 5 shops	Channel Communication & Electronics Centre	1	June
	Sun Win Phone Shop	1	June
	Innomax Telecommunication Centre	1	July
	Impian Communication	1	Oct.
	Multi Communication Enterprise	1	Oct.
Personal Computer Shop (Walk-in) Total 5 shops	Gadgetzone	2	Oct.
	NC Computer / Nanyang Digital	1	Oct.
	Mind Maker	1	Oct.
	E-Tech Computer	1	Oct.
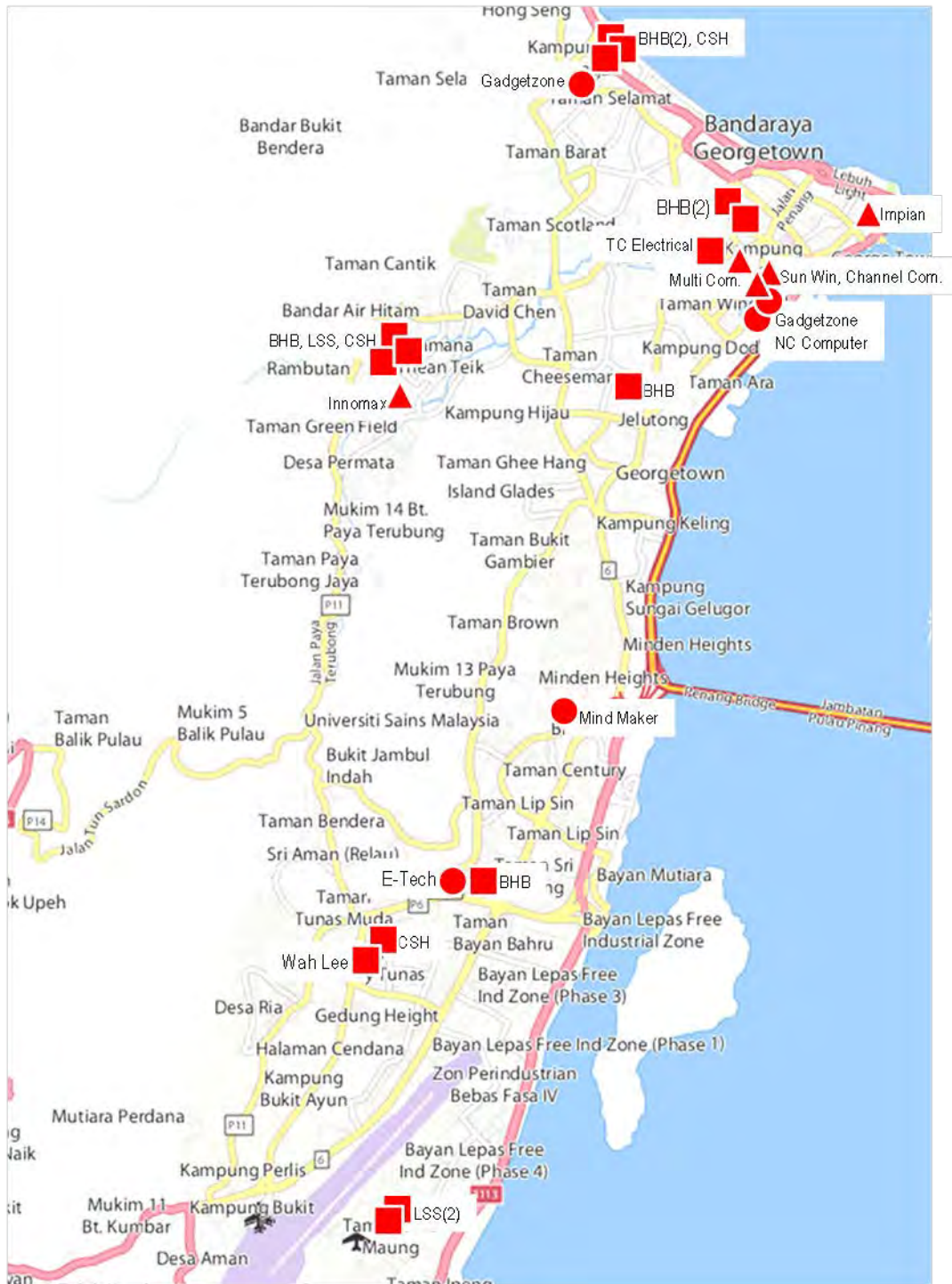
Figure 3-19. Location of the participating retailers

Legend) Square: Home electric appliance shop, Triangle: Mobile phone shop, Circle: Computer shop

b) Collected e-waste

The item collected most in terms of number was Mobile Phone. On the other hand, Washing Machine was the item collected most followed by TV(CRT) in terms of weight.
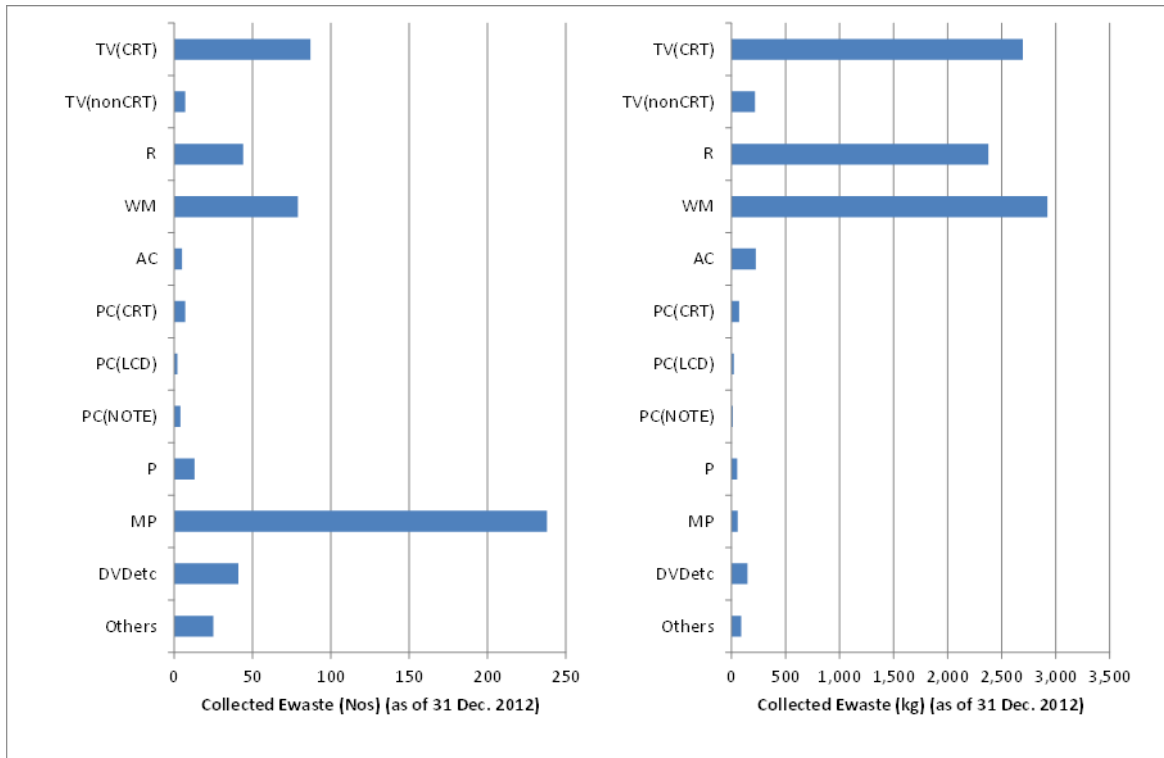
Figure 3-20. Number and weight of collected e-waste

Figure 3-21. Photos of collected e-waste

c) **Cooperation rate**

Cooperation rate of e-waste is tentatively defined as follows:

● *Cooperation rate* (%) = (Collected E-waste (kg))/(Discarded E-waste$d(kg)$ * Market Share(%) $*(1-RepairRate(\%)))$

The figure below shows the cooperation rate for each item. Mobile Phone recorded a quite high rate among the items. Low rates for PC and Printers are due to the fact that these items are not sold by the participating retail shops.
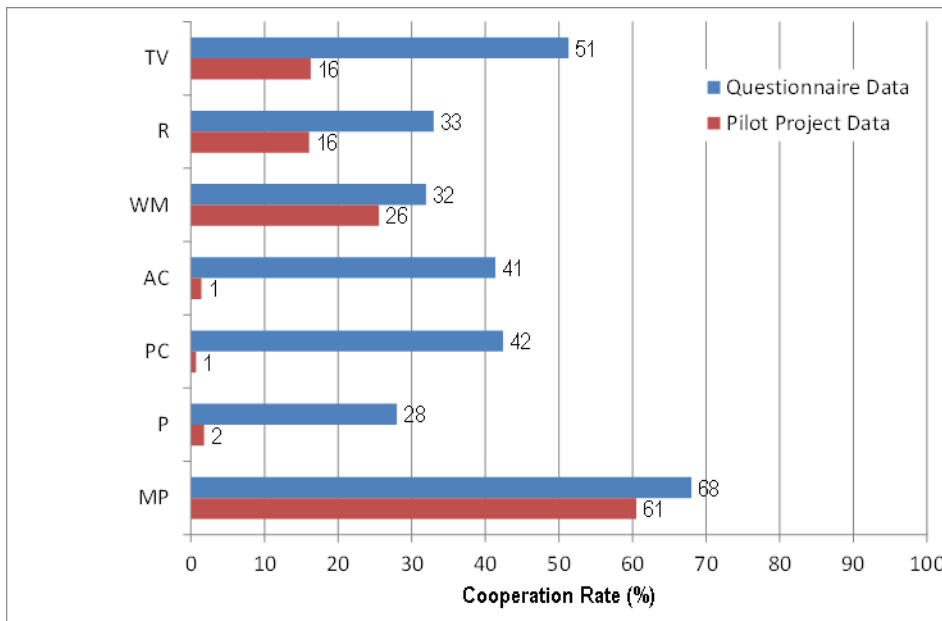
Figure 3-22. Cooperation rate

d) Willingness to be paid curve

By using the cooperation rates above and the market prices, the willingness to be paid curves were described in Figure 3-23.
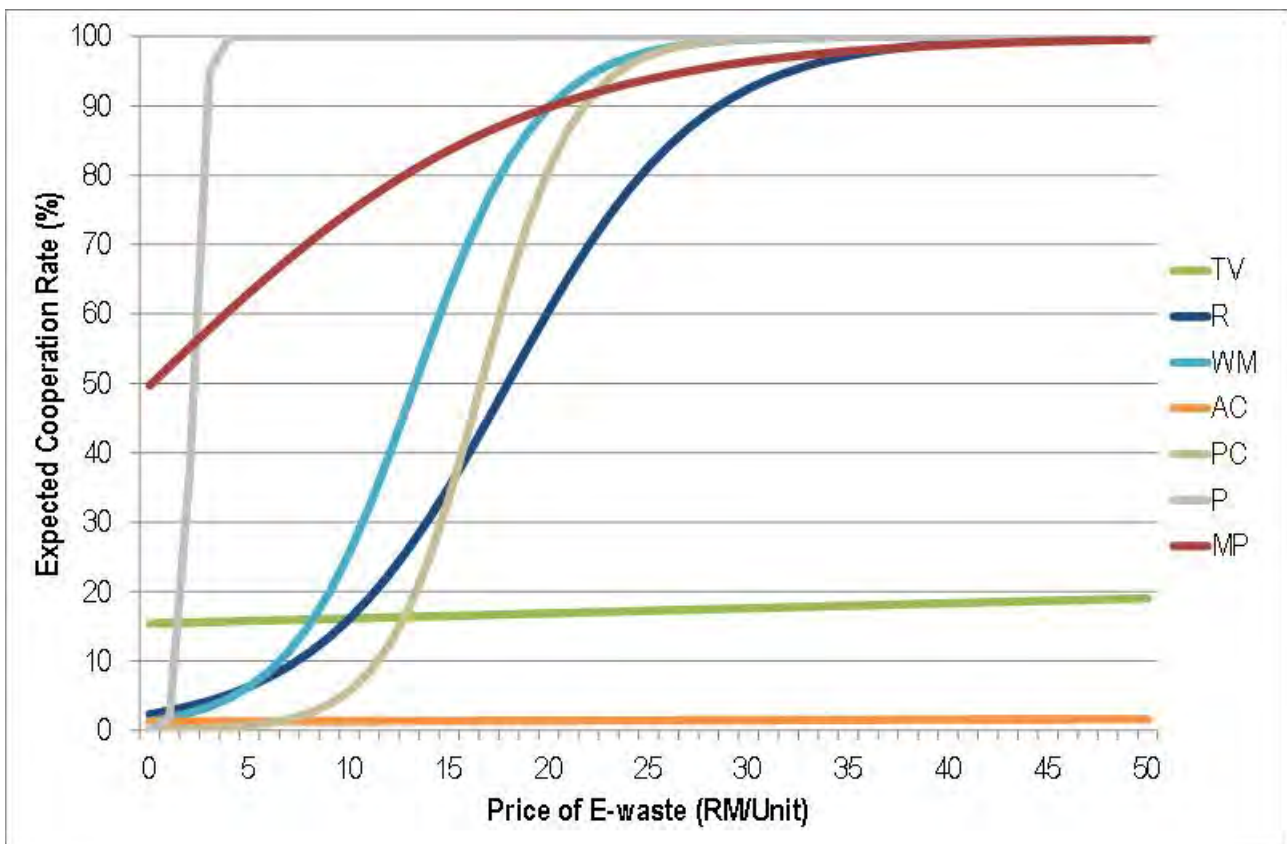
Figure 3-23. Willingness to be paid for each type of e-wastes obtained from the collected e-wastes

3-3. To conduct the public awareness program

a) Mass media

Newspapers listed below published articles about the Pilot Project Launching.

- The Star
- Guang Ming
- Sin Chuw
- Kwong Hwa
- China Press

b) Publicity materials

Publicity materials were developed and distributed to the participating retail shops as planned. In addition, a Facebook page was developed, in order to complement the short messages of the publicity materials. The materials guided people to the Facebook page.

Figure 3-24. Publicity materials

Publicity materials such as banners, flyers and sign boards were prepared and distributed to the participating retail shops as shown in the photos below.

Figure 3-25. Publicity materials at retail shops

4-1. To evaluate the pilot project and review the lessons learnt and recommendations

The e-waste collection system could collect e-wastes very efficiently. A model for estimating the expected cooperation rates were developed. The system can be used nationwide.

a) Analysis on each type of e-wastes

i) Television sets

The cooperation rate for television sets was lower than the expected cooperation rate obtained from the questionnaire survey. For attaining a higher collection rate, it is advisable to have the participating retailers explain to the customers that they can collect all types of e-wastes kept in their houses when the customers buy some bulky e-products at the shops.

ii) Refrigerators and washing machines

The take back system from households worked the most effectively for refrigerators and washing machines. High collection rates are possible for refrigerators and washing machines as far as shops explain about the e-waste collection service to the customers, if the voucher prices are attractive enough for the customer.

iii) Air-conditioners

The cooperation rate of air-conditioners was so low. One of the major reasons is outsourced installation. Air-conditioners are installed by the special installing teams. It is very common that the installing teams take back the old air-conditioners and recycle them by themselves. So it is difficult to control the outsourced installing team. It is necessary to solve this structural problem for improving the cooperation rate of air-conditioners.

iv) Personal computers and printers

No computer or printer was collected in five computer shops for three month from October 2012. Unlike bulky e-wastes, the shops cannot offer taking back e-waste collection to their customers. The computer collection can be improved by offering higher voucher prices and more advertisement of the existence of the Pilot Project.

v) Mobile phones

The Pilot Project system worked well for mobile phones successfully. It is possible to expand the mobile phone collection further by inviting more mobile phone shops widely and advertising about the collection system more actively at the participating shops.

b) Other findings

i) Retailers' difficulties

Retailers had two major difficulties. One is to do with the relationship with conventional recyclers, and the other is regarding the difficulty in securing the storage spaces. Due to the above two difficulties, some retailers wanted to go back to the conventional trade from the Pilot Project. It can be pointed out that asking the retailers to understand the significance of the Pilot Project is very important for getting their continuous cooperation.

ii) Difficulty in paper works

Some retailers had a trouble in managing the receipts and the transportation slips. Each shop has its original paper work procedure and logistic system. The paper works should be designed so as to fit to their system.

c) Recommendations

i) Succession of the Pilot Project

The Pilot Project was designed by considering project sustainability. It does not need a lot of management cost. It is expected that MPPP, DOE and other related agencies will succeed the Pilot Project.

ii) More participation from retailers

The number of the participating retailers is just over 20 shops as of 31 December 2012. More participation is needed for further e-waste collection. It is advisable to plan an expansion plan with increased number of participants in the future.

iii) Data accumulation and update of WTP curves

The duration of the Pilot Project was only for several months and some retailers just joined in last October. Longer data accumulation is needed. By using more data, the WTP curves can be updated for further improvement.

4-2. To propose a future e-waste recycling plan in Penang

Regarding expansion of the pilot project, targets in the future have been set by DOE and MPPP as follows.

Targets (to be prepared after the 4$^{\text{th}}$ JCC meeting)

Documents prepared in the course of implementation of the project such as the Pilot Project Plan with Evaluation and Standard Operation Structure can work as technical guides to implement the expansion and to achieve the targets.

4-3. To hold a workshop with stakeholders on 4.1 and 4.2

A workshop for reviewing the pilot project was held on 1$^{\text{st}}$ November 2012 having participation of the stakeholders such as manufactures, appliance retailers, recyclers (full

recovery facilities), NGOs and government institutions. Consecutively, the participants visited retail shops which participated in the pilot project. Some of photos of the events are shown below.

5-1. To prepare a program to strengthen the capacity of e-waste management of DOE, local authority and relevant organizations

This was carried out when the Project began. The program was attached to the Inception Report as "Taskbook for Capacity Development". The Taskbook was subject to revision by taking into consideration of outcomes arisen during the course of the Pilot Project implementation.

5-2. To conduct seminars or workshops on the method of survey / planning / implementation / evaluation / public awareness raising on e-waste management

On 5th February 2013, a workshop was held having a participation of the stakeholders such as manufactures, recyclers (full recovery facilities), appliance retailer organizations and government institutions.

5-3. To conduct a study tour and/or a training course in Japan or other countries

Training in Japan was carried out in February 2012 having targeted at the counterpart officials,

10 persons in total.

In addition, other training in Japan for full recovery facility was carried out in September 2012 having 7 participants.

5-4. To conduct a training and/or a workshop for officers of DOE, local authority on e-waste management

Taskforce meetings were held ten (10) times having participation of members from DOE HQ, DOE Penang and MPPP. In the course of meetings, technical issues on current situation surveys, pilot project planning and implementation, EPR policy formulation, etc. were presented and discussed. The counterparts deepened their knowledge.

5-5. To propose main elements for regulatory control on "Take-Back Scheme (extended producer responsibility)" for electronic and electrical equipment

A document, Factor Analysis for an EPR System Based on the EPR Systems in Asian Counties, was prepared and presented in February 2013 in order DOE HQ to further carry on EPR policy formulation.

3.3 CAPACITY DEVELOPMENT

Various opportunities of capacity development were provided during the course of the project such as joint site surveys, joint planning and implementation of the pilot project, Taskforce meetings, JCC meetings, seminars/workshops and trainings in Japan.

Some of principal counterpart members were asked to make self-evaluation of understanding level on issues related to e-waste management. The self-evaluation was made three times; October 2011, March 2012 and October 2012. Only two counterparts made the self-evaluation at all occasions. Others made once or twice due to replacement or other reasons.

Tables below show questions and results of the self-evaluation. There are 17 questions and understanding level is evaluated with point from 0 to 10. Then, 170 are the full marks.

Many counterparts tended to give high scores on their understanding level at the beginning of the project. This might be brought from insufficient explanation of the questions to the counterparts. Therefore, it may be appropriate to assume the first result as reference. From the 2nd time, the score increased along with progress of the project.

Table 3-6. Questions of self-evaluation

No.	Questions	Understanding level (Score 0 -10) (Self-evaluation)
1	Do you understand what data should be collected for estimating the present and future amount of waste to be discarded?	
2	Do you understand what data should be collected for describing the present	

No.	Questions	Understanding level (Score 0 -10) (Self-evaluation)
	e-waste flow?	
3	Do you understand what criteria should be set for selecting pilot project areas?	
4	Do you understand what factor should be determined for designing an e-waste collection system?	
5	Do you understand how to involve stakeholders in a pilot project?	
6	Do you understand what public awareness programs are effective?	
7	Do you understand what forms should be developed for collecting required data for monitoring the pilot project and evaluation on it?	
8	Do you understand what factors should be planned for designing a pilot project by considering what are "pilot" points?	
9	Do you understand what factors should be planned for the future expanding plan?	
10	Do you understand how to estimate the future expected amount of collected e-wastes?	
11	Do you understand how to finance the future required cost?	
12	Do you understand what and when to speak to the mass media?	
13	Do you understand what indexes are required to evaluate the e-waste collection system?	
14	Do you understand how to review a pilot project by considering the future possibility to expanding it?	
15	Do you understand how to apply the Penang model to other areas in Malaysia by considering the similarity and differences?	
16	Do you understand what stakeholders should be invited for discussing cost sharing and roles?	
17	Do you understand what documents should be developed for negotiating with the stakeholders?	

Table 3-7. Results of self-evaluation

Counterpart	2011 Oct.	2012 Mar.	2012 Oct.
A	104	89	94
B	120	-	-
C	126	-	106
D	98	119	130
E	104	-	-
F	132	-	-
G	-	88	-
H	-	87	-
I	-	-	87
J	-	-	131
K	-	-	87
Ave.	114	96	106

4. TRAINING IN JAPAN

Training in Japan was carried out between 18th and 29th February 2012. Ten persons from government institutions participated in the course.

In addition, training in Japan for full recovery facility was carried out in September 2012. Two companies joined in the course.

4.1 1ST TRAINING IN JAPAN FOR POLICY MAKERS

(1) Participants

No.	Name	Position
1	Ms. Datin Paduka Che Asmah IBRAHIM	Director, Hazardous Waste Substance Division, Department of Environment
2	Mr. Khiruddin MOHAMAD IDRIS	Principal Assistant Director, Hazardous Substance Division, Department of Environment
3	Mr. Mohd Zaidi Bin HASSAN	Assistant Environmental Control Officer, Hazardous Substance Division, Department of Environment
4	Mr. Badlishah Bin AHMAD	Head, Operation Division, Department of Environment, Penang
5	Mr. Mohd Fitri MOHD MOKHTAR	Assistant Director, Operation Division, Department of Environment
6	Mr. WONG Kiong Kok	Senior Principal Assistant Secretary, Policy Division, Ministry of Housing and Local Government
7	Mr. LIM Wei Urn	Assistant Director, Environment and Natural Resources Economic Section, Economic Planning Unit
8	Mr. JUNUS Mubarak	Director, Urban Services Department, Municipal Council of Penang
9	Mr. PITCHAY SEBASTIAN Xavier	Assistant Director, Urban Services Department, Municipal Council of Penang
10	Mr. V MUTHU Arul Selven	Senior Health Supervisor, Urban Services Department, Municipal Council of Penang

(2) Schedule

Date	a.m.	p.m.
Feb. 18 (Sat.)		Departure for Japan
Feb. 19 (Sun.)	Arrival in Japan	
Feb. 20 (Mon.)	0900-1100 Briefing about the study tour by JICA 1100-1230 Lecture "Program Orientation" by Hideki Wada	15:00-17:00 Lecture "Home Appliance Recycling Law" by Mr. Shigeyoshi Sato, Ministry of the Environment
Feb. 21 (Tue.)	1000-1200 Lecture "PC recycling based on Law for Promotion of Effective Utilization of Resource" by Mr. Kazuhiro Yano, Ministry of Economy, Trade and Industry	1400-1500 Courtesy visit to JICA
Feb. 22 (Wed.)	1000-1200	1400-1600

Date	a.m.	p.m.
	Lecture "Discussion on e-waste related laws" by Mr. Shin-ichi Sakuma, Dynax Urban Environment Research Institute	Site visit to EEE shops and mobile shops in Shinjuku attended by Hideki Wada
Feb. 23 (Thu.)	1000-1200 Lecture "Operation of PC recycling" by Mr. Takashi Unno, PC 3R Promotion Association	1430-1600 Site Visit to an e-waste recycling factory "Tokyo Eco-Recycle" in the east of Tokyo
Feb. 24 (Fri.)	1000-1200 Lecture "Mobile Phone Recycling" by Mr. Yasuo Yabashi, Telecommunications Carriers Association	1400-1500 Site visit to a mobile phone recycling factory "Future Ecology" in the south-east of Tokyo
Feb. 25 (Sat.)	1000-1700 Lecture and Discussion "EPR Policy Trend in the Asian countries and regulation design in Malaysia" 1000-1100 Lecture 1: "EPR Policy Trend in the Asian countries" by Dr. Michikazu Kojima, Institute of Developing Economies 1100-1200 Lecture 2: "WEEE regulations in some Asian countries" by Dr. Rie Murakami 1300-1400 Presentation for discussion "What we discussed in Malaysia so far and some proposals for the next steps" by Mr. Hideki Wada 1400-1700 Discussion facilitated by Prof. Yoshifumi Fujii, Bunkyo University	
Feb. 26 (Sun.)	Data/Information arrangement	
Feb. 27 (Mon.)	1000-1200 Lecture "Policy and services of solid waste management in Chuo-ku, Tokyo" by Ms. Noriko Sonoda, director of solid waste management department, Chuo-ku	1330-1500 Site Visit to Chuo Incineration plant
Feb. 28 (Tue.)	Preparation of presentations	Presentations from the participants
Feb. 29 (Wed.)	Departure for Malaysia	

4.2 2ND TRAINING IN JAPAN FOR RECYCLERS

(1) Participants

No.	Name	Position
1	Mr. BADLISHAH Ahmad	Head of Operational Division/ Department of Environment, Penang
2	Mr. JOHN ASHOK	Deputy Managing Director/ TES-AMM(M) Sdn Bhd, Penang
3	Mr. VEILAYUTHAM Krishnan	Maintenance Assistant Manager/ TES-AMM(M) Sdn Bhd, Penang
4	Mr. DINESH RAJAMANICKAM	Process Engineer/ TES-AMM(M) Sdn Bhd, Penang
5	Mr. B THINESH KUMAR	Director Operation Department/ Shan Poornam Metals Sdn Bhd, Penang
6	Mr. RAJAMANICKAM ANNAMALAY	Production Manager/ Shan Poornam Metals Sdn Bhd, Penang
7	Mr. SAW SHYH	Business Development Manager/ Shan Poornam Metals Sdn Bhd, Penang

(2)   Schedule

Date	a.m.	p.m.	Stay
Sep. 8 (Sat.)		Departure for Japan	-
Sep. 9 (Sun.)	Arrival in Japan	-	Yokohama
Sep. 10 (Mon.)	0900-1200 Briefing about the study tour by JICA at YIC	1300-1430 Lecture "Program Orientation and E-waste Recycling System In Japan" by Mr. Hideki Wada at YIC	Kakogawa
Sep. 11 (Tue.)	0900-1200 Lecture "Home Electric Appliance Dismantling Technique" by Panasonic at PETEC	1400-1630 Practice to dismantle home electric appliances at PETEC	Kakogawa
Sep. 12 (Wed.)	(Mobilization)	1500-1630 "Business Matching Workshop" at JICA HQ	Tokyo
Sep. 13 (Thu.)	(Mobilization)	13:00-1600 Lecture and Practice "PC dismantling technique" by Kimura Metal Industry at Kimura Metal Industry	Tokyo
Sep. 14 (Fri.)	1000-1200 Lecture and Practice "Mobile Phone Dismantling Technique" by Future Ecology at Future Ecology	1500-1700 Evaluation by JICA at JICA HQ	Tokyo
Sep. 15 (Sat.)	Departure for Malaysia	-	-

5. CHALLENGES IN CONDUCTING THE PROJECT

This chapter describes the challenges faced in conducting the Project.

(1) Looking forward from the starting point

Any pilot project has to be planned based on the hypothesis to be proved in the pilot project. The hypothesis should be drawn from draft final pictures of future e-waste collection systems, even if they are quite tentative.

So, the project was started from discussing what kind of collection system is appropriate and how the policy with EPR should be designed. The Team started the taskforce meeting from explaining the failure and success of the Japanese system. We discussed what kind of EPR policy can be introduced in Malaysia during the study trip in Japan.

Of course, at this moment, before the regular discussion with manufactures in advance of the pilot project commencement, it should be very tentative one. Even it is very tentative, once we can share the hypothesis, we can explore the final solution by changing the hypothesis.

(2) Policy making process in the Japanese law systems

In the study tour in Japan, the Expert Team tried to arrange the program so that the participants come to know the policy making process of the EPR laws used in Japan. Especially, the focal point was put on what and how the governments negotiated with related industries. The participants might have ideas how to consult with the related industries in Malaysia.

However, it was not so easy to find the proper lecturers in the governments due to the personal rotation, even the lecturers tried to explain the policy making process. The Expert Team asked the lecturers to make interviews to the person who was in charge of the policy makings when the policies were discussed. Also, the Expert Team tried to invite the lecturers from the industrial sides and the consultants involved the policy makings.

(3) Cooperation from the academic community

The e-waste issues are shared well among the academics. There are several academics to be nominated as the pioneers. In the Project, such academics were involved in every chance as the outer resources.

The academics do not have any experiences to introduce policies practically; however, they have a lot of information regarding e-waste regulations introduced in several countries. By comparing the policies in several countries, they have clear ideas what kinds of policies are appropriate and what should not be done with their academic backgrounds. This was very effective to consider the policy from the deeper point of view.

(4) Involvement of stakeholders

Participation of stakeholders is crucial for establishment of proper e-waste management such as residents, business entities, EEE retailers, EEE manufactures, recovery facilities and public institutions. However, it is difficult in a practical sense to find right persons for this purpose.

The Project has strategically tried to search such right persons by means of visiting them personally or inviting them to seminars/workshops. Then, the Project has kept in contact with those who showed intention to be involved.

The Project tried to formulate two working groups. One consists of mainly the EEE retailers and the recovery facilities in Penang. The other is composed of mainly mega-manufactures. The members were officially involved in planning and implementing the Pilot Project, and in discussing regulation regarding EPR, etc.

(5) Utilization of ITs for the communication among the members of the Project

The Malaysian counterpart consists of three institutions, i.e., DOE HQ, DOE Penang and MPPP. Each institution has individual mandate. Their offices are located in different sites. And, they play respective roles in the Project.

As e-waste management can function properly only by involving various actors such as law makers, operators and supervisors, an appropriate coordination of the Malaysian side is quite important. However, it is also true to maintain close communication and to share information among different actors be difficult.

In order to overcome this challenge, a tool of information and communication technology has been utilized among members of the counterpart and JICA Expert Team. Reports, seminar presentation materials and other information are stored in the share folder and each member can access these whenever they need. The figure shows an image of the share folder on the computer screen.
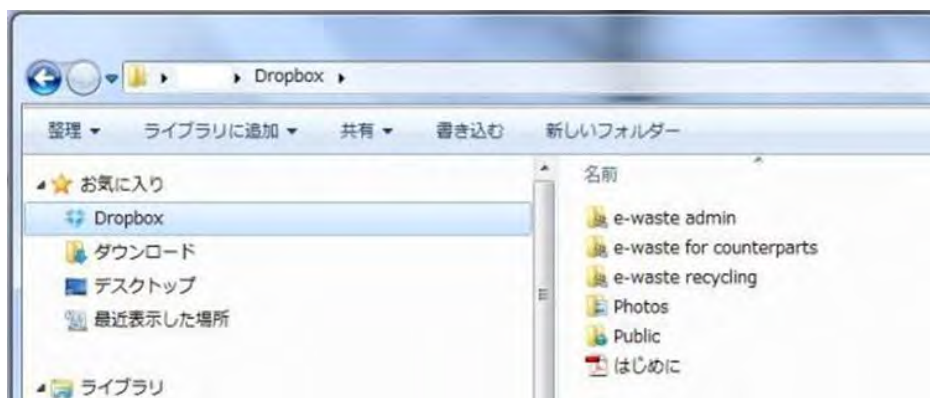
(6) Public relations

The project has developed a website to communicate with the public. The website has a title of "Penang E-waste Project." The URL is http://weeepenang.blogspot.com/.

The website records activities of the Project. The visitors can follow the project process through the internet. The figure shows an image of the website.

The website was visited by 7066 persons by Feb. 21, 2013. Many visitors came from India, Thailand, Australia and Vietnam where e-waste policies are discussed, besides Japan, Malaysia and Singapore in which many related persons to the Pilot are based.
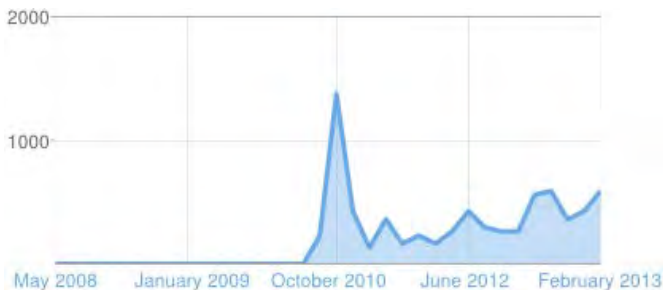
Country of visitors	Number of Visitors	Component rate (%)
Malaysia	4156	63
Japan	1221	19
Singapore	322	5
United States	270	4
India	186	3
United Kingdom	100	2
Luxembourg	98	1
Thailand	85	1
Australia	76	1
Vietnam	53	1
Total	6567	100

In addition to the website, the Project tried to utilize mass media. The Team leader, Wada, appeared in local newspapers several times. It gave synergy effect on increase of visitor number to the website.

6. RECOMMENDATIONS FOR ATTAINING THE OVERALL GOAL

The overall goal of the Project is

● A proper collection, segregation and transportation programs / system for recycling e-waste generated from households are implemented nationwide; and

the important assumption for achieving the overall goal is set as

● E-waste collection, segregation and transportation system from households in Malaysia is institutionalized.

As for the latter assumption, as described in "Annex VIII. Factor Analysis for an EPR System based on the EPR Systems in Asian Countries", it can be proposed that any guideline which promotes systems with manufactures initiatives with the following principles is necessary.

● Primary responsibility should be taken by households who discard e-waste;
● Coordination on an intersectorial group meeting is one of the important roles of the governmental sector;
● Setting of target collection rates which are responsible by manufactures is a must; and
● Manufactures can participate in the e-waste collection voluntarily.

Under the enforcement of the guideline, it is advisable that local "E-waste Alam Alliance" meetings which played an important role in the Pilot Project are to be established. Also, the centralized alliance is necessary. This central alliance can coordinate the local alliance through discussions with the manufactures.

7. JOINT COORDINATION COMMITTEE MEETINGS

Joint Coordination Committee Meetings were held 4 times during the course of the project as follows.

- 1st Meeting on 3rd November 2011 at DOE Putrajaya
- 2nd Meeting on 31st May 2012 at MPPP Penang
- 3rd Meeting on 2nd November 2012 at DOE Putrajaya
- 4th Meeting on 4th February 2013 at DOE Putrajaya

Meeting Minutes are presented hereinafter.

MEETING MINUTES
1ST JOINT COORDINATING COMMITTEE MEETING
PROJECT FOR MODEL DEVELOPMENT FOR E-WASTE COLLECTION, SEGREGATION
AND TRANSPORTATION FROM HOUSEHOLDS FOR RECYCLING

Date : 03rd November 2011 (Thursday)
Time : 10:00 – 12:45
Venue : Level 2, DOE Putrajaya

ATTENDEES: As attached
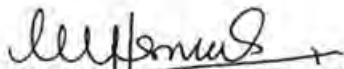
AGENDA DISCUSSED

No.	Item	Action
	Matters Discussed	
1.	The Chairperson informed that Ir. Lee Heng Keng, Deputy Director General (Operation) of DOE head office in Putrajaya has retired on 31st October 2011 and his successor is yet to be appointed.	Notification
2.	The Meeting was being informed that Datin Paduka Che Asmah Bt. Ibrahim has been appointed as the new Director of Hazardous Substances Division of DOE Putrajaya recently and she will also be the Project Director for this technical cooperation project.	Notification
3.	JICA Experts informed & made explanations on additional defination of the 'Task' used in the draft 'Inception Report' which was distributed in the 'Kick-Off Meeting' of the Project and seek confirmation for the 'Annual Work Plan'. The modifications as follows were discussed. 1) "DOE is responsibile to license e-waste recycling activities including partial and full recycling facility" is to be written replacing the last sentence of item b) on page 1. 2) "Other area or exported" in Fig. 3.2 is to be deleted.	Confirmation
4.	The meeting approved both the 'Draft Final Inception Report' and the 'Annual Work Plan' as the official one with some modifications mentioned in No.3.	Confirmation
5.	DOE Penang reported on the progress as well as the latest status of the Project in Penang. The details are as per attached reference materials.	Notification
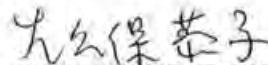
6.	JICA Experts introduced the 'Japanese E-Waste Recycling Laws' during the meeting and the information served as good references for further improvement of E-Waste Recycling Laws in Malaysia. Further discussions with DOE will be carried out with regard to the regulatory issues.	Introduction
7.	The meeting discussed about the 'Training in Japan' and agreed that it will be conducted from 18th February to 03rd March, 2012. It was also agreed that a total maximum of 8 persons from DOE Putrajaya (3), DOE Penang (2) & MPPP(3) will participate in the 'Training in Japan' and the participants should be nominated by end of November 2011. The Team promised to provide the tentative program by 10th November, 2011.	DOE & MPPP
8.	The meeting discussed & agreed that the 2nd JCC Meeting will be held on the fourth week of May, 2012 in Penang.	Confirmation

Approved by

Datin Paduka Che Asmah Bt. Ibrahim
Chairperson / Director of Hazardous
Substances Division of DOE Putrajaya

Madam Kyoko OKUBO
Senior Representative
Japan International Cooperation Agency

MEETING MINUTES
2nd JOINT COORDINATING COMMITTEE MEETING
PROJECT FOR MODEL DEVELOPMENT FOR E-WASTE COLLECTION, SEGREGATION
AND TRANSPORTATION FROM HOUSEHOLDS FOR RECYCLING

Date : 31st May 2012 (Thursday)
Time : 10:30 – 13:00
Venue : Bilik Perdana Level 4, MPPP Office, Komtar, Penang

ATTENDEES: As attached

AGENDA DISCUSSED

No.	Item	Action
	Matters Discussed	
1	The meeting was being informed that Dr. Zulkifli Abdul Rahman has been appointed as the new Deputy Director General (Operation) of DOE head office in Putrajaya. He will be the Chairperson of the Joint Coordinating Committee of this technical cooperation project.	Notification
2	JICA Experts explained the draft progress report (1) and it is endorsed by the meeting.	Confirmation
3	JICA Experts presented the draft Pilot Project Plan and the meeting accepted the Plan.	Confirmation
4	The meeting accepted the 'Annual Work Plan' as of May 31, 2012 with inclusion of item 5)-3.	Confirmation
5	DOE informed the meeting on the progress of data collection of the domestic supplies by e-products. DOE is having some difficulties in obtaining complete data required by the project team from Department of Statistics. DOE will continue to try to get the data.	DOE
6	DOE informed the progress of the official consultative meeting.	Confirmation
7	JICA Experts explained regarding participation from the potential some hypermarkets in the Pilot Project. DOE will try to approach to the head quarters of the hypermarkets for their participation.	DOE
8	The meeting discussed the framework of the "Training Tour in Japan for Full Recovery Facilities" and agreed that it will be conducted from 1st September to 8th September, 2012. It was also agreed that the number of the participants will be 10 persons in which 9 persons from the full recovery facilities and one person from DOE Penang. Participants should be nominated by the end of June, 2012.	DOE
9	The meeting agreed that the 3rd JCC Meeting will be held in early November, 2012.	Confirmation

Approved by

....

Dr. Zulkifli Abdul Rahman
Deputy Director General (Operation)
DOE Putrajaya

....

Mr. Masayuki Hayashi
Representative
Japan International Cooperation Agency

MEETING MINUTES
3rd JOINT COORDINATING COMMITTEE MEETING
PROJECT FOR MODEL DEVELOPMENT FOR E-WASTE COLLECTION, SEGREGATION
AND TRANSPORTATION FROM HOUSEHOLDS FOR RECYCLING

Date : 2nd November 2012 (Friday)
Time : 9:00 – 11:30
Venue : DOE Putrajaya

ATTENDEES: As attached

AGENDA DISCUSSED

No.	Item	Action
	Matters Discussed	
1	JICA Experts presented the draft progress report (2) and the progress of the Pilot Project to the meeting.	Confirmation
2	JICA Experts presented a "draft of SOP" for e-waste collection system for further consideration on roles of DOE and MPPP for the future formation of the Pilot Project. In principle, DOE and MPPP agreed to cooperate with each other for continuing and expanding the Pilot Project System.	DOE, DOE Penang and MPPP
3	The meeting confirmed the necessity to develop the future expansion plan for the Pilot Project. DOE, DOE Penang and MPPP will propose the expansion plan in the next JCC Meeting.	DOE, DOE Penang and MPPP
4	JICA Experts explained the possible regulatory options for promoting e-waste collection for further discussion.	Confirmation
5	The meeting accepted the 'Annual Work Plan' as of Nov. 2, 2012.	Confirmation
6	DOE informed the meeting that three consultative meetings were held with the home appliances group on 26th March, 4th July and 9th October, 2012. Two consultative meetings were held with the personal computer groups on 26th March and 15th August, 2012. Both groups have agreed to submit their proposals to DOE by the end of November, 2012.	Confirmation
7	DOE proposed the wrap-up workshop and the 4th JCC to be held in early February, 2013 and JICA will confirm the date later.	JICA
8	JICA informed the meeting that terminal evaluation of the Project will be conducted before the Project ends. The actual date will be confirmed later.	Notification

Approved by

....
Dr. Zulkifli Abdul Rahman
Deputy Director General (Operation)
DOE Putrajaya

....
Mr. Masayuki Hayashi
Representative
Japan International Cooperation Agency

MINUTES OF MEETING
ON
THE 4TH JOINT COORDINATING COMMITTEE
FOR
PROJECT FOR MODEL DEVELOPMENT FOR E-WASTE
COLLECTION,SEGREGATION AND TRANSPORTATION FROM HOUSEHOLDS FOR
RECYCLING

In line with the Minutes of Meetings signed between the Government of the Malaysia and the Japan International Cooperation Agency (hereinafter referred to as "JICA") on July 15, 2011, the fourth Joint Coordinating Committee (hereinafter referred to as "JCC") meeting was held in Putrajaya on February 4, 2013.
As a result of the discussions, the Meeting agreed to summarize the matters referred to in the document attached hereto.

Putrajaya, February 4th, 2013

....
Dr. Zulkifli Abdul Rahman
Deputy Director General (Operation)
Department Of Environment
Ministry of Natural Resource and Environment

....
Mr. Hideo Noda
Director
Environmental Management Division 1,
Global Environment Department,
Japan International Cooperation Agency

1. Opening Remarks
   Meeting started at 10:00 by the Opening Remarks from Dr. Zulkifli Abdul Rahman and self introduction of each participant. List of participant is shown in Annex I.

2. Discussion on the progress and wrap up of the Project
   Mr. Hideki Wada, JICA Expert Team presented the summary of the draft final report. The Meeting accepted the report in principle. The members of the JCC were given two weeks for reviewing the draft final report and further comments would be submitted to DOE by February 18th.

3. Roles and responsibilities of each stakeholder for continuing the Pilot project in Penang
   Mr. Mubarak Junus, MPPP presented the plan to continue the Pilot project after Project completion in March. The Roles and responsibilities of each stakeholder are as follows.

   (1) Taskforce
   The taskforce composed of DOE Penang and MPPP shall annually propose a draft e-waste collection plan which contains the following items and conduct the midterm review in the first year in October, 2013.
   - Objective of the e-waste collection system
   - Target number of the participating e-waste collection members
   - Target number of the participating e-waste voucher members
   - Target cooperation rates
   - Necessary supporting measures to the participating local businesses
   - Possible public relation measures
   - Organization structure with persons in charge and their mandates

   (2) DOE Penang
   - To consult with the full recovery facility for proposing the classification system for the target e-waste and the prices of vouchers as necessary
   - To educate the participating local businesses by providing the importance of the e-waste collection
   - To collect the data regarding the e-waste collection system from the full recovery companies and analyzes them to know the cooperation rates
   - To consider an award program
   - To monitor the performance of the full recovery companies and take necessary measures if there are any problems

   (3) MPPP
   - To promote the e-products retailers to participate in the e-waste collection system
   - To promote the general shops to participate in the e-waste collection system as e-waste voucher members

- To visit the participating e-waste collection members in a predetermined frequency and take necessary measures so as to secure their performance for attaining the cooperation rate target
- To visit the participating e-waste voucher members preodically and take necessary measures so as to secure their appropriate procedure
- To conduct the studies on the e-waste prices in the conventional recyclers in a predetermined frequency and report to DOE Penang
- To take possible measures for advertising the e-waste collection system, including the management of Facebook page: "https://www.facebook.com/ewaste.Penang"

4. Future continuation of the Pilot project
   Mr. Mubarak Junus confirmed the future continuation of the Pilot Project in Penang Island by taking into consideration of the following factors.
   - Target number of the participants
   - Community based e-waste collection system

5. Future policy for the nationwide e-waste collection system
   Datin Paduka Che Asmah Ibrahim informed the Meeting that coordination with related governmental agencies is necessary for further discussions on the road map on household e-waste management in Malaysia as a follow-up to the project.

6. Final Remarks
   Mr. Hideo Noda, Director of Environmental Management Division 1, Global Environment Department, JICA extended sicere gratitudes to all the Project members, especially at the occasion of the final JCC of the Project, for their supports and efforts leading to the success of the Project which cannot be achieved without active participation of Malaysian government, the good coordination of the private sector, and the huge contribution of JICA Expert team. JICA hopes that it would be a role model for the e-waste recyling in the South East Asian region in the near future.

7. Others
   Dr. Zulkifli Abdul Rahman expressed his appreciation on behalf of the Meeting to JICA for the cooperation and successful implementation of the project. Necessary measures based on EPR concept in consultation with manufactures would be considered. DOE welcomes JICA's further support in the future.
   JICA responded that under this transition stage, it is recommended that further assistance be requested if necessary after internal coordination meeting within the Malaysian agencies on the way forward, which was agreed by the Meeting.

Annex I

Current Situation of Waste Management

Contents

Abbreviations

3Rs	Reduce, Reuse, Recycle
CFCs	Chlorofluorocarbons
DOE	Department of Environment
e-waste	Electrical and Electronic Equipment Waste
GRDP	Gross Regional Domestic Product
JICA	Japan International Cooperation Agency
MHLG	Ministry of Housing and Local Government
MONRE	Ministry of Natural Resources and Environment
MPPP	Majlis Perbandaran Pulau Pinang (Municipal Council of Penang Island)
MPSP	Majlis Perbandaran Seberang Prai (Municipal Council of Seberang Prai)
NSWMD	National Solid Waste Management Department, MHLG
PPSPPA	Perbadanan Pengurusan Sisa Pepejal dan Pembembersihan Awam (Solid Waste Management and Public Cleansing Corporation)
SW	Scheduled Waste
SWM	Solid Waste Management
T/S	Transfer Station

1. POLICIES IN THE CENTRAL GOVERNMENTS

1.1 TENTH MALAYSIA PLAN 2011-2015

"Tenth Malaysia Plan 2011-2015" provides the following items regarding solid waste management. Among them, the last one related to take back systems is paid attention as one of the background of this project.

- Transference of the responsibility on SWM from the local government to the federal governments (federalization)
- Full enforcement of "Solid Waste Management Act 2007"
- Expansion of waste collection are by year 2015 to 3.7 million households
- Closure or rehabilitation of 112 unsanitary disposal sites by year 2015
- Introduction of waste collection with segregation for households
- Achievement of the recycling target of 25% from households by year 2015
- Improvement in waste collection frequency
- Introduction of door-to-door collection by using 120 liter containers
- Promotion of construction of transfer station, sanitary landfill, material recovery facilities (MRF)
- Improvement of SWM system by participating from manufactures in promotion of 3Rs and development of take back systems

1.2 RELATED MINISTRIES

The related Ministries to SWM are 1) Department of Environment (DOE), Ministry of Natural Resources and Environment (MONRE) and 2) National Solid Waste Management Department (NSWMD), Ministry of Housing and Local Government (MHLG).

(1) DOE

DOE is responsible for "Scheduled Waste" (SW) including e-waste and licensing to SWM/recycling facilities regarding Scheduled Wastes. DOE mainly regulates the industrial sector which discards SWs, however wastes classified as a SW are responsible by DOE even if it was discarded by a household, where SWs are specified by the types of wastes, not by the types of generations.

(2) NSWMD

NSWMD is responsible to wastes other than SWs, especially municipal waste from households and commercial entities.

1.3 LAWS/REGULATIONS

(1) Environmental Quality Act 1974

This is the basic law for environmental conservation including solid waste management. This law has the regulations, rules and orders. Scheduled Wastes are provided the regulation under this law.

(2) Environmental Quality (Scheduled Waste) Regulation (P.U.(A)294/2005)

In 2005, the regulation under Environmental Quality Act was enacted and e-wastes were added in the list of Scheduled Waste with the code of SW110.

(3) Solid Waste and Public Cleansing Management Act 2007

This law targets the waste other than Schedule Waste. The major contents are 1) the management body, 2) licensing to SWM facilities and 3) disposal fees. Among the provisions, the highlight is the provision of a "Corporation" which is to cooperate in developing policies and implementing the policies. The major present mission of the Corporation is to control the concessionaires for collection of municipal solid waste.

So far, eight states accepted the Act out of eleven states and two federal territories in the Malay Peninsula. Remaining five states including State of Penang have not accepted.

1.4 ORGANIZATION

(1) DOE

"Hazardous Substance Division" under "Deputy Director General (Operation)" is responsible for the control of Scheduled Wastes, as shown in Figure 1-1.

DOE has 15 state offices. One of them is the state office of Penang, whose organization is shown in Figure 1-2. "Scheduled Waste Unit" is responsible for the Scheduled Waste. The number of staff of the unit is five. The mandates of the unit are

- To process license of the schedule waste recovery/recycling facilities,
- To audit these recovery/recycling facilities,
- To take legal action if there is any incompliances arise,
- To enter data inventory of schedule waste, and
- To investigate illegal dumping of schedule waste case.
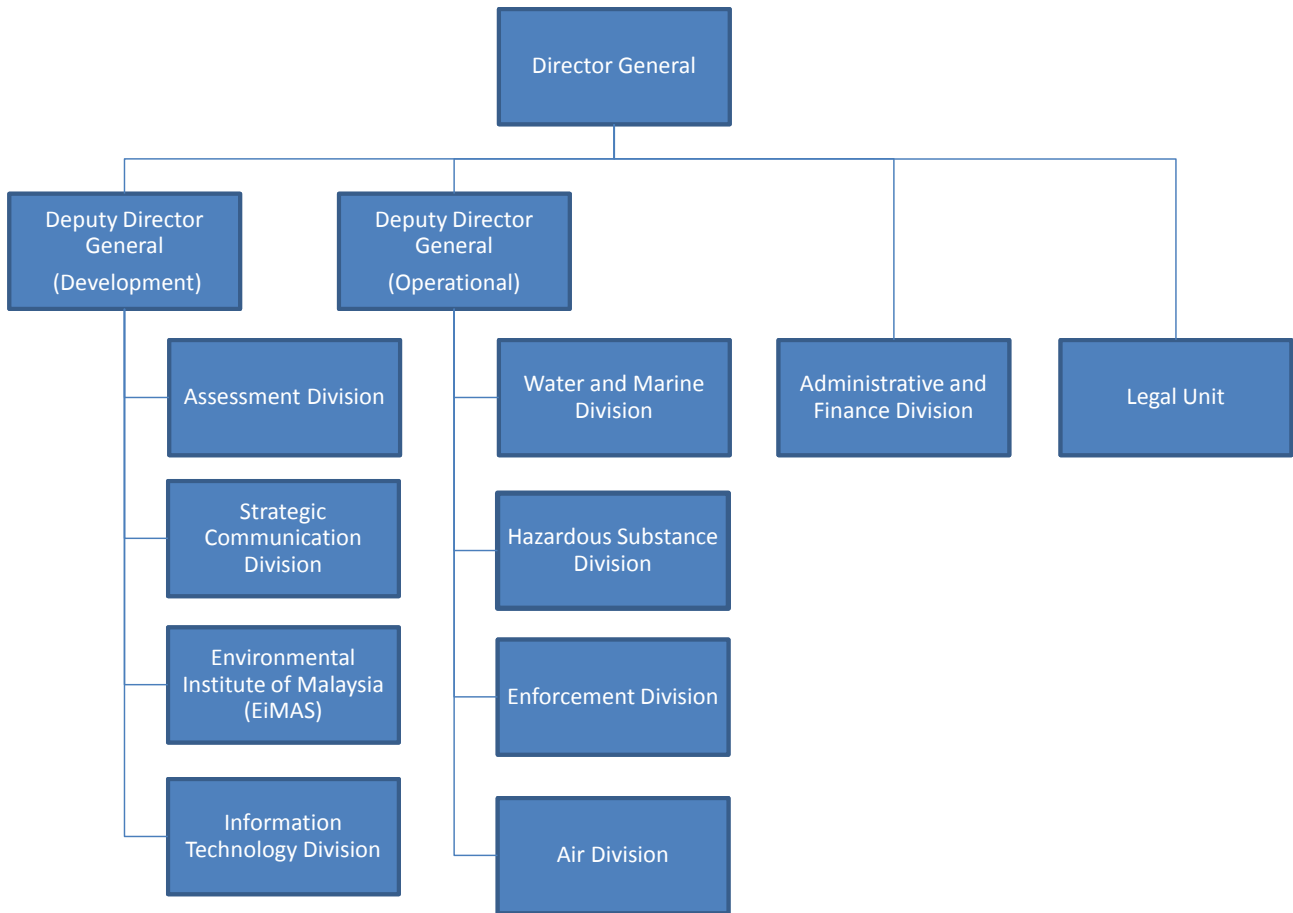
Figure 1-1. Organization chart of Department of Environment

Source: Website of Department of Environment (http://www.doe.gov.my/portal/jabatan/carta-organisasi/)(available as of 31 Mar. 2012)
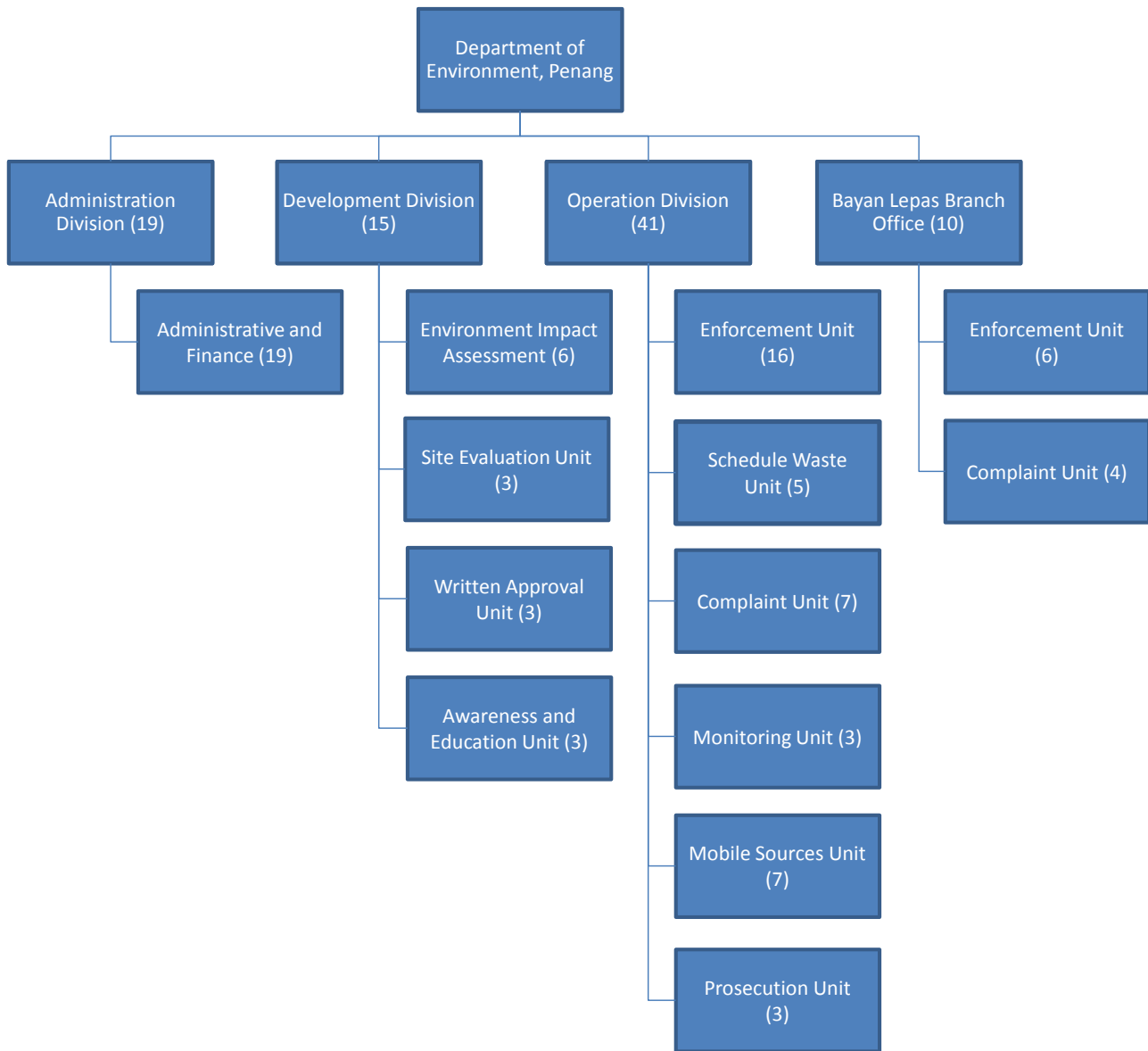
Figure 1-2. Organization chart of the state office of DOE Penang

Source: DOE Penang

Table 1-1. Mandates of the state office of DOE Penang

Division	Unit	Mandate
Administration Division	Administrative and Finance	- To order and make payment to the contractor, who provide the new furniture, cleaning service and drinking water - To make sure all DOE Penang staff have basic amenities - To provide service of cleaning ICT equipment - To make payment that claims by DOE Officer - To administer the files in the files room - To manage storage area of valuable assets - To take care of the department vehicles - To manage personnel data of DOE staff
Development Division	Environment Impact Assessment	- To empower the Minister of Natural Resources and Environment after due consultation - To prescribe any activity which may have significant environmental impact as a prescribed activity - The Project Proponent of a Prescribed Activity has to submit a report (the EIA) to the Director General of Environmental Quality before approval for the proposed activity is granted by the relevant approving authority - The EIA report must be in accordance with the guidelines issued by the DOE contain an assessment of the impact of the Prescribed Activity on the environment and detail the

Division	Unit	Mandate
		proposed measures that shall be instituted to prevent, reduce or control adverse impacts on the environment. DOE have to evaluate and approve the EIA report first, before any development can initiate
	Site Evaluation Unit	- The criteria for selecting a new site normally include engineering, environmental and economic aspects - To investigate the suitability through site visits and analysis of existing information - Measures to protect the environment and resolve socio economic issues - DOE have to evaluate and approve the propose site first, before any development can be build
	Written Approval Unit	- Any premises that want to install new chimneys, fuel burning equipment and/or any outlet that can discharge air impurities into the air and/or discharge industrial effluent have to submit their proposal for DOE to evaluate the efficiency of the air pollution control equipment or waste water treatment plan. - To get DOE approval first before they can install air pollution control equipment and/or waste treatment plan.
	Awareness and Education Unit	- To expose the public on the importance of environmental awareness - To develop positive and responsible attitude and instill love to the environment and appreciate the beauty of nature - To develop attitude and cooperation among public in environmental conservation and sustainability - To enable the public to enjoy recreational activities on the environment
Operation Division	Enforcement Unit	- To ensure all industries or premises comply with Environmental Quality Act 1974 - To observe any black smoke emit from chimney and do the classification base on ringlet matt chart, finally take legal action if it is very bad to the environment or issuing notice to the premises to take remedial action - To investigate immediately if there any complaint by the media or public to specific factory that polluted the environment
	Schedule Waste Unit	- To process license of the schedule waste recovery/recycling facilities annually - To audit these recovery/recycling facilities so that they follow the license conditions and EQA 1974 - To take legal action if there is any incompliances arise - To enter data inventory of schedule waste generated by each factories in Penang and data of SW transported to recycling/recovery facilities - To investigate illegal dumping of schedule waste case
	Complaint Unit	- To investigate complaint that receive from media, public, VIP and other agencies related to the pollution of the environment in 24 hours - To take action against polluter within 7 days and report to DOE headquarters immediately - To monitor any open burning case by vehicle or air surveillance during haze period or air pollution index exceeding 100 - To investigate oil spill occurrence within Malaysian water and exclusive economic zone
	Monitoring Unit	- To establish baselines and detect water quality changes in river water and groundwater quality - To identifying of pollution sources - Monitoring programme of marine water quality involves in-situ measurements of parameters such as temperature, pH, dissolved oxygen, conductivity, salinity, turbidity and tar balls, and laboratory analyses of parameters such as Escherichia coli, oil and grease, total suspended solids, arsenic, cadmium, copper, lead and mercury - To assist in the management of the recreational waters and marine ecosystem
	Mobile Sources Unit	- To measure smoke density emit from diesel vehicle - To measure gaseous pollutant emit from petrol vehicle - To measure noise generated by motorcycle - To take legal action if any incompliance detected
	Prosecution Unit	- To check all investigation paper prepare by other DOE officer - To go to the court and prosecute the person who polluted the environment - To manage evidence collected from the investigation site
Bayan Lepas Branch Office	Enforcement Unit	- To ensure all industries or premises comply with Environmental Quality Act 1974 - To observe any black smoke emit from chimney and do the classification base on ringlet matt chart, finally take legal action if it is very bad to the environment or issuing notice to the premises to take remedial action - To investigate immediately if there any complaint by the media or public to specific factory that polluted the environment
	Complaint Unit	- To investigate complaint that receive from media, public, VIP and other agencies related to the pollution of the environment in 24 hours - To take action against polluter within 7 days and report to DOE headquarters immediately - To monitor any open burning case by vehicle or air surveillance during haze period or air pollution index exceeding 100

Division	Unit	Mandate
		- To investigate oil spill occurrence within Malaysian water and exclusive economic zone

Source: DOE Penang

(2) NSWMD

a) **Organization structure**

Ministry of Housing and Local Government (MHLG) has six departments and three related organizations at the department level.

One of the departments is NSWMD which is responsible for municipal solid waste management.

One new organization at the department level is "Solid Waste and Public Cleansing Management Corporation" which is mainly responsible for concessionaires for municipal waste collection services. The name of the corporation is "Solid Waste Management and Public Cleansing Corporation" (Perbadanan Pengurusan Sisa Pepejal dan Pembembersihan Awam) (PPSPPA).

b) **Solid Waste Management and Public Cleansing Corporation (PPSPPA)[1]**

PPSPPA was established in 2008 based on "Solid Waste and Public Cleansing Management Act 2007". The organization structure is shown in the following figure.

PPSPPA is preparing its offices in States. So far, eleven states including the federal territories have already the offices. Three states out of eleven states are the ones which will accept the Law soon. The State of Penang has not accepted the Law yet, so the office has not established.

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[1] Source: JICA Malaysia Office: Report (draft) on the study on the recent solid waste management policies (2012)

Figure 1-3. Organization structure of　Solid Waste Management and Public Cleansing Corporation (PPSPPA)
Source: Website of MHLG (http://www.kpkt.gov.my/carta/chart.html)(available on 31 Mar. 2012)

1.5　RECENT POLICIES

(1)　DOE

a)　Introduction of control of e-waste

As already mentioned above, "Environmental Quality (Scheduled Wastes) Regulation (P.U.(A)294/2005)" added e-waste in the list of Scheduled Wastes. The definition of e-wastes is:

● SW110: Waste from electrical and electronic assemblies containing components such as accumulators, mercury-switches, glass from cathode-ray tubes and other activated glass or polychlorinated biphenyl-capacitors, or contaminated with cadmium, mercury, lead, nickel, chromium, copper, lithium, silver, manganese or polychlorinated biphenyl.

b) Recycling facility for e-waste

Since year 2005, DOE licensed 133 partial recovery facilities and 21 full recovery facilities.[2] However, the technical standards among the facilities vary. It is recognized that the technical standards regarding partial/full recovery facilities have to be improved.

Also, the facilities have to be equipped with the equipment for e-waste recycling from households such as lead contained glass cutter and CFCs recovery facilities, while the facilities are functioned for industrial e-wastes.

Table 1-2. Number of partial/full recovery facilities for e-waste in Malaysia (as of 31 Mar. 2012)

State	Partial recovery facility	Full recovery facility	Total
Total	133	21	158
Pulau Pinang	38	7	46
Johor	15	4	19
Kedah	16	1	16
Melaka	14	3	17
Negeri Sembilan	5	2	11
Perak	5	0	5
Sarawak	7	0	7
Selangor	25	4	29
W.P. Kuala Lumpur	8	0	8

Source: List of scheduled waste contractors in Malaysia (Website of DOE)
http://www.doe.gov.my/portal/hazardous-substances-2/hazardous-substances-list-of-contractor/senarai-kontraktor-pembuangan-berjadual-malaysia-2011-2012/attachment/b1-7/ (available on 31 Mar. 2011)

(2) MHLG

As already mentioned, MHLG is now enforcing Solid Waste and Public Cleansing Management Act 2007 by establishing the state office of PPSPA for federalizing solid waste management. At the same time, MHLG is being introducing what is called as "Two plus One" collection system. In this system, two days will be assigned for organic waste collection and one day for recyclables. Also, distribution of certain size of container for door-to-door collection has been started in some states.

It is a problem if models to be developed in Penang Island could not be a model for other states, because the situations in Penang Island could be different from other states due to the un-acceptance with the Act. According to the discussion with MPPP directors and officials, models developed in Penang Island could be used in other areas, because the waste collection system in Penang Island is rather advanced than other areas which are catching up to the Penang Island standard.

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[2] According to DOE Penang, there is another full recovery facilities newly licensed. So the total number of full recovery facilities in Penang Island is eight.

2. MUNICIPAL SOLID WASTE MANAGEMENT SYSTEM IN PENANG ISLAND

2.1 POPULATION, NUMBER OF HOUSEHOLDS AND RGDP IN PENANG ISLAND

(1) Population

Table below shows population data in Penang Island, Penang State and Whole Malaysia.

Table 2-1. Population

Year	Penang Island	Penang State	Whole Malaysia
1991	518,478	1,064,166	17,563,420
2000	575,498	1,231,209	22,198,276
2010	704,376	1,520,143	27,565,821

Source: Department of Statistics, Preliminary Country Report 2010

(2) Households

Table below shows Number of Households in Penang Island, Penang State and Whole Malaysia.

Table 2-2. Number of Households

Year	Penang Island	Penang State	Whole Malaysia
1991	104,359	212,663	3,566,859
2000	137,272	280,903	4,801,835
2010	189,829	385,658	6,396,174

Source: Department of Statistics, Preliminary Country Report 2010

(3) Gross regional domestic product

Table below shows Gross Regional Domestic Product (GRDP) of Penang State and Gross Domestic Product of the country. The GRDP per capita can be calculated as 31,000 in Penang State and 20,000 in Malaysia.

Table 2-3. Regional Gross Domestic Product

Unit: Million RM

Year	Penang State	Whole Malaysia
1990	-	119,081
1991	-	135,124
1992	-	150,682
1993	-	172,194

Year	Penang State	Whole Malaysia
1994	-	195,461
1995	-	222,473
1996	-	-
1997	-	281,795
1998	-	-
1999	-	-
2000	-	343,215
2001	-	334,404
2002	-	362,012
2003	-	398,017
2004	-	449,609
2005	37,780	449,251
2006	41,721	475,525
2007	44,695	506,342
2008	47,307	530,684
2009	42,217	522,001
2010	46,455	559,554

Source: Department of Statistics, GDP by State 2010

2.2 MUNICIPAL SOLID WASTE MANAGEMENT SYSTEM

(1) Overall view of municipal solid waste management in Penang Island

In 2010, approximately 249,000 ton of waste was collected in Penang Island. The amount includes both ordinal municipal waste (approx. 220,000 ton) and construction waste (approx. 28,000 ton). The amount of waste 220,000 corresponds to 856 gram per capita per day.

Technical flow of the ordinal municipal solid waste consists of collection, transfer, transport and final disposal. Collection is conducted by 7 contractors and MPPP. Waste collected is carried to Ampang Jajar Transfer Station (T/S) located in the mainland. After the reloading at the T/S, waste is transported to Pulau Burung Landfill which receives municipal waste from MPPP and MPSP.

The construction waste is mainly transported by construction companies' vehicles to Jelutong Landfill located in the Island.

The following figure shows locations of the municipal solid waste management facilities mentioned above.
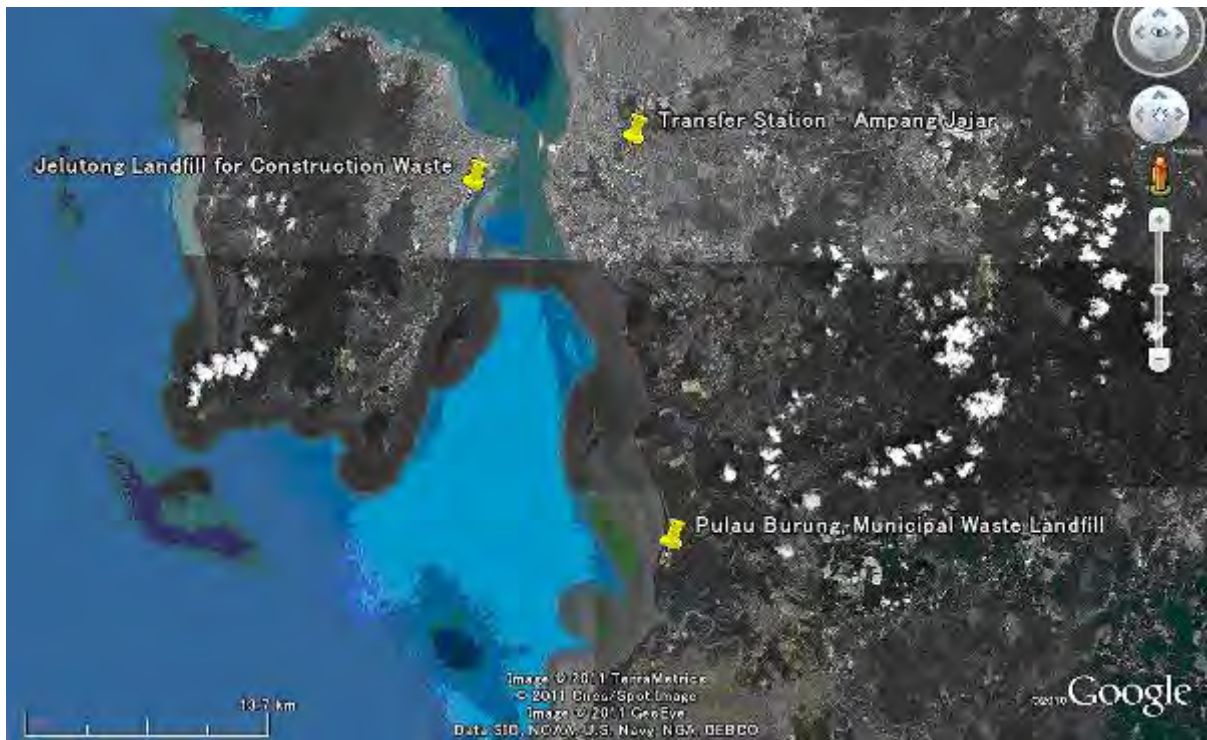
Figure 2-1. Location Map of Municipal Solid Waste Facilities

(2) Recycling

Various recycling activities are carried out by the public sector and the private sector. Waste bins for recyclable materials are seen at government offices, shopping centers, etc. Public awareness on recycling seems higher compared with other developing countries.

Systematic recycling, in other words separated collection system, has not yet been applied for households and commercial entities. MPPP provides two types of collection service. One is for regular waste such as kitchen waste, the other one is for bulky waste.

Recycling is carried out by waste collectors, building maintenance workers, etc. Recyclable materials are often found during the bulky waste collection service. Waste collectors collect and sell them to buyers. Building maintenance workers also find recyclable materials at waste storage. Then, they call buyers and sell the materials to buyers.

MPPP published "The Recycling Wheel of Penang - a directory of recycling communities, agents, and buyers in Penang," in 2005. The book provides information of stakeholders in recycling in Penang in order for them to know each other for facilitating recycling activities. The stakeholders are churches, NGOs, residents' associations, hospitals, schools and buyers.

(3) Collection/transportation

a) Zoning
Penang Island is divided into eight (8) zones in regard to the municipal solid waste collection service. There are eight (8) actors in the service, i.e., seven (7) contractors and MPPP itself. Each actor takes charge of one (1) zone.

b) Collection for regular waste
Since July 2011, the waste collection service is carried out at night. This is due to operation schedule of Ampang Jajar Transfer Station; it deals with waste from MPSP in the daytime and waste from MPPP in the nighttime.

Detached houses are served with regular waste collection service at three (3) days a week; apartments are six (6) days a week from Monday to Saturday; and commercials are every day.

MPPP has a system to correspond to residents' complaints about waste services. It is called "Complain Line" operated 24 hours a day.

c) Collection for bulky waste
Bulky waste collection service has started in 2007. This service targets waste from houses and commercials that are difficult to be collected by the regular service such as furniture, e-waste, etc. In addition to those waste, pruning waste is also collected by this service.

(4) Transfer and transport
Waste collected by the regular waste collection service is carried to Ampang Jajar Transfer Station that is located in the mainland. The current transfer and transport system has started in July 2011. Until that moment, waste was transported by barge to the mainland.

The T/S receives waste from MPSP during the day and from MPPP during the night. According to an operator of the T/S, it receives approximately 960 ton of waste per day; 380 ton/day from MPSP and 580 ton/day from MPPP.

Compaction method is applied to the T/S. One container after compaction can contain approximately 13 to 14 ton of waste. One trailer usually carries two containers, that is approx. 26 to 28 ton of waste, to Pulau Burung Landfill.

The T/S is operated by a private company which also operates the landfill.

Figure 2-2. Ampang Jajar Tranfer Station

(5) Landfill

a) **Pulau Burung Landfill (municipal solid waste)**

Municipal solid waste is disposed of in Pulau Burung Landfill that is located in Seberang Perai Selatan in the mainland, approximately 40 minutes away from Ampang Jajar Transfer Statoin.

The landfill operation commenced in February 2002. Phase I was closed in July 2007. As of October 2011, the operation is carried out at Phase II. It is said that the remaining life period is approximately 30 years.

Around 30 waste pickers were working at the site in October 2011 when the Task Force visited. Their target materials were plastics and aluminum. E-waste could not be seen at the site.

The land is owned by MPSP and the operation is carried out by the private company that operates the T/S.

Figure 2-3. Pulau Burung Landfill (municipal solid waste)

b) Jelutong Landfill (construction and bulky wastes)

Construction and bulky wastes are disposed of in Jelutong Landfill that is located in Penang Island and close to the Penang Bridge.

Around 10 waste-pickers were found in October 2011 when the Task Force visited. They dealt with woods, metals, etc. used for construction. No e-waste found at the site at that moment.

This landfill is operated by MPPP.

Figure 2-4. Jelutong Landfill (construction and bulky wastes)

3. E-WASTE RECYCLING IN PENANG ISLAND

3.1 OVERALL VIEW OF E-WASTE RECYCLING

The e-waste flow in Malaysia can be illustrated bellow.
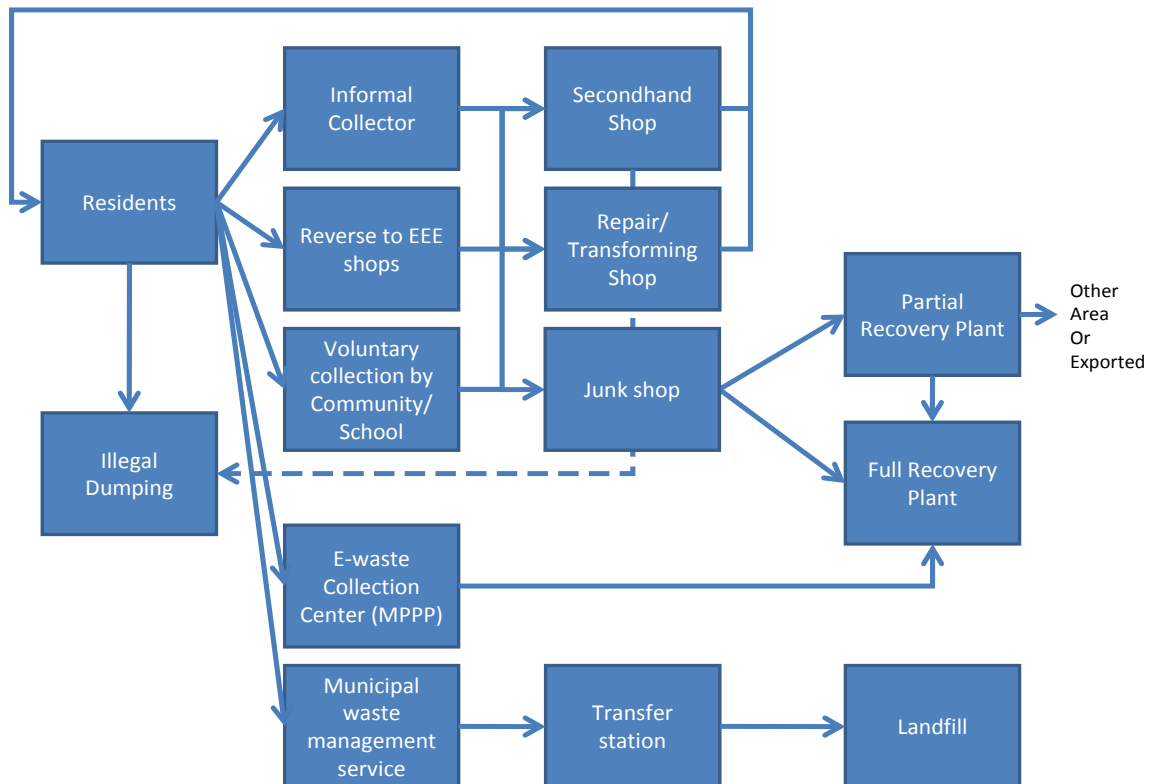
Figure 3-1. Prototype of e-waste flow

3.2 DISCHARGE/COLLECTION

There are several ways of discharging/collecting e-waste from households and commercials.

(1) Taking to recycling program

a) Computer recycling by MPPP

Computer Recycling Program has been conducted since 2005 by MPPP, DEL, Sunshine, PEWOG and IRM targeting computer and its peripheral device such as monitor, printer, etc. There are twelve collection centers. Citizens bring the target materials to the collection centers. Those can be converted into coupon ticket at a rate of RM 0.50/kg. The coupon can be used at Sunshine shopping centers.

Figure 3-2. Computer recycling program by MPPP, DELL, Sunshine, IRM and PEWOG

b) Computer recycling by Penang State

Another recycling program targeting e-waste regarding information and communication such as PC, mobile phone, etc. was found at a shopping center "Prangin Mall" where many ICT shops do their business. Citizens by themselves brought their e-waste to the program.

According to counterpart personnel, this program was initiated by the Penang State Government.

Figure 3-3. E-waste recycling program at Prangin Mall

(2) Taking to small recyclers

There are several small recyclers in the city. Citizens by themselves, recyclable material collectors and others bring their e-waste to those recyclers.

One small recycler told the Task Force that he receives e-waste from hotel/building maintenance companies. When hotels/offices replace old electric appliances with new ones, old ones become e-wastes. Then, those maintenance companies often take them to the small recyclers. Some of same type refrigerators from a hotel were found at his place, when the

Taskforce visited him

Other small recycler received newspapers from a citizen, when the Task Force visited. The recycler also receives e-waste. According to the recycler, small e-waste such as CD player, DVD recorder, etc., are not repaired due to their little economic values. However, there are people who buy such small e-waste for repair and reuse. They are usually foreigners who come to work for construction and other labor-intensive businesses.

Figure 3-4. Small recycler

(3) Taking to repair shops

Repair shops are one of destination of e-waste from households and commercials, however only a little amount of e-waste seems to go there. The repair shop to which the Task Force visited is licensed by large manufactures such as SHARP, SANYO, PHILIPS, etc. The shop chiefly repairs their appliances under warranty. According to the repair shop, repair work is not economically feasible due to high labor cost. People prefer buying new one to repairing one out of warranty these days.

Figure 3-5. Repair shop

(4) Trade-in

It seems common for people in Penang to ask for trade-in when buying new one. A retailer that deals with home appliances such as refrigerators, air-conditioners, washing machines, etc. told the Task Force that approximately 60 % of customers ask trade-in. However, most of appliances traded in are not repaired by scrapped.

Figure 3-6. Traded in appliances at a retail shop

(5) Discharging as bulky waste

MPPP provides bulky waste collection service. Penang people often discard e-waste as bulky waste. Waste collectors take the e-waste to recyclers.

According to a person who maintains a waste storage of apartment, he calls recycler when he found recyclable materials such as paper, cardboard, e-waste, etc. Then, he sells the materials to the recycler.

(6) Discharging as regular waste

Small size appliances may be discarded as regular waste. However, amount of such discarded appliances seems to be small, as the recycling market of e-waste is active in Penang.

3.3 SECONDHAND SHOP/JUNKSHOP

Many street stalls are in business in an area next to City Stadium. Some of stalls sell second hand audio apparatus, second hand mobile phones, etc.

Figure 3-7. Secondhand shop and Junkshop

3.4 LARGE RECYCLER/MIDDLEMAN

There seem to be a certain number of large recycler/middlemen according to interviews from the small recycler, the retailer, licensed recovery facility, etc. They buy recyclables from the small recycler and/or others, then, sell them to the licensed recovery facilities and/or others. Parts after dismantling have much value than products before dismantling.

The Task Force visited some of large recyclers. One of them chiefly targets ferrous metal. Other largely deals with plastics. In addition to those materials, some of e-wastes were present at their stock yards.

Figure 3-8. Large recycler

3.5 LICENSED RECOVERY FACILITIES

Recovery facilities licensed by DOE are important actors in realizing appropriate e-waste recycling. The Task Force visited two full recovery facilities and one partial recovery facility in October 2011. Those are located in Bukit Minyak Industrial Park in mainland. Their

customers are largely manufacturing companies. They deal with recyclable materials generated from production processes of those companies.

Although e-waste generated from households and commercials are very little for them, they showed their interest in being involved in recycling of such e-waste. One of them, Reclaimtek, is actually involved in the Computer Recycling Program as a member of IRM Group. Other one, Ming Engineering Plastic, mentioned that they participate in an e-waste recycling program in other state from a view point of corporate social responsibility, CSR.
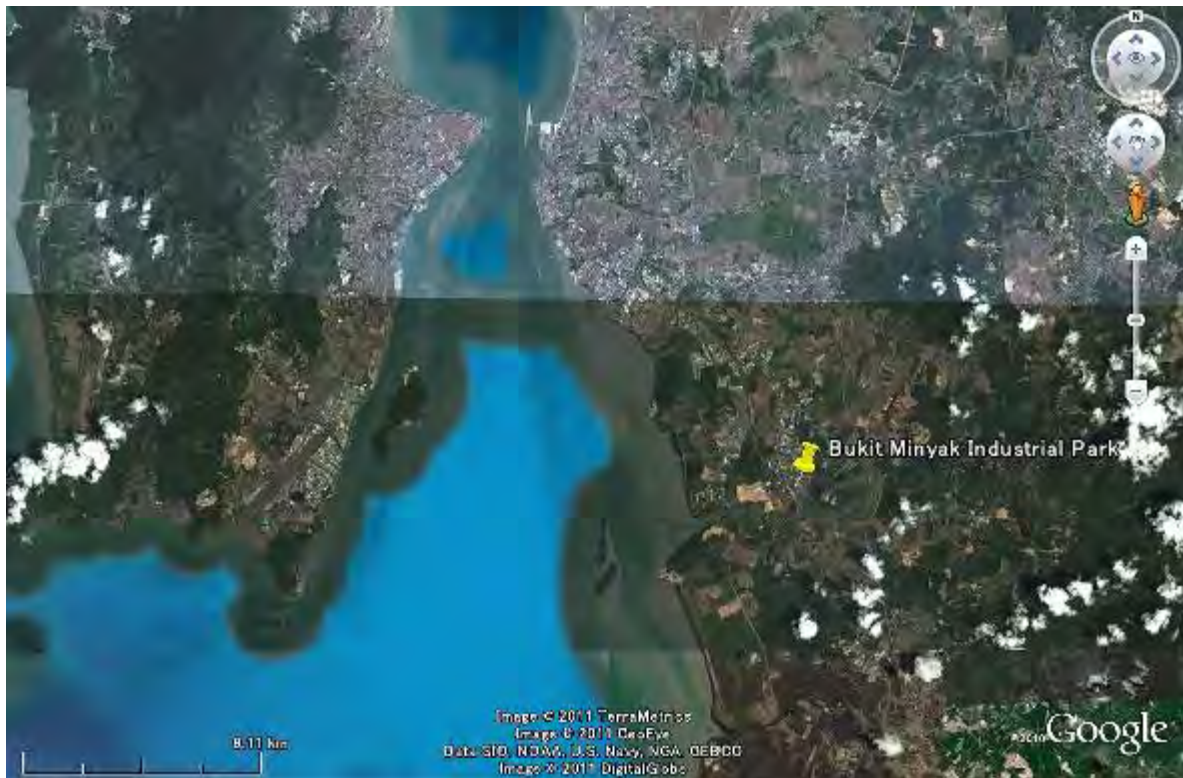
Figure 3-9. Location of Bukit Minyak Industrial Park

Annex II

E-waste flow analysis

Contents

Abbreviations

CRT	Cathode Ray Tube
DOE	Department of Environment
DOS	Department of Statistics
EEE	Electrical and Electronic Equipment
e-waste	Electrical and Electronic Equipment Waste
GDP	Gross Domestic Products
IT	Information Technology
JICA	Japan International Cooperation Agency
LCD	Liquid Crystal Display
MFA	Material Flow Analysis
MPPP	Majlis Perbandaran Pulau Pinang (Municipal Council of Penang Island)
PC	Personal Computer
PCB	Print Circuit Board
SFA	Substance Flow Analysis
TV	Television

1. PRECONDITIONS AND BASIC PROCEDURE

1.1 PRECONDITIONS FOR THE ESTIMATION OF DISCARDED E-WASTE

(1) Target e-wastes

In this study, the following six items were targeted by considering the dominancy, hazardousness, precious metals concentration and other factors shown in the inception report.

- Television set (CRT and non-CRT)
- Refrigerator
- Washing machine
- Air-conditioner
- Personal computer (desktop with CRT, desktop with non-CRT and laptop)
- Mobile phone

(2) Study year

- As of 2011

(3) Estimation duration

- From year 2005 to up to 2025

  For calculating these data between the year 2005 to 2025, data as much as possible were considered. The data since 1990 were used for the calculation.

1.2 PROCEDURE TO ESTIMATE THE AMOUNT OF E-WASTE AND E-WASTE FLOW MODEL

(1) Basic procedure to estimate the amount of e-waste

The amount of discarded e-waste is estimated based on the domestic supply of e-waste in each year. In this project, the data were collected from year 1990 up to the present, considering that the data duration should be longer enough than the average ages of e-waste.

The amount of e-waste can be calculated by considering the domestic supplies and the discarding distributions. The discarding distributions can be defined by the average ages of e-waste as the parameters. The number of discarded e-waste can be converted to weight by using the weight of each EEE.

The weight of e-waste is divided into two parts: one is e-waste returned to the consumers after repaired, and another one is e-waste from which materials are recovered in the downstream of the e-waste stream.
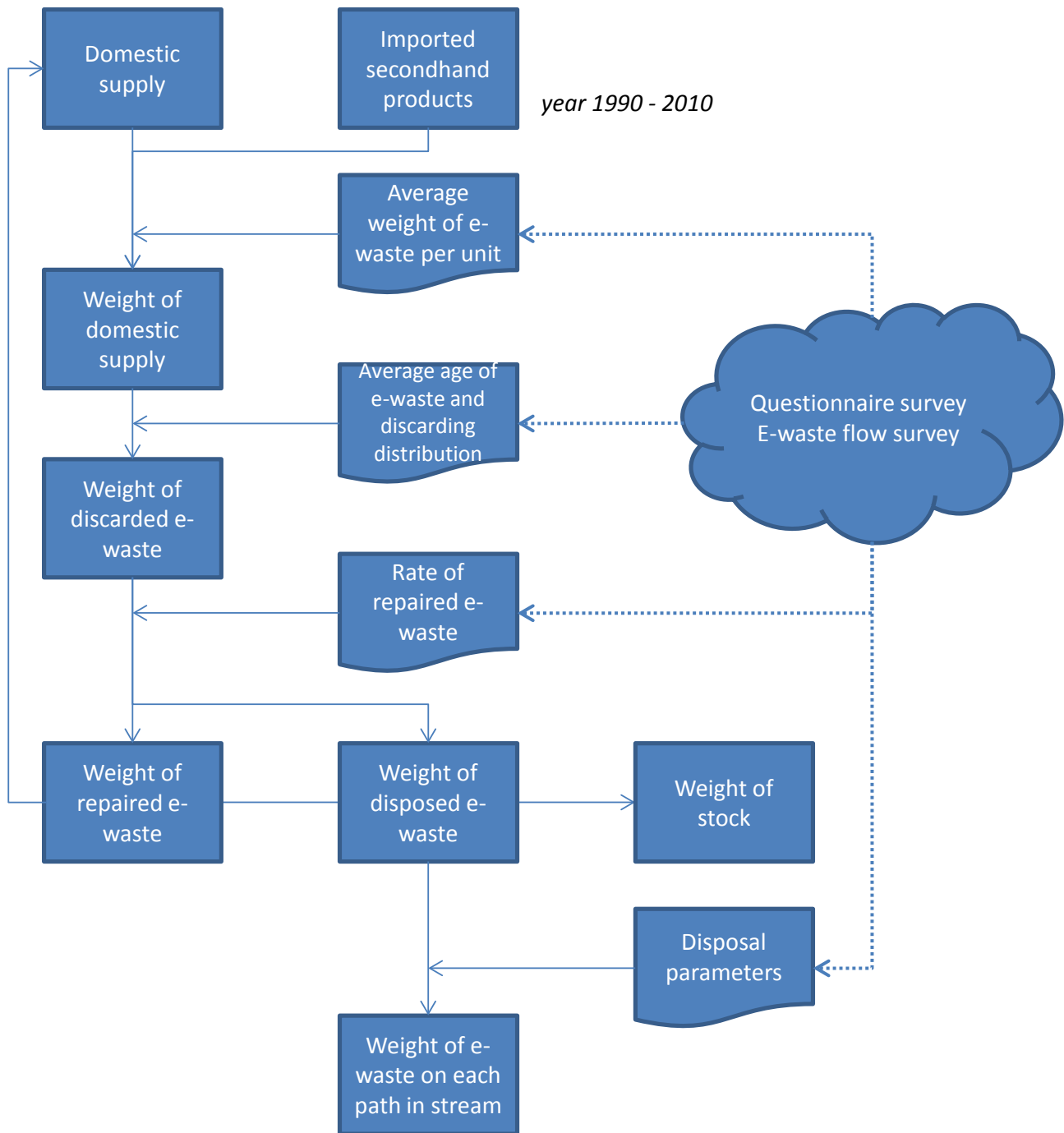
Figure 1-1. Procedure to estimate the amount of e-waste

(2) E-waste flow model

The calculated amounts of e-waste every year will be inputted to e-waste flow model shown in Figure 1-2.

Based on our survey, the generated e-wastes are sent to 1) full recovery recyclers, 2) various recyclers and 3) scrap dealers, where the path 2) is the major one. The amounts of e-waste on these three paths are given by the parameters: *p1*, *p2* and *p3*.

The various recyclers include the repair shops which repair e-wastes and sell to the customers.

The rate of repaired e-waste is given as the parameter *r*.

The parameters *q1* and *q2* show the rates sent from various recyclers to full recovery recyclers and scrap dealers respectively.
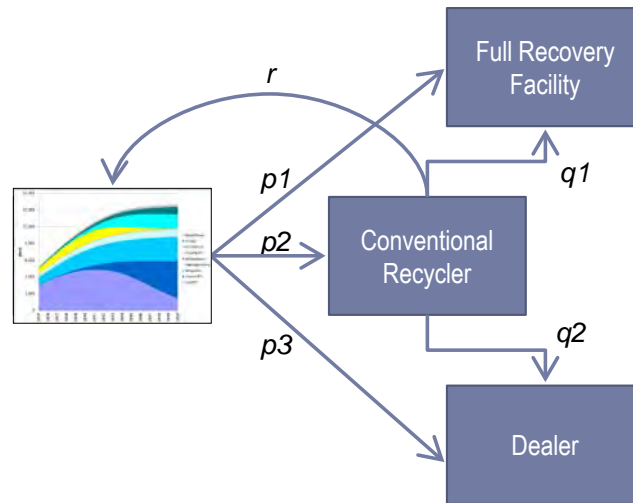
Conventional recyclers' Switching Model

Figure 1-2. E-waste flow model for policy evaluation

2. ESTIMATION ACCORDING TO THE PROCEDURE

2.1 DOMESTIC SUPPLY

(1) Domestic supply in whole Malaysia

The data of domestic supply to whole Malaysia were supplied by DOS as follows. The future projection was conducted by considering the calculated stock of EEE units (explained in 2.8). Consideration of the stock in terms of unit gives us the prevalence rate of the EEE.
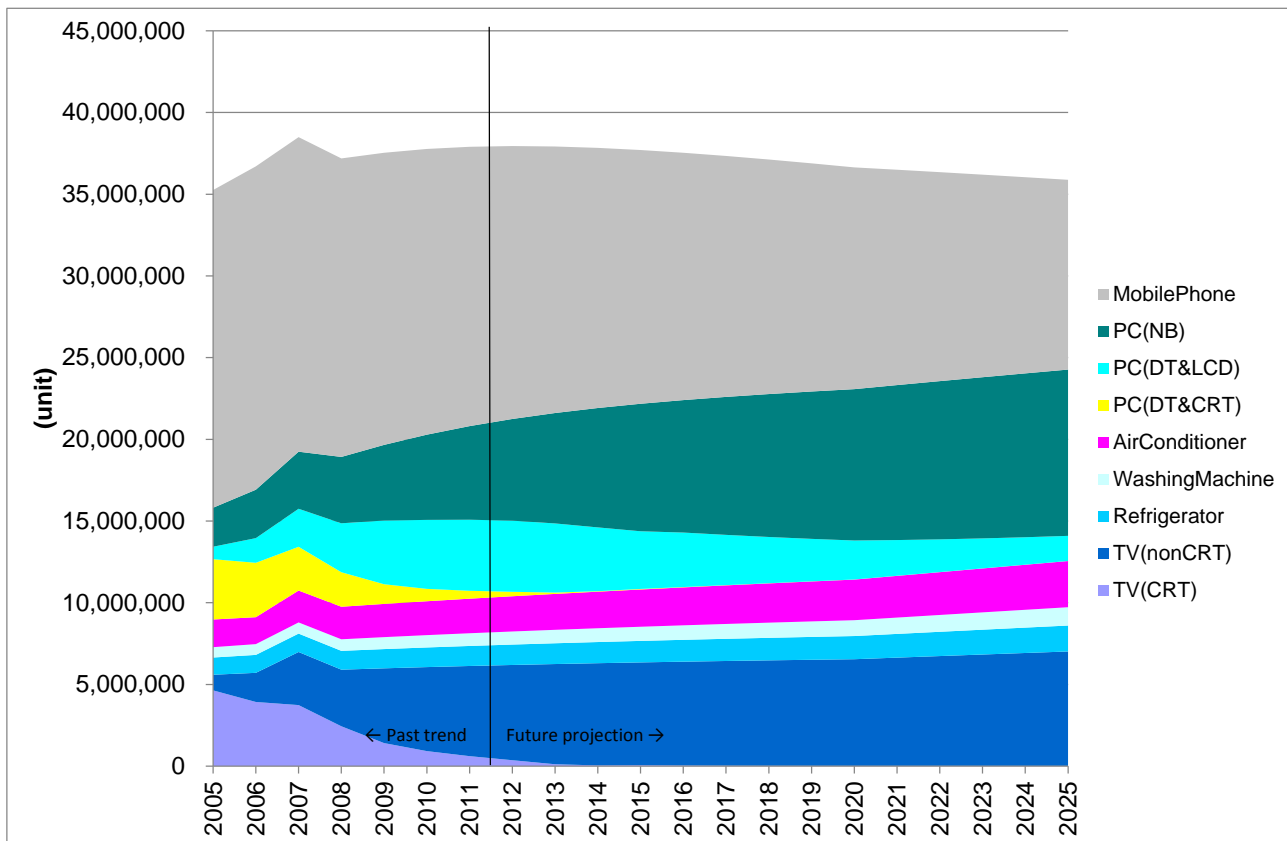
Figure 2-1. Domestic supply to whole Malaysia in terms of number of units
(Source) The past and future data was regressed by the data from Department of Statistics.

(2) Conversion to Penang Island

The domestic supply to Penang Island was converted by the following equation by considering the economic situation in Penang Island.

- $$DSpi = \frac{DS_m}{POP_m} * POP_{pi} * \frac{GCp}{GCm} = \frac{DS_m}{POP_m} * POP_{pi} * \frac{GDPpi/POPpi}{GDPm/POPm} = DSm * \frac{GDPpi}{GDPm}$$

where

- DS: *Domestic supply*

- GC : $GDP\ per\ capita$
- GDP : $Gross\ Domestic\ Products$
- POP : $Population$
- $suffix\ pi$: $Penang\ Island$
- $suffix\ m$: $Malaysian$

However, the data of GDP_p is not available and the data of GDP of Penang State is only available. So, assuming that the GDP capita of Penang Island is the same as the GDP capita of Penang State, DS_p was calculated by

- $DSp = DSm * \dfrac{GDPpi}{GDPm} = DS_m * \dfrac{GDP_{ps}}{GDP_m} * \dfrac{POP_{pi}}{POP_{ps}}$

where

- $suffix\ ps$: $Penang\ State$

(3) Data
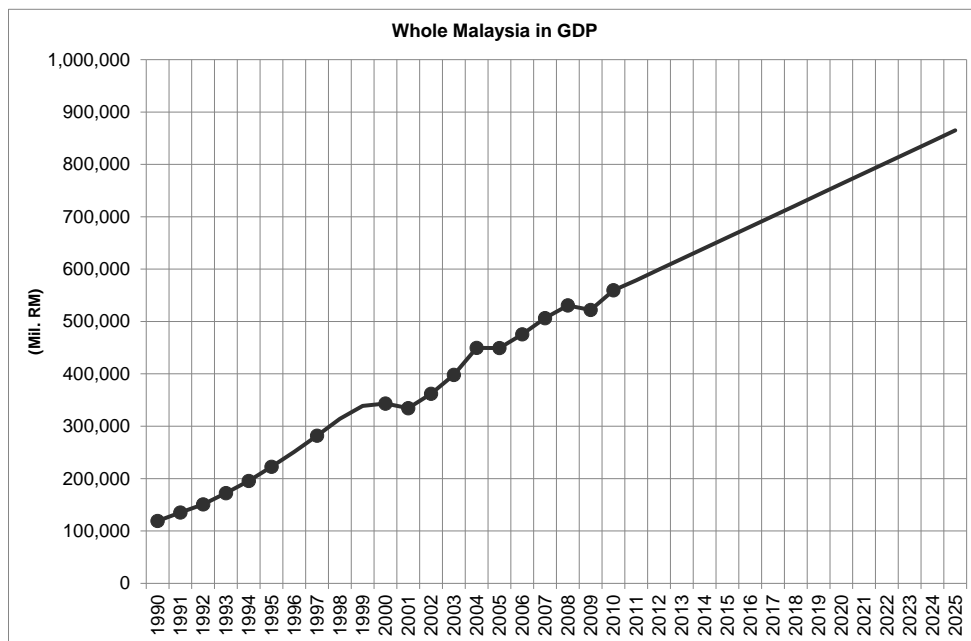
Figure 2-2. Trend of GDP in Malaysia

(Source) The data was regressed by the data from Department of Statistics.
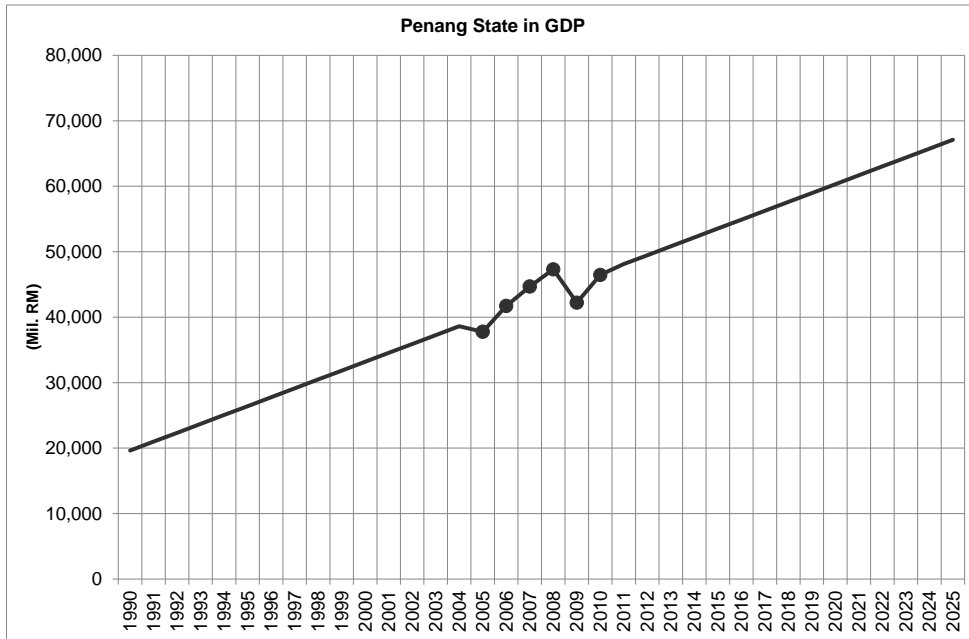
Figure 2-3. Trend of GDP in Penang State

(Source) The data was regressed by the data from Department of Statistics.
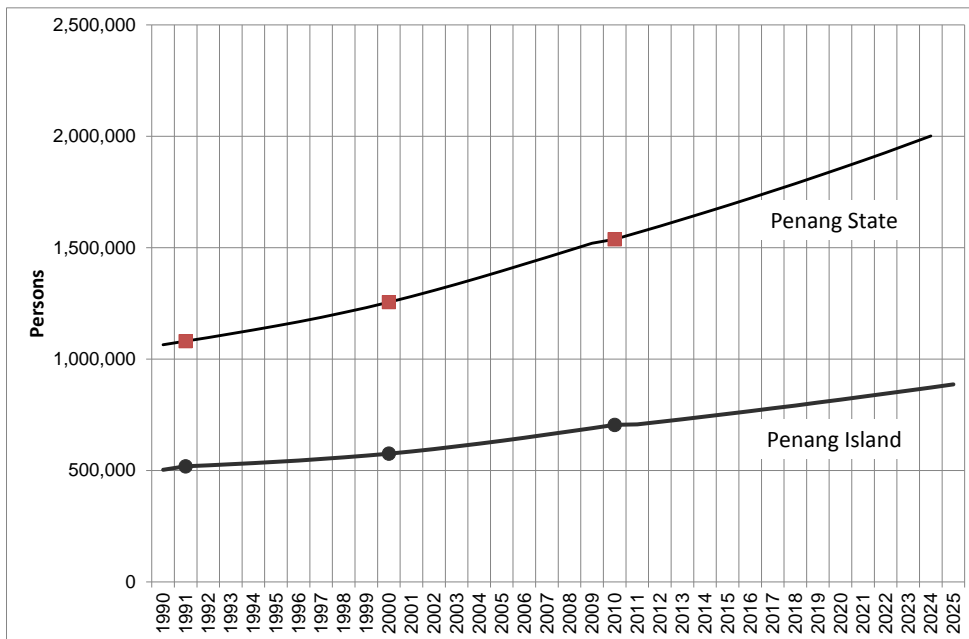
Figure 2-4. Trend of population in Penang State and Penang Island

(Source) The data was regressed by the data from Department of Statistics.

(4) Division of some domestic supplies by the product types

The domestic supply of television sets and personal computers are necessary to be divided further by types, because the concentration of materials contained in these products are different from CRT type and non-CRT type.

The domestic supply of television sets were divided to two categories: CRT type and

non-CRT type. The data of computers were divided to three categories: desktop with CRT, desktop with non-CRT and laptop.

The data used for division TV is shown in Figure 2-5. The remaining can be thought as the non-CRT TVs.

The computers were divided into desktop type and laptop type first by using the data shown in Figure 2-6. After this division, the desktop computers were divided into CRT type and non-CRT type by using the data used for TVs.
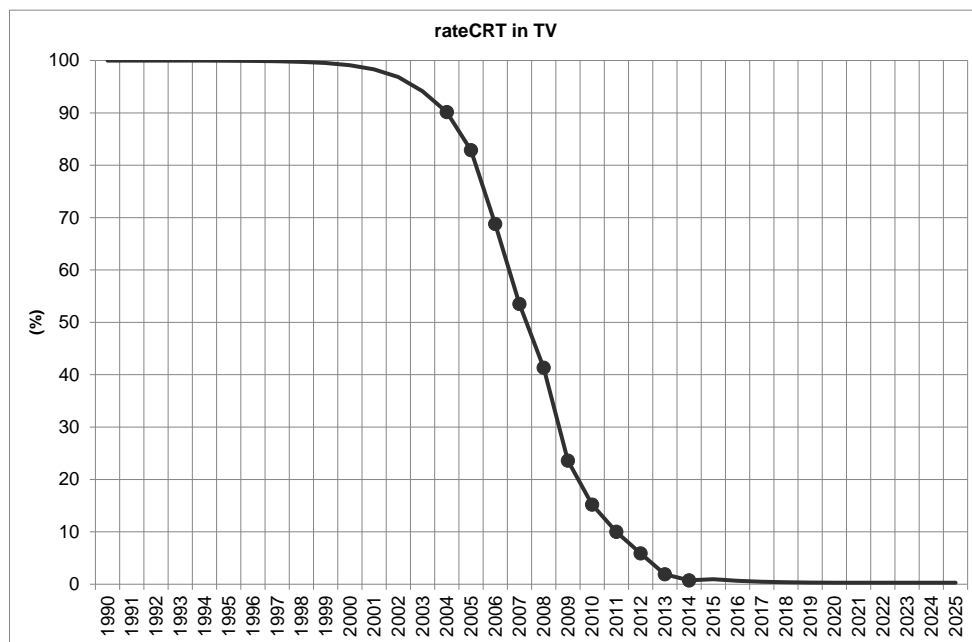
Figure 2-5. Trend of rate of CRT TV supplied to the world market

Source: NPD DisplaySearch Advanced Quarterly Global TV Shipment and Forecast Report
URL:http://www.displaysearch.com/cps/rde/xchg/displaysearch/hs.xsl/120103_lcd_tv_shipment_growth_to_improve_in_2012_driven_by_40_and_larger_sizes.asp (confirmed as of 12/March/2012)
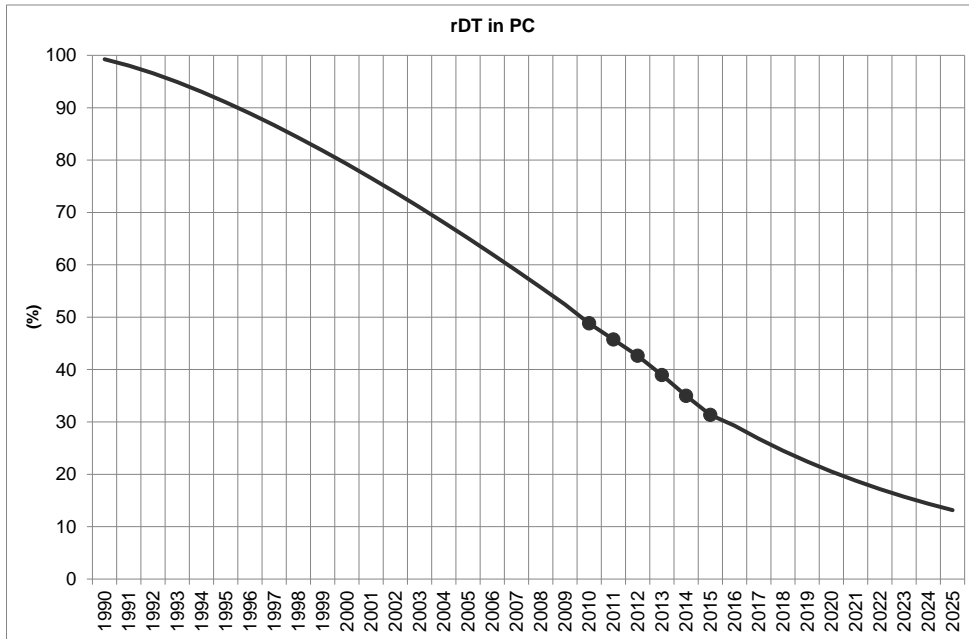
Figure 2-6. Trend of rate of desktop PC supplied in the emerging market

Source: IDC Worldwide Quarterly PC Tracker, May 2011
(*http://www.idc.com/getdoc.jsp?containerId=prUS22861211(Confirmed* as of 12/March/2012)
Note: The number of desktop computers divided by the data on this figure was divided again into CRT type and not-CRT type by using the data used for TVs.

(5) Domestic supply

The domestic supply calculated by the above procedure can be described in the following figure.
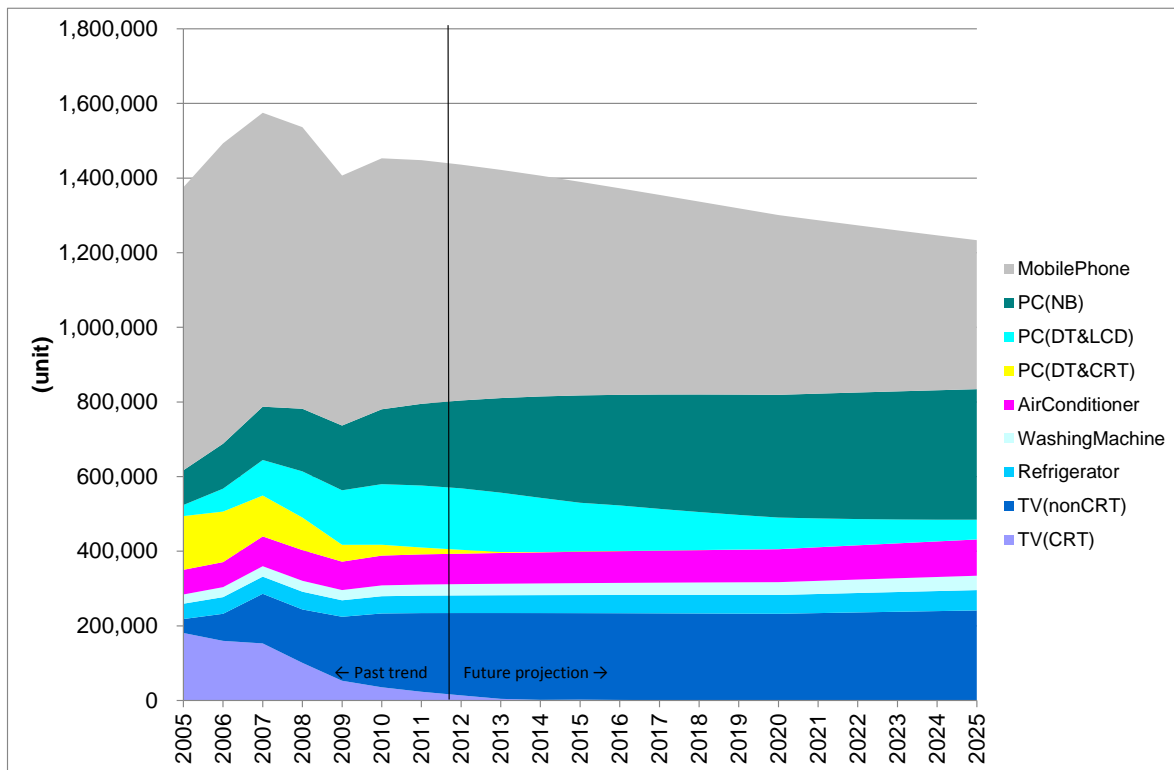
Figure 2-7. Domestic supply to Penang Island in terms of number of units

2.2 IMPORTED SECONDHAND PRODUCTS

(1) Units of imported secondhand products

There is no data of imported secondhand products. However, there seems that the certain amount of personal computers are imported. The rate of imported secondhand computers can be assumed around 20% of the new products. As for other products, the imported products are not considered.

(2) Average age of imported secondhand computers

According to DOE regulations[1], the importation of secondhand computers is allowed as far as their ages are less than three years. So the average ages of the imported secondhand computers were set equally from one to three years.

2.3 AVERAGE WEIGHT OF E-WASTE PER UNIT

E-wastes were weighted by types in junkshops and repair shops. The data were aggregated as shown in the following table.

Table 2-1. Average weight of e-waste per unit

	Television	Refrigerator	Washing Machine	Air-conditioner	Personal Computer (Desktop)	Personal Computer (Laptop)	Mobile Phone
Number of Sample	100	100	100	90	100	100	100
Average	31.33	53.76	37.01	44.68	10.47	2.87	0.24
Standard error	7.30	12.13	7.76	11.02	1.46	0.67	0.04
Upper (*)	32.76	56.13	38.53	46.96	10.76	3.00	0.24
Lower (*)	29.90	51.38	35.48	42.41	10.18	2.73	0.23

Source: Study Team
Note: Significance=5%

2.4 WEIGHT OF DOMESTIC SUPPLY

The domestic supply in terms of unit can be converted to weights shown in Figure 2-8.

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[1] Department of Environment: Guidelines for the Classification of Used Electronic and Electrical Equipment in Malaysia (2008)
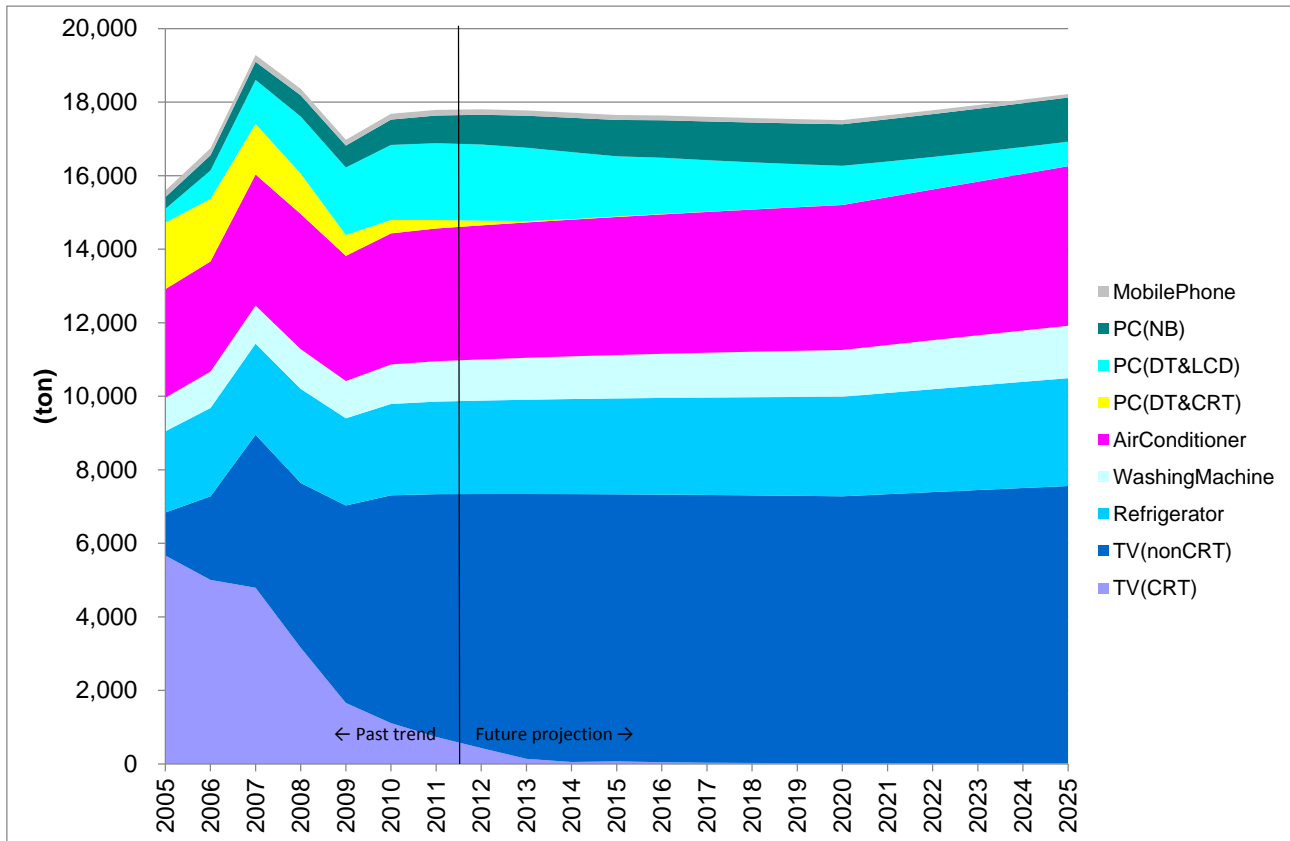
Figure 2-8. Domestic supply to Penang Island in terms of weight
Note: Including imported secondhand computers

2.5 AVERAGE AGE OF E-WASTE AND DISCARDING DISTRIBUTION

(1) Average age of e-waste

The age of e-waste were checked for the same samples of which weights were observed as shown in Table 2-2.

Table 2-2. Average age of e-waste per unit

	Television	Refrigerator	Washing Machine	Air-conditioner	Personal Computer (Desktop)	Personal Computer (Laptop)	Mobile Phone
Number of Sample	100	100	100	90	100	100	100
Average age	12.13	9.83	10.99	14.06	9.16	5.90	4.07
Standard error	4.57	4.53	5.16	7.35	3.77	3.45	2.68
Upper (*)	13.03	10.72	12.00	15.57	9.90	6.58	4.60
Lower (*)	11.23	8.94	9.98	12.54	8.42	5.22	3.54

Source: Study Team
Note: Significance=5%

(2) Discarding distribution

The lifetime of EEE varies depending on the users. The distribution of the discarding probability slowly rises from zero and reaches to the peak at the average age of the e-waste. The *Weibull* distribution is commonly used for the calculation of lifetime of e-waste. The cumulative probability function of *Weibull* is described as

- $W_t(y) = 1 - exp[-\left(\frac{y}{\bar{y}_t}\right)^b * \{\Gamma(1 + \frac{1}{b})\}^b]$

- where

- $W_t(y)$: Cumulative probability to be discarded up to the number of years passed *y* after supplied

- y_t: Average age of target e-waste

- Γ: gamma function

Here, the parameter *b* can be set as 3.0 – 4.0 practically according to *Yoshida* et. al[2]. In this project, 3.5 was used for the parameter *b*.

The percentage to be discarded in year *y* after supplied can be given as

- $W'_t(y) = W_t(y) - W_t(y-1)$
- Here $W_t(0) = 0$

2.6 Weight of discarded e-waste

The weight of the discarded e-wastes in year y_i can be calculated from the domestic supplies from the first year up to year y_i.

The mathematical expression is

- $D_i = \sum_{j=1}^{i} P_j * W'_t(i-j)$
  where

- P_j: Domestic supply in year *j*
- D_i: Discarded e-waste in year *i*.

2.7 Rate of repaired e-waste

One of the unique characters of the e-waste in developing countries is the high rate of repair activities. The study team investigated the repair rate by the product categories and found the rate shown in the following table.

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[2] Tomohiro Tasaki, Masahiro Oguchi, Takashi Kmeya and Kohei Urano: A prediction method for the number of waste durable goods, Journal of the Japan Society of Waste Management Experts, Vol. 12, No. 2, pp. 49 – 58, 2001

Table 2-3. Rate of repaired e-waste (r)

Television	Refrigerator	Washing Machine	Air-conditioner	Personal Computer (Desktop)	Personal Computer (Laptop)	Mobile Phone
56%	65%	59%	63%	19%	77%	82%

Source: Study team survey
Note: The rate for CRT TV was used for non-CRT TV and the rate for CRT PC was used for non-CRT PC (desktop), because the data for non-CRT products was insufficient.

2.8 STOCK AND E-WASTE SENT TO MATERIAL RECOVERY

The relation between the repaired and disposed e-waste can be explained in the following figure.
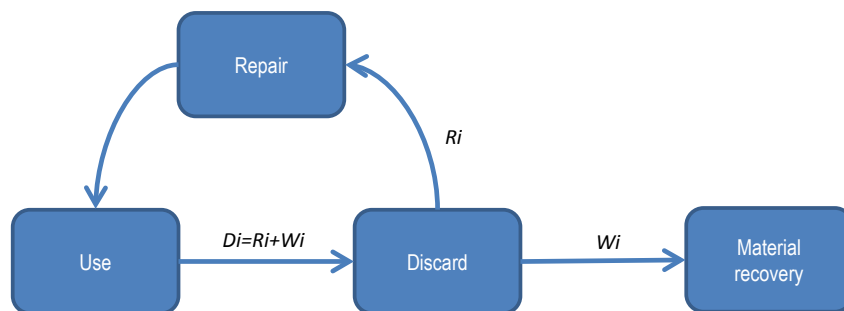
Figure 2-9. Relation between repaired e-waste and the e-waste sent to material recovery

In the above figure,

- $R_i = r * D_i$
  and

- $W_i = (1 - r) * D_i$
- r: Repair rate (shown in the Table 2-3).

Here, the stock in year *i* can be expressed as

- $S_i = S_{i-1} + P_i - W_i$
  Where

- S_i: Stock in year *i*

The amount of stocked EEE and the amount of e-waste sent to material recovery can be calculated as shown in Figure 2-10 and Figure 2-12, respectively. The amount of repaired e-waste will be shown later in the e-waste flow.
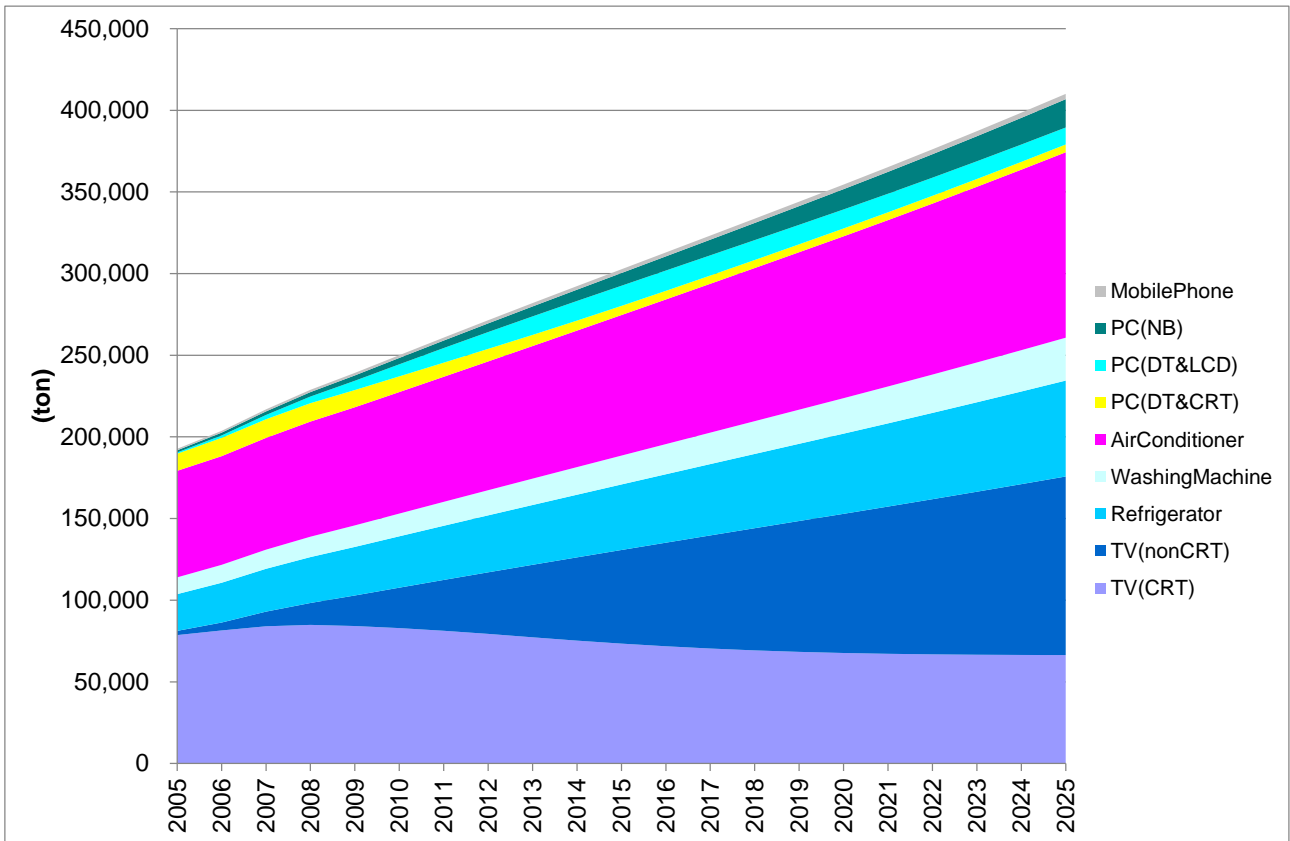
Figure 2-10. The amount of EEE stock in Penang Island (Si)
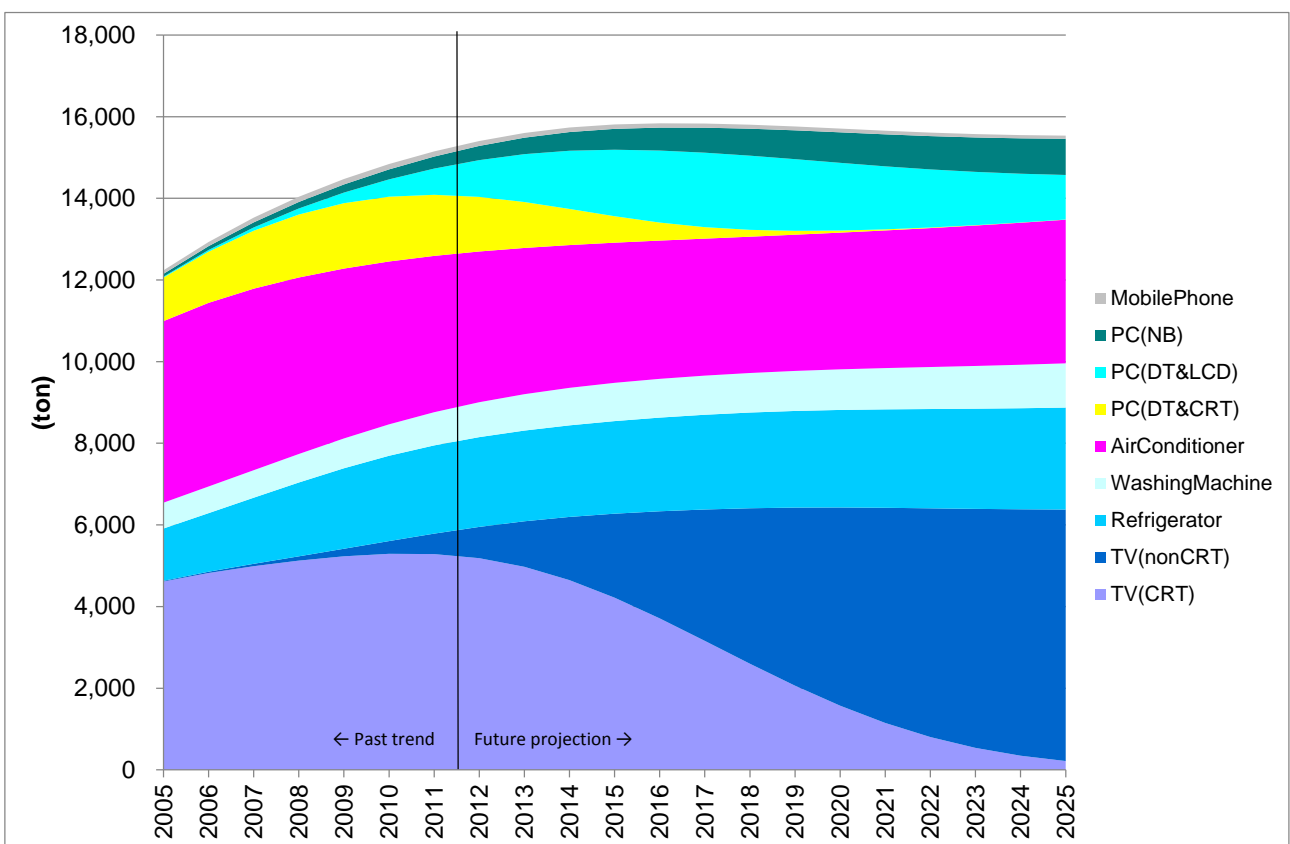
Figure 2-11. The amount of discarded e-waste in Penang Island including repaired (Di)
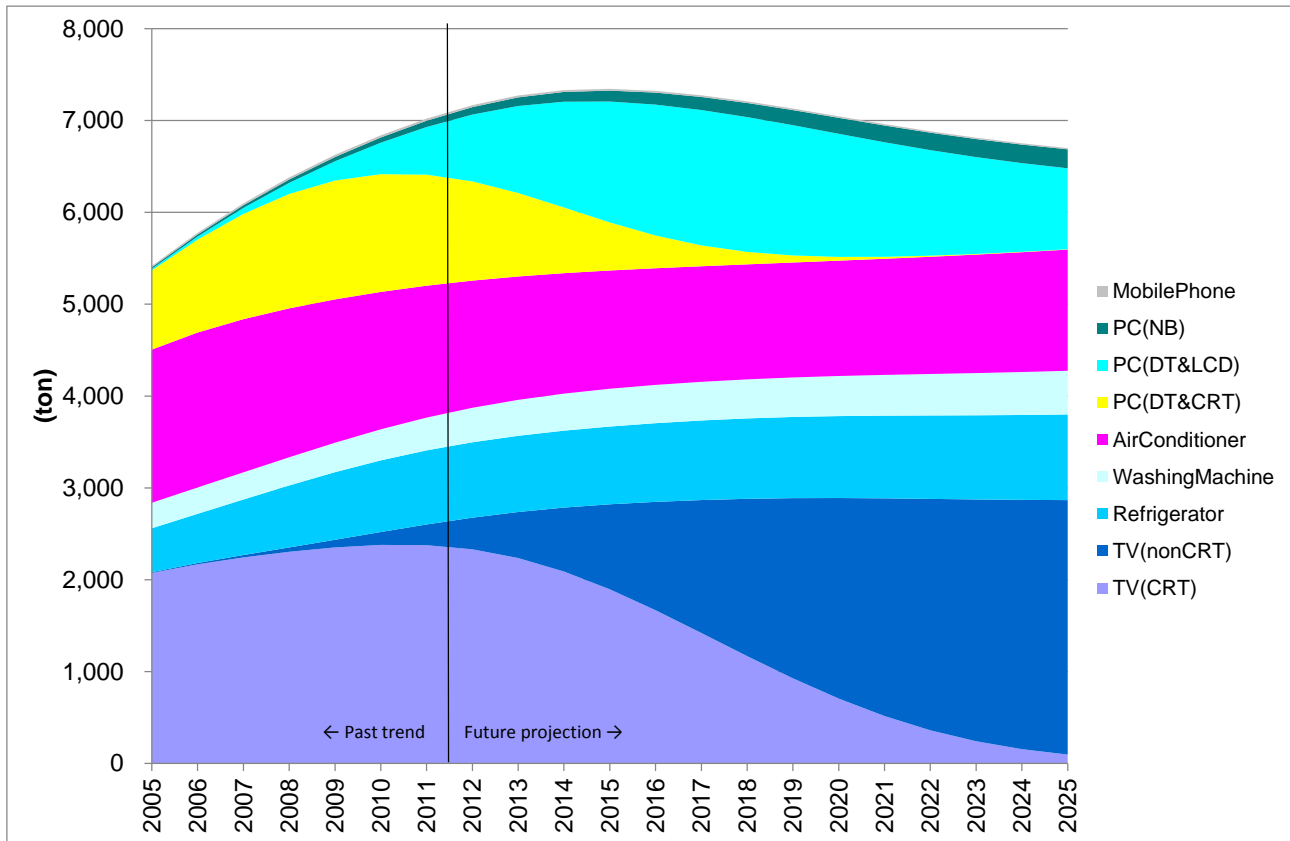
Figure 2-12. Trend of e-waste sent to material recovery from Penang Island (excluding repaired) (Wi)

2.9 E-WASTE FLOW

(1) Disposal parameters

The e-waste flow survey conducted by the team discovered the disposal parameters. The disposal parameters can be summarized as shown in Table 2-4. The symbols from p_1 to q_2 means the symbols used in Figure 1-2.

Table 2-4. Disposal parameters

	Television	Refrigerator	Washing Machine	Air-conditioner	Personal Computer (Desktop)	Personal Computer (Laptop)	Mobile Phone
p_1 (%)	0	0	0	0	5	0	0
p_2 (%)	100	100	100	100	95	100	100
p_3 (%)	0	0	0	0	0	0	0
q_1 (%)	9	3	2	0	15	14	0
q_2 (%)	91	97	98	100	85	86	100

Source: The e-waste flow study by the team.

(2) E-waste flow

The e-waste flows by product are described as follows (Figure 2-13 to Figure 2-21), using the

model shown earlier in Figure 1-2.
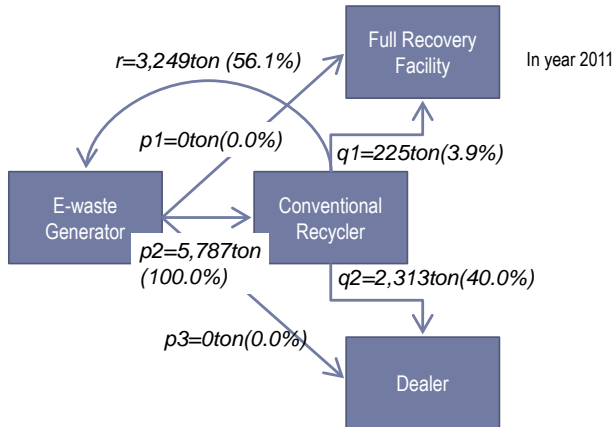
Figure 2-13 E-waste flow (Television set, year 2011)
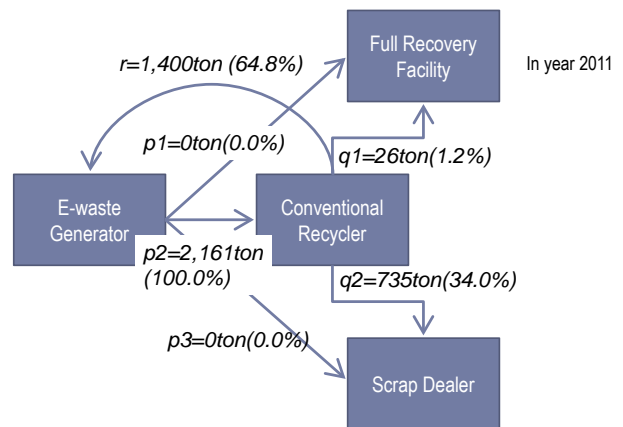
Figure 2-14 E-waste flow (Refrigerator, year 2011)
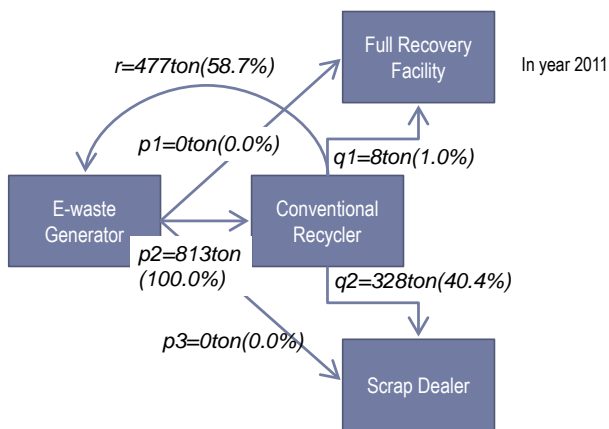
Figure 2-15 E-waste flow (Washing machine, year 2011) Figure 2-16 E-waste flow (Air-conditioner, year 2011)
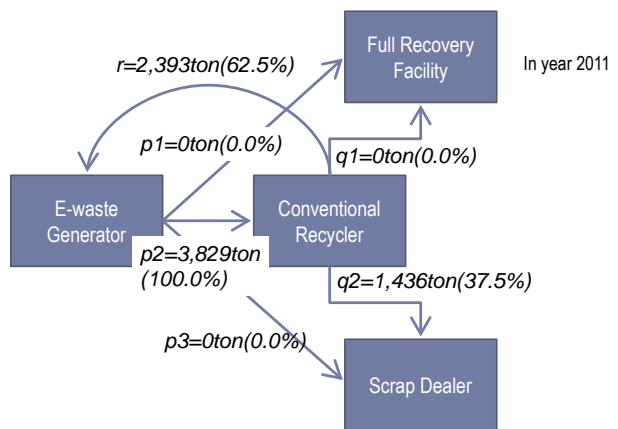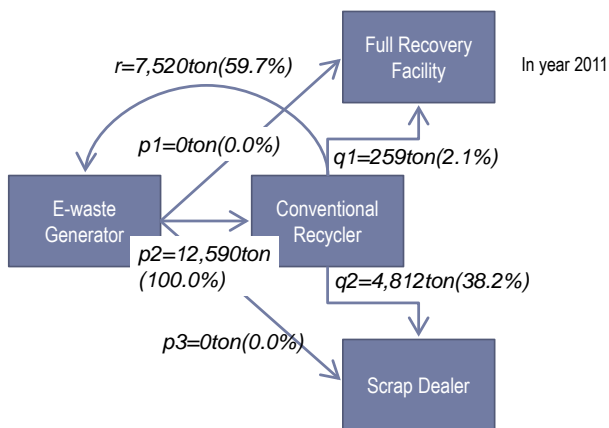
Figure 2-17 E-waste flow (Four items, year 2011) Figure 2-18 E-waste flow (PC Desktop, year 2011)
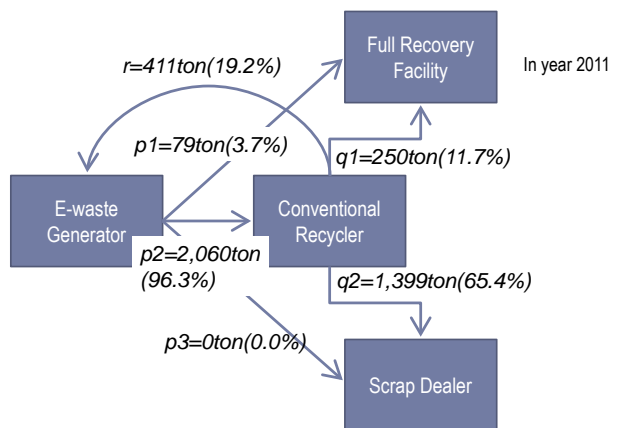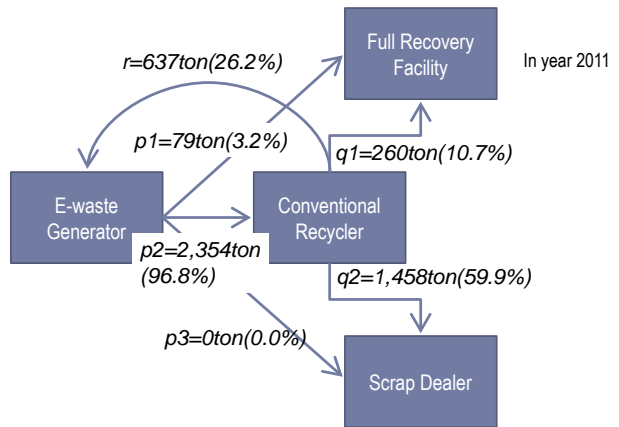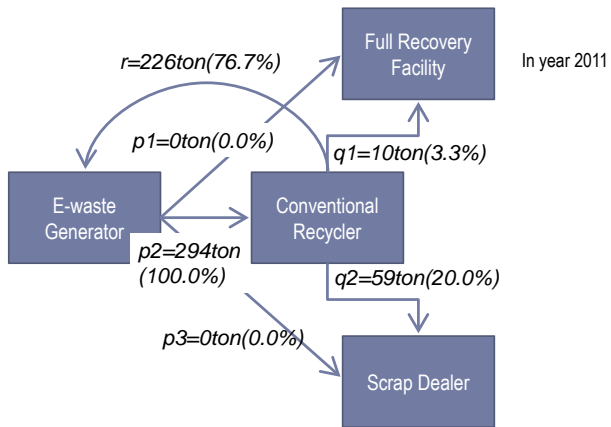
Figure 2-19 E-waste flow (PC Notebook, year 2011) Figure 2-20 E-waste flow (PC Total, year 2011)
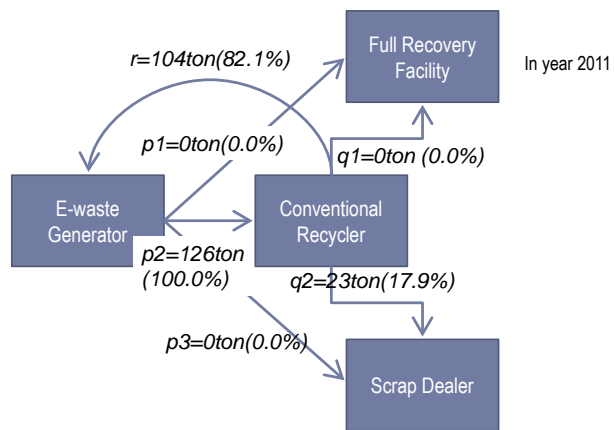
Figure 2-21 E-waste flow (Mobile phone, year 2011)

3. SUBSTANCE FLOW MODEL FOR POLICY EVALUATION

3.1 INDEXES FOR POLICY EVALUATION

The e-waste flow can be converted to substance base by setting the substance concentration contained in the e-waste. By giving the concentration of hazardous substances, the hazardousness can be quantified. By giving the concentration of precious metals, the loss of precious metals to outside of Malaysia can be quantified.

In this project, the three indexes shown in the following table were applied.

Table 3-1. Three indexes for policy evaluation

Index	Unit	Definition	Explanation	Considered Substances
1. Hazardousness	%	$1 - \dfrac{FR}{W}$	The amount of lead which is not covered by the full recovery facilities (potential amount of lead which might be released to the environment)	Lead
2. Resource Recovery	%	$\dfrac{FR}{W}$	The amount of precious metals which are sent to the full recovery facilities (conservation of the domestic resources)	Gold (Au), Silver (Ag), Platinum (Pt), Palladium (Pd) (converted to equivalent amount of gold by LME prices)
3. Traceability	%	$\dfrac{FR}{W}$	The amount of e-waste which is monitored by DOE	E-waste

Note 1: Hazardousness was calculated by considering only lead, because the concentration such as mercury, cadmium, hexavalent chromium regulated by RoHS is very small.
Note 2: W means the amount of disposed e-waste excluding repaired e-waste. FR means the e-waste accepted by the full recovery facilities.

3.2 DATA PREPARATION

(1) Data for calculating hazardousness

The data of lead concentration contained in e-waste by product types is summarized in the following table.

Table 3-2. Concentration of hazardous substances   (wt%)

	Television	Refrigerator	Washing Machine	Air-conditioner	Personal Computer (Desktop)	Personal Computer (Laptop)	Mobile Phone
Lead	CRT 6.7 [1] non-CRT 0.059 [1]	0.0089 [1]	0.0078 [1]	0.0084 [2]	CRT 6.7 [3] non-CRT 1.1 [4]	1.9 [4]	1.7 [5]

Note: After year 2006, the concentration was set to 0.1% for lead, mercury and hexavalent chromium, and 0.01 % for cadmium according to RoHS[3] directive. But the products which do not exceed these rates even before year 2005 were given the original rates.

---

[3] DIRECTIVE 2002/95/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment

1) Tomoo Sekido, Nobutoshi Tanaka, Toshihiko Matsutou, Hiroko Kouda: Estimation on the amount of lead contained in home electric appliances, The 9th proceedings of the Japan Society of Waste Management, 1988
2) Average of refrigerator and washing machine
3) The same data for CRT television was used.
4) Japan Oil, Gas and Metals National Corporation (JOGMEC): Report of a project to develop technologies for more efficient energy use and rare metal recovery, March 2008
5) Tohoku Bureau of Economy, Trade and Industry: Feasibility study report on precious and rare metal recycling network from end-of-use digital home electric appliances, March 2007

(2) Data for calculating precious metals

The data of precious metals concentration contained e-waste by product types is summarized in the following table. The precious metal concentrations were aggregated to gold equivalent concentration by using the prices in London Metal Exchange.

Table 3-3. Concentration of precious metals   (wt%)

	Personal Computer (Desktop)	Personal Computer (Laptop)	Mobile Phone	LME Price [3] (USD/kg)
Gold	0.094 [1]	0.022 [1]	0.16 [2]	50.44
Silver	0.11 [1]	0.057 [1]	0.24 [2]	0.91
Platinum	0.0003 [1]	0.0002 [1]	0.0008 [2]	44.01
Palladium	0.036 [1]	0.011 [1]	0.034 [2]	19.87

1) Japan Oil, Gas and Metals National Corporation (JOGMEC): Report of a project to develop technologies for more efficient energy use and rare metal recovery, March 2008
2) Average of JOGMEC and data from Tohoku Bureau of Economy, Trade and Industry: Feasibility study report on precious and rare metal recycling network from end-of-use digital home electric appliances, March 2007
3) Prices in London Metal Exchange Market, as of 6 Jan. 2012

3.3 TREND OF HAZARDOUS SUBSTANCES AND PRECIOUS METALS

The hazardous substances and precious metals contained in e-waste can be calculated based on the amount of e-waste discarded as shown in Figure 3-1 and Figure 3-2.
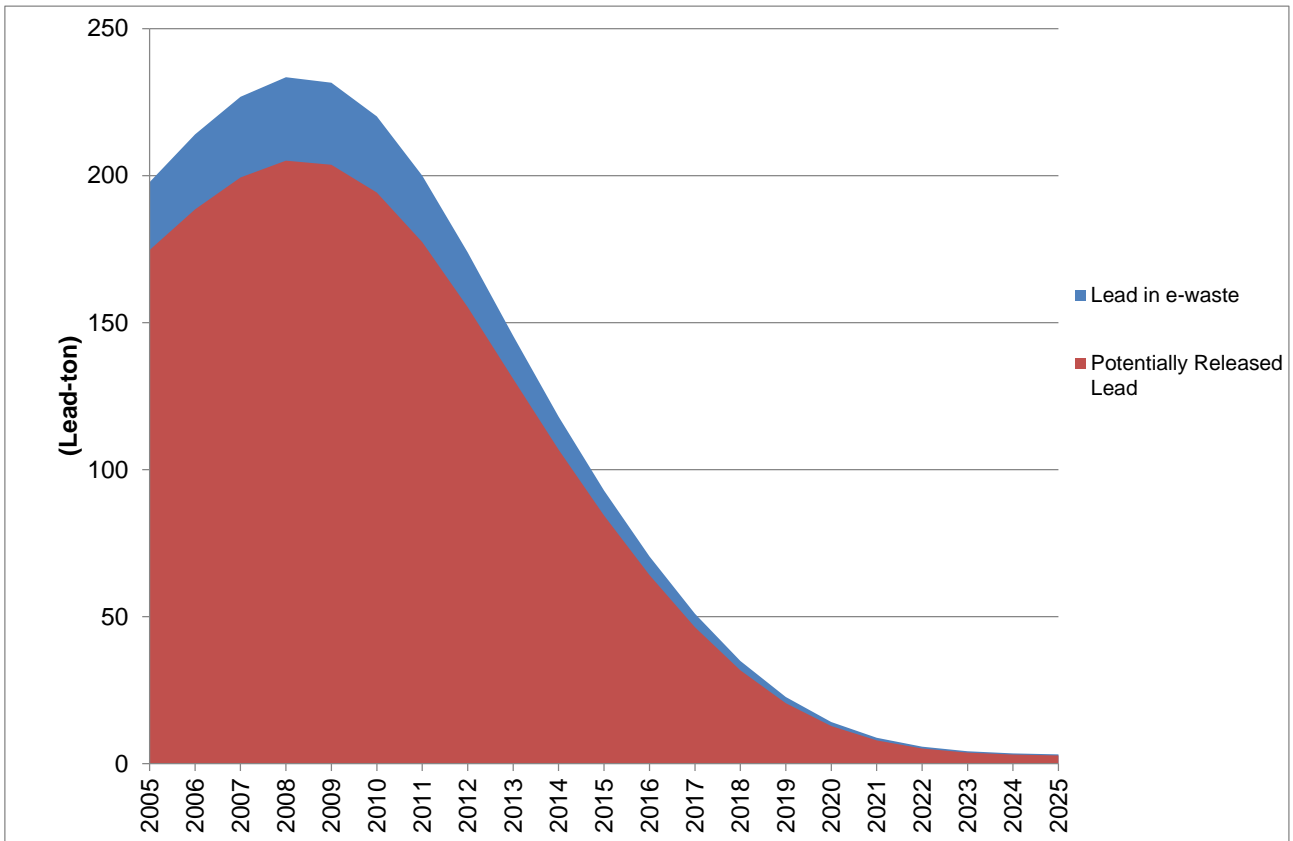
Figure 3-1. Trend of lead contained in e-waste as an index for hazardousness
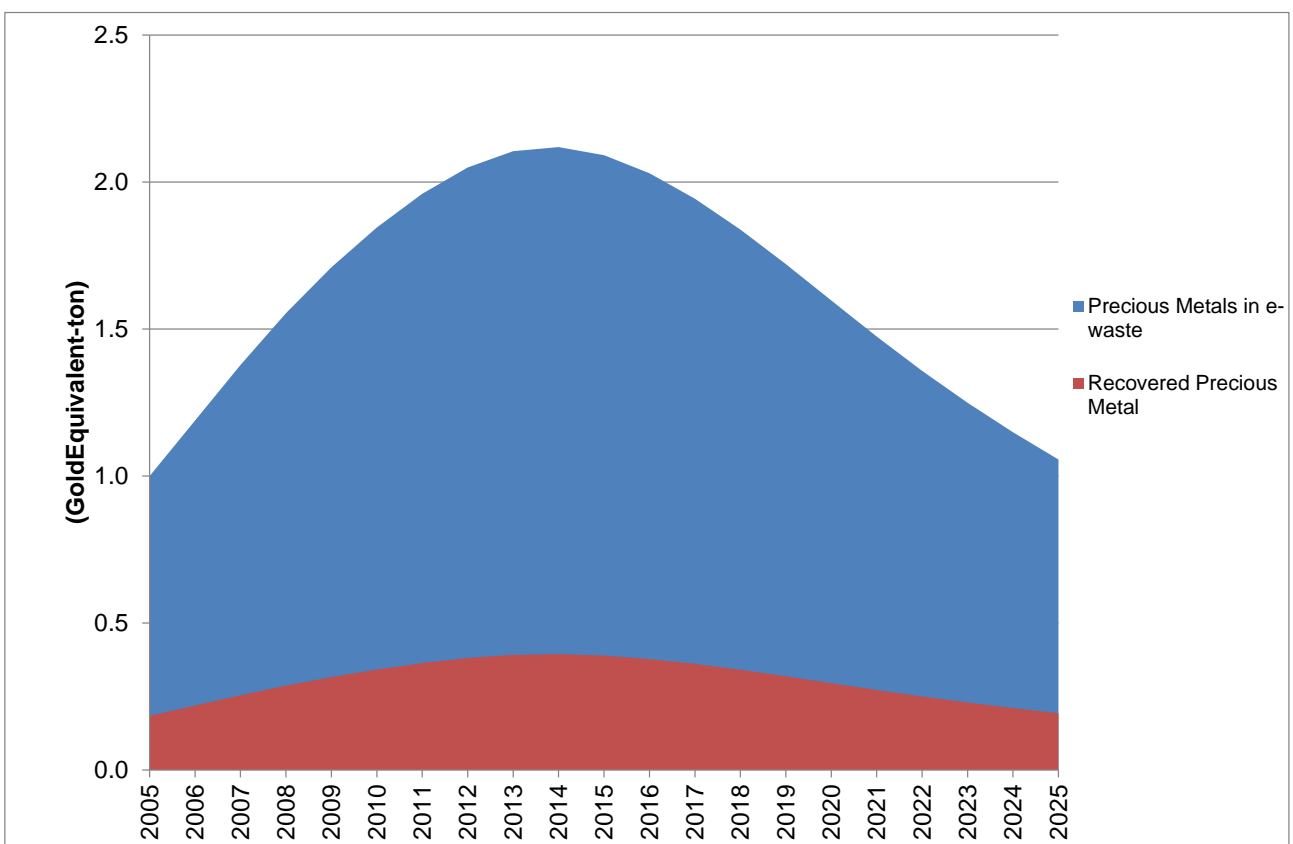
Figure 3-2. Trend of precious metals contained in e-waste

3.4 TREND OF THREE INDEXES

(1) Business as usual

The three indexes can be calculated chronologically based on the amount of e-waste discarded. Figure 3-3 shows the trend in the business-as-usual case (BAU) without policy whereas Figure 3-4 shows the case when any policy succeeds to change the e-waste flow. Even in the BAU case, the trend changes a little due to the change in the product component rate.
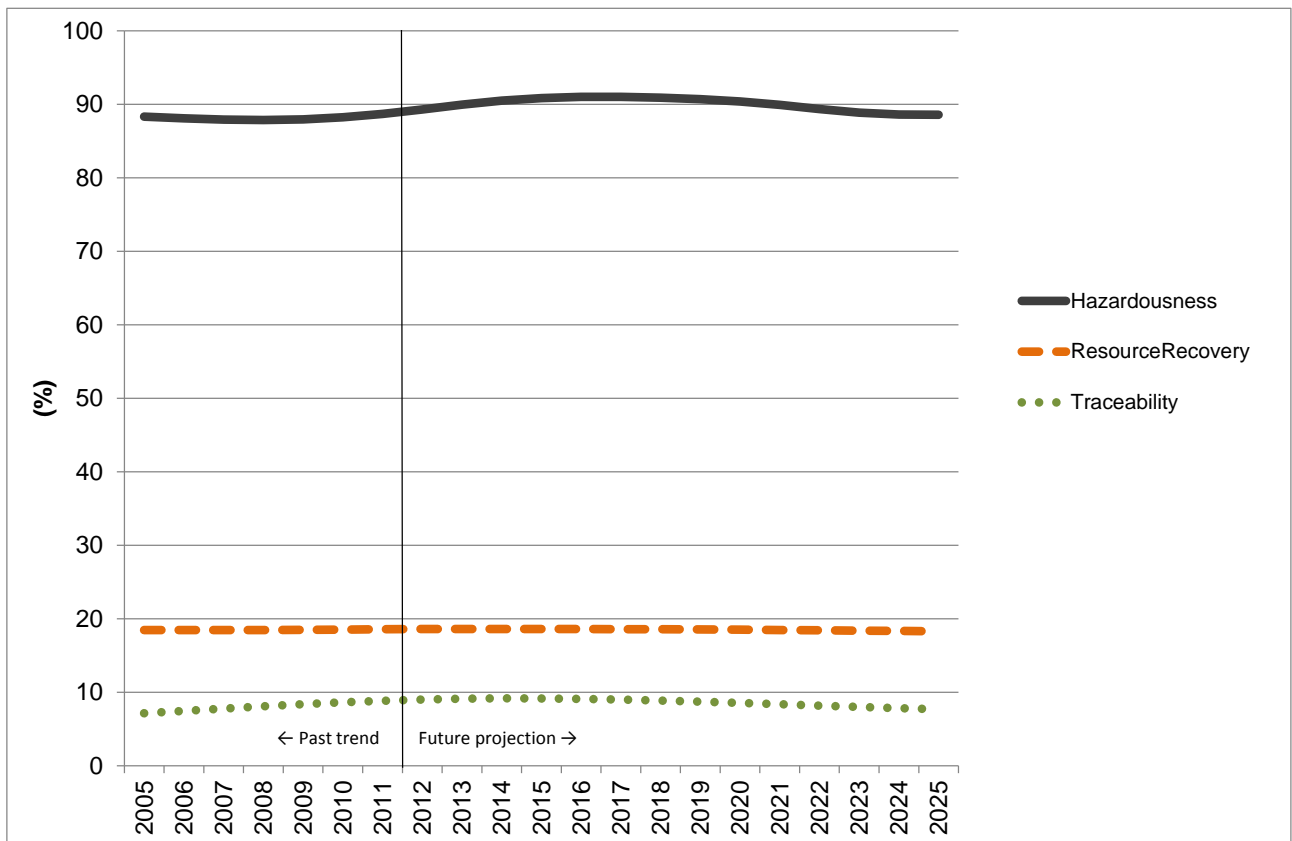
Figure 3-3. Trend of the three indexes for policy evaluation <without policy>

(2) With policy

The change of the three indexes with any policy can be evaluated by setting the future e-waste flow parameters. The parameters can be set as shown in Table 3-4. The result can be seen in Figure 3-4.

Table 3-4 The parameters set to evaluate the policy effect in the year of 2020

	Value
k	Same as the present value
p_1	50% ($p_1=p_2$)
p_2	
q_1	50% ($q_1=q_2$)
q_2	

Note: The data between 2012 and 2019 was interpolated smoothly.
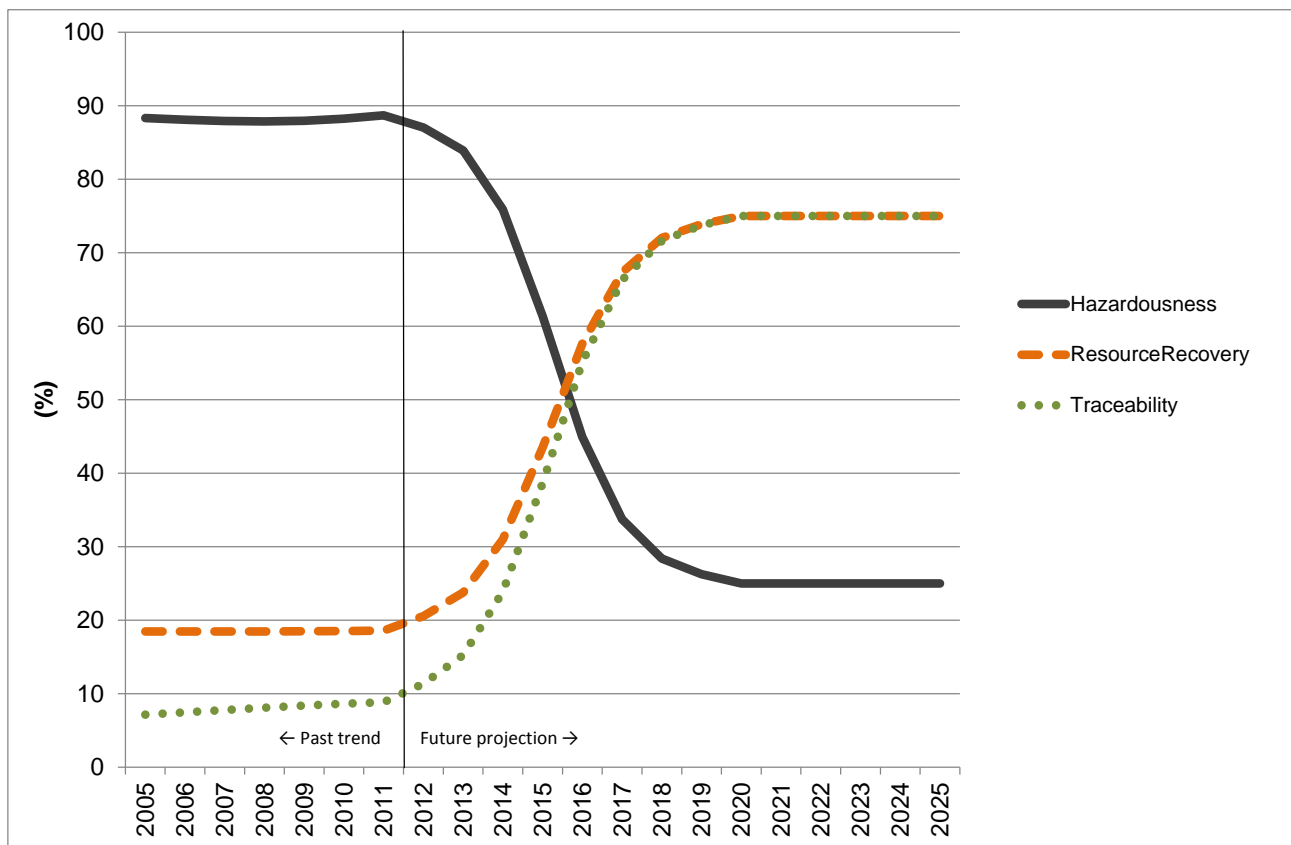
Figure 3-4. Trend of the three indexes for policy evaluation <with policy>

4. OTHER CONSIDERATIONS

4.1 CONSIDERATION TO THE DEAD STORAGE OF BROKEN EEE IN HOUSEHOLDS

(1) Data of dead storage from questionnaire survey

According to the questionnaire survey, some e-wastes are kept inside households even after they are broken. The rates are summarized in the following table.

In Japan, mobile phones are easily kept by the discarders for some reasons such as keeping memories. In Penang Island, not only mobile phone but also other bulky EEEs are kept in households after out of use.

Table 4-1. Percentage of broken EEE possessed by households in the total stock as of year 2011

Television	Refrigerator	Washing Machine	Air-conditioner	Personal Computer (Desktop)	Personal Computer (Laptop)	Mobile Phone
CRT 5.0% non-CRT 1.3%	1.5%	2.8%	1.4%	CRT 6.9% non-CRT 1.6%	1.7%	4.1%

Source: Questionnaire survey by the Study team

(2) Consideration to the dead storage

The discarded rates were sought by iterations as that the amount of stock meets the rates of broken EEEs. The amount of stock is incremented by the amount of broken kept EEEs.

By this means, the discarded rates, i.e. physically discarded e-waste divided by total discarded e-waste including the ones kept inside households, are resulted in the following table.

Table 4-2. Discarded rate by product types

Television	Refrigerator	Washing Machine	Air-conditioner	Personal Computer (Desktop)	Personal Computer (Laptop)	Mobile Phone
87%	94%	90%	95%	95%	80%	73%

Note 1: The rate for CRT type television is applied to non-CRT type television.
Note 2: The rate for personal computer (desktop) is applied to all types of computers, where personal computer (laptop) is on the prevailing process and its discarding rate cannot be estimated by the iterations.

4.2 CONSIDERATION TO THE LIFETIME OF NON-CRT DISPLAY

It is said that non-CRT displays such as LCD have shorter lifetime than CRT displays due to the lifetime of the backlight. But the practical lifetime of non-CRT displays is unsure and such data cannot be obtained from the questionnaire surveys, because not so many non-CRT display products have been discarded yet.

Based on the situations, in this project, the sensitivity of the results was checked, changing the

lifetime of non-CRT displays. Target products are non-CRT televisions and non-CRT personal computers. The minimum lifetime of the products were set as 3/4 of the lifetime of CRT displays. 9.1 years were set to non-CRT TVs and 5.6 years were set to non-CRT desktop PCs, while 12.1 years and 7.5 years were the lifetimes of CRT TV and CRT desktop PCs respectively.

The result can be seen in Figure 4-1. For example, when "Average used year of TV (non-CRT)" changes from the standard value to 3/4 of the standard value, it changes the amount of e-waste sent to material recovery at the rate of 7%. As for desktop non-CRT PCs, the change is -2%. So, the change in the lifetime of non-CRT products changes the total weight of e-waste in 2011 at the rate of 5%. It is concluded that the change in the average lifetime of non-CRT displays does not affect the amount of e-waste sent to material recovery much. Here, considering the prevalence speed of non-CRT products, the estimation was made based on the year 2020 figure.
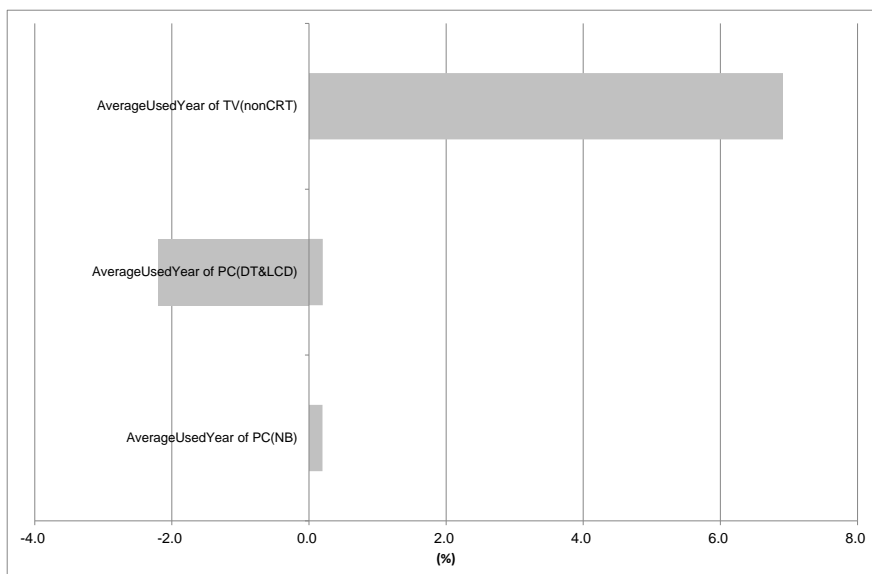
Figure 4-1. Rate of change in total weight of e-waste sent to material recovery in year 2020

4.3 CONSIDERATION TO THE ORPHAN PERSONAL COMPUTERS

It is said that there were many orphan personal computers in Penang in the 1990's, but there hardly is such a case recently. But the reliable data do not exist to describe this situation. So, the sensitivity analysis was conducted for the evaluation regarding non-CRT lifetime.

The component rate of orphan PCs was set as shown in Figure 4-2 so that the rate of orphan PCs in the 1990's is 50% and the rate in 2011 is nearly zero. This means that the domestic supply in the 1990's will become 1.5 times of the standard values.

The result is shown in Figure 4-3. The additional domestic supply from orphan PCs affects the amount of e-waste sent to material recovery in the year 2011 at the rate of 5% at the

maximum.
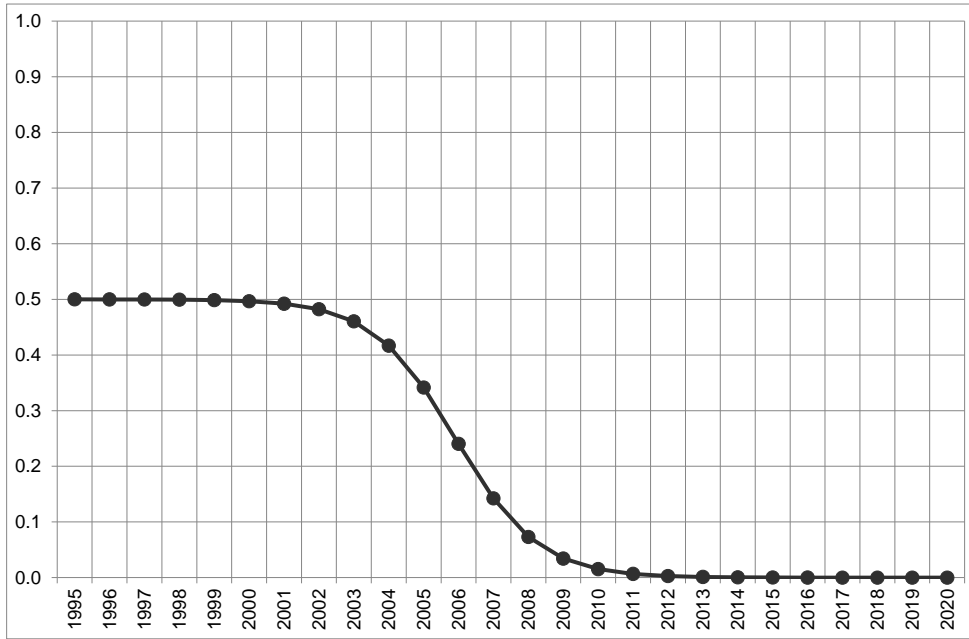
Figure 4-2. Rate of orphan personal computer

Note: The rate was set so that the rate in 1990' is 50% and nearly zero in 2011.
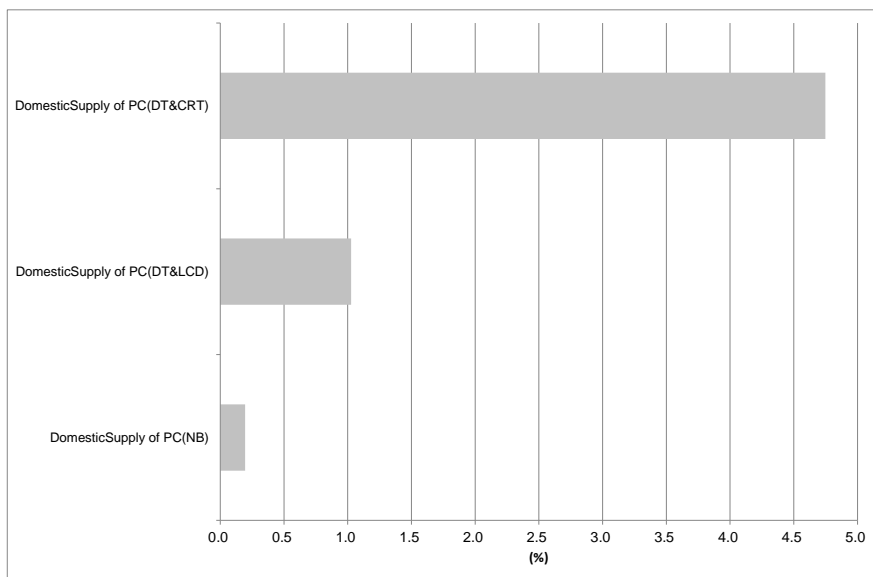
Figure 4-3. Rate of change in total weight of e-waste sent to material recovery in year 2011

4.4 SENSITIVITY ANALYSIS ON THE IMPORTATION OF SECONDHAND PERSONAL COMPUTERS

The data of the imported secondhand personal computers were set as 20% of the new products, as the data are not available. Here, the sensitivity of the imported secondhand personal computers was analyzed, changing the imported rate from 10% to 30% of the standard value 20%.

The changes in the amount of the imported secondhand computers affects the total weight of the discarded e-waste at the rate of less than 1.5% at the maximum in the case of the desktop CRT computer. The amount of the imported secondhand computers is ignorable in terms of the total e-waste.
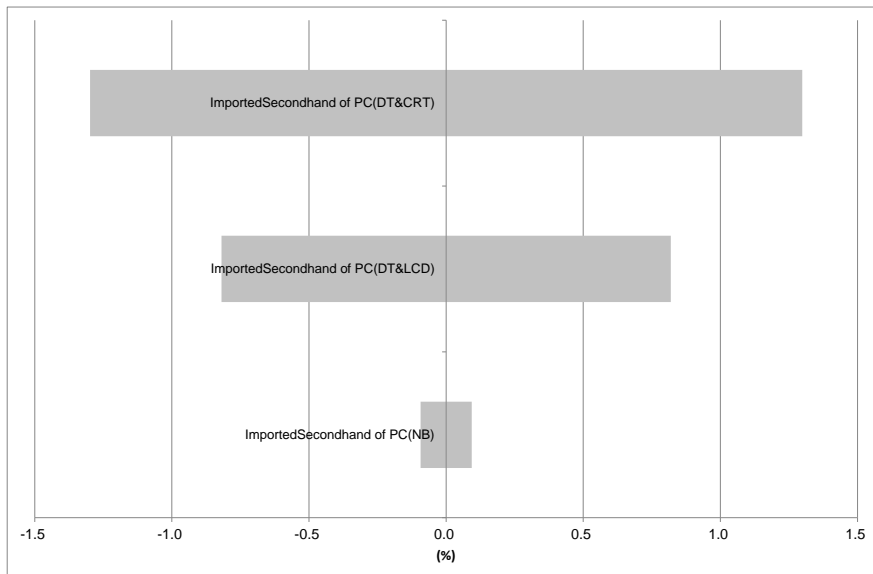
Figure 4-4. Sensitivity analysis on the imported secondhand computers in year 2011

4.5   CONSIDERATION TO THE E-WASTE FROM BUSINESS ENTITIES

In this project, e-waste from business entities was investigated by means of some questionnaire surveys. By checking the questionnaire survey data, the major discarding way is reportedly to take them to small junk shops or other conventional recyclers. There is not an obvious direct flow into full recovery facilities. E-wastes from business entities flows to small conventional recyclers first and some of them are repaired. Among the portions going to material recovery, some of them may be sent to full recovery facilities besides the ones sent to conventional scrap dealers. This means the discarding structure is similar to that of households, and the difference between households and business entities does not affect the macroscopic results such as the three indexes. So, in this project, the flow data obtained from households were used for the calculation.

Annex III

E-waste flow study

Contents

Abbreviations

CRT	Cathode Ray Tube
EEE	Electrical and Electronic Equipment
e-waste	Electrical and Electronic Equipment Waste
LCD	Liquid Crystal Display
MPPP	Majlis Perbandaran Pulau Pinang (Municipal Council of Penang Island)

1. PRECONDITIONS AND DATA SOURCES FOR DESCRIBING E-WASTE FLOW

1.1 PRECONDITIONS FOR THE ESTIMATION OF DISCARDED E-WASTE

(1) Target e-wastes

In this study, the following six items were targeted by considering the dominancy, hazardousness, precious metals concentration and other factors shown in the inception report.

- Television set (CRT and non-CRT)
- Refrigerator
- Washing machine
- Air-conditioner
- Personal computer (desktop with CRT, desktop with non-CRT and laptop)
- Mobile phone

(2) Study year

- As of 2011

1.2 DATA SOURCES FOR DESCRIBING E-WASTE FLOW

(1) Data sources for describing e-waste flow

The following two surveys are the data sources for describing the current e-waste flow in Penang Island.

- The Questionnaire Survey on Public Attitude to E-waste in Penang Island in Malaysia (Questionnaire survey)
- The Survey on the Current Situation of E-waste in Penang Island in Malaysia (e-waste flow survey)

The data from the questionnaire survey and the e-waste survey are used for the description of the e-waste flow passed out from the waste generators to the primary destination, such as repair shops, secondhand shops and junk shops, and the e-waste flow after the primary destination, respectively.
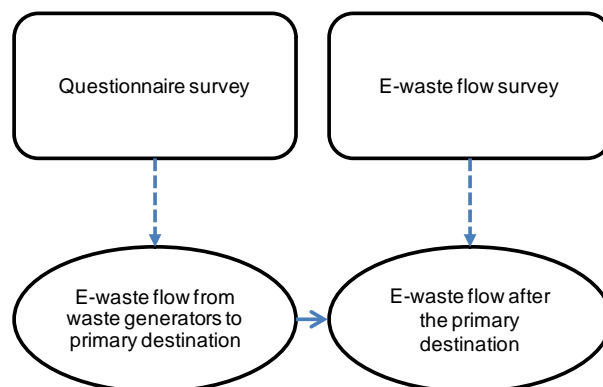
Figure 1-1. Target e-waste flows to describe based on the two surveys

In the e-waste flow survey, some of the information on the amount of e-waste or on where to buy/sell the e-waste from/to that was considered clearly miswritten was corrected by the Team by inquiring the respondents directly.

(2) Outlines of the two surveys

The outlines of the above-mentioned surveys are shown in the following table.

Table 1-1. Outlines of the questionnaire survey and the e-waste flow survey

	Questionnaire survey on public attitude e-waste in Penang Island (questionnaire survey)	Survey on current situation of e-waste in Penang Island (e-waste flow survey)
Survey period	October 2011 to December 2011	October 2011 to January 2012
Targets and number of samples	- Household: 418 - Business: 124	- Full Recovery Facility: 8 - Partial Recovery Facility: 12 - Retailer: 5 - Repair ship/ maintenance shop: 3 - Secondhand shop: 21 - Junkshop/ Scrap shop/ Collector: 20 - NGO/ Recycling Centre:3
Main survey items	- Experiences to discard e-wastes - Information and activities on present e-waste recycling system - Opinion on future e-waste recycling system	- Amount of e-waste - From where to receive e-waste - Where to sell e-waste - Reception price and selling price of e-waste

2. DESCRIBING THE E-WASTE FLOW

2.1 MODEL OF THE E-WASTE FLOW

(1) Model flow

The following figure shows a model of e-waste flow in Penang Island. The parameters of inflow and outflow of boxes in the figure are expressed with signs, such as g1, r1, rs1 and d1 given to each arc of input flow and output flow of the boxes in the figure.
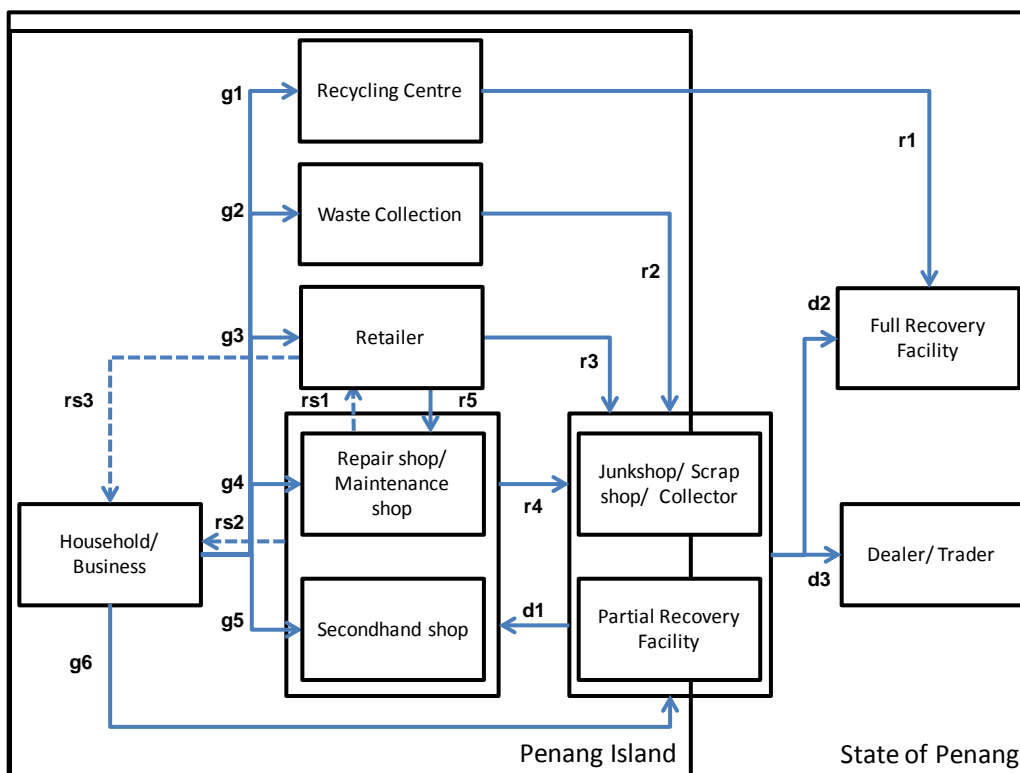
Figure 2-1. Model of e-waste flow in Penang Island

(2) Description of the rules for the model

The total value of parameters of inflow and outflow for each box is calculated to be equal.

How the estimations of the parameters in the model were made is explained in the next section.

2.2 ESTIMATION OF PARAMETERS

(1) Estimation of Parameters g1 to g6

The parameters "g1" through "g6" are estimated data from the questionnaire survey.

To calculate ratios for the parameters "g1" to "g6," the number of answers to the question on discarding e-wastes in the questionnaire is counted with the exception of no responses and answers of "Sell/ give to relative or friend", "None of the above" or "Others". In addition, answers of "Take to Recycling Center for coupon" are excluded for the calculation except in the cases where computers are received at Recycling Centre.

Indeed, the parameters "g1" to "g6" can be calculated based on the data from the e-waste flow survey too, but the data from the questionnaire survey are applied to the estimation in this model in consideration of data stability with more than 400 samples of households.
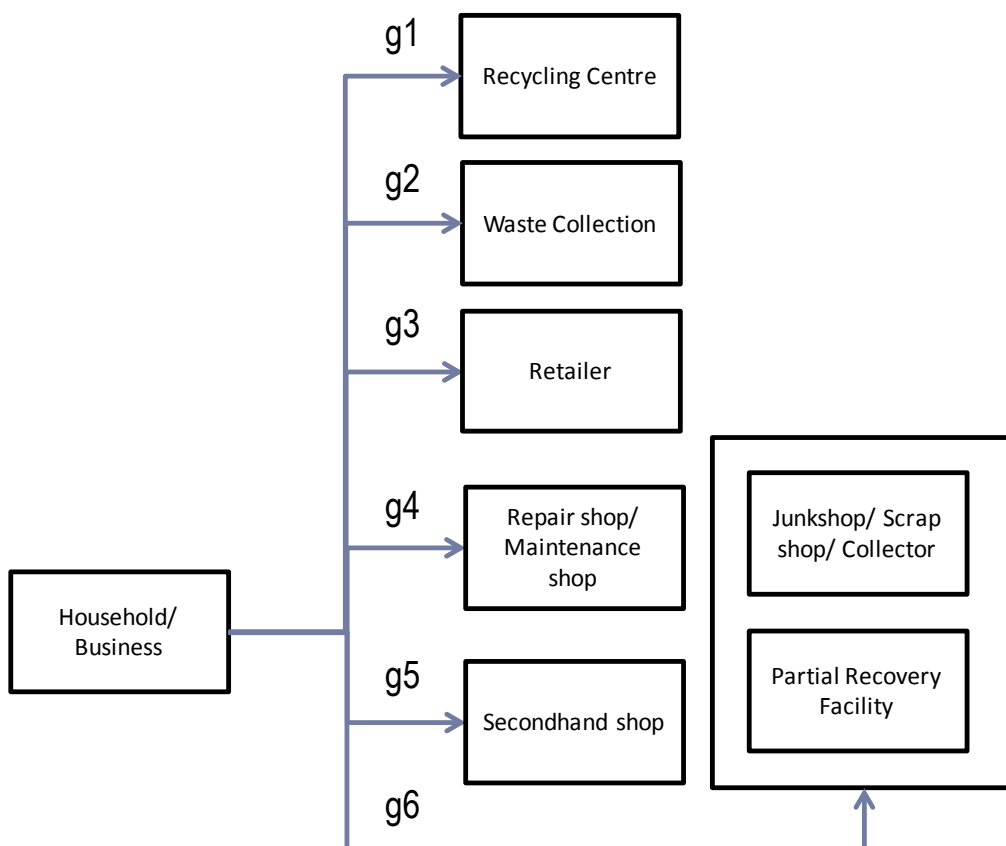
Figure 2-2. Primary destination for e-waste discarded by households and businesses

(2) Estimation of Parameters r1 and r2

E-waste flow models for Recycling Centre and Waste Collection are shown in the following figures.
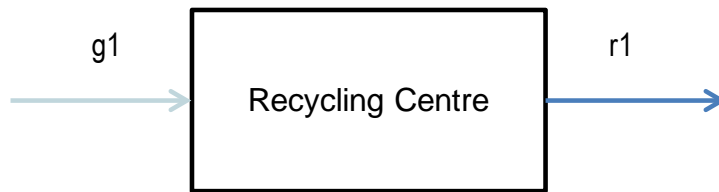
Figure 2-3. Inflow and outflow of recycling centre

Figure 2-4. Inflow and outflow of waste collection

In accordance with the description of the rules, "r1" and "r2" each equals to "g1" and "g2" respectively.

- $r1 = g1$
- $r2 = g2$

(3) Estimation of Parameters r3, r5, rs1 and rs3

E-waste flow model for Retailer is shown in the following figure.
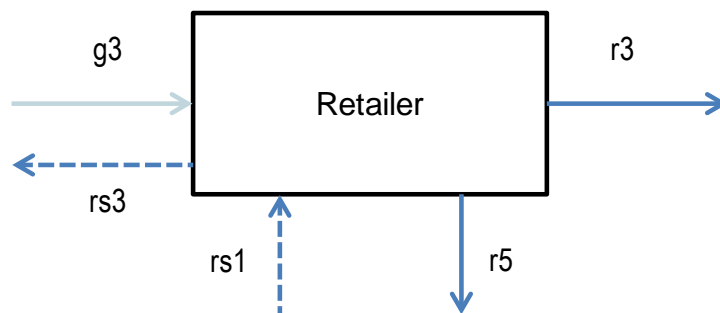
Figure 2-5. Inflow and outflow of retailers

The parameter "r3" is obtained by the following equation.

- $r3 = g3 * k$

where

- k: Ratio of irreparable e-waste

The parameter "k" is estimated based on the data in the e-waste flow survey.

The number of samples of retailers in the survey is comparatively small. Therefore, another ratio of e-waste passed over from Repair shops/ Maintenance shops to Junk shops/ Scrap shops/ Collectors or Partial Recovery Facilities in the survey is used as the parameter "k" assuming that it is the same as the ratio of e-waste passed out from Retailer to Junk shops/

Scrap shops/ Collectors or Partial Recovery Facilities.

The parameter "r5" is obtained by the following equation assuming that "r5" is equivalent to "rs1" and "rs3".

- $r5 = g3 - r3$
- $rs1 = rs3 = r5$

Under warranty, even though the e-products are irreparable, they are replaced with new ones and send back to consumers. Therefore, "rs1" and "rs3" are considered same as "r5".

(4) Estimation of Parameters r4 and rs2

E-waste flow model for Repair shops/ Maintenance shops and Secondhand shops is shown in the following figure.
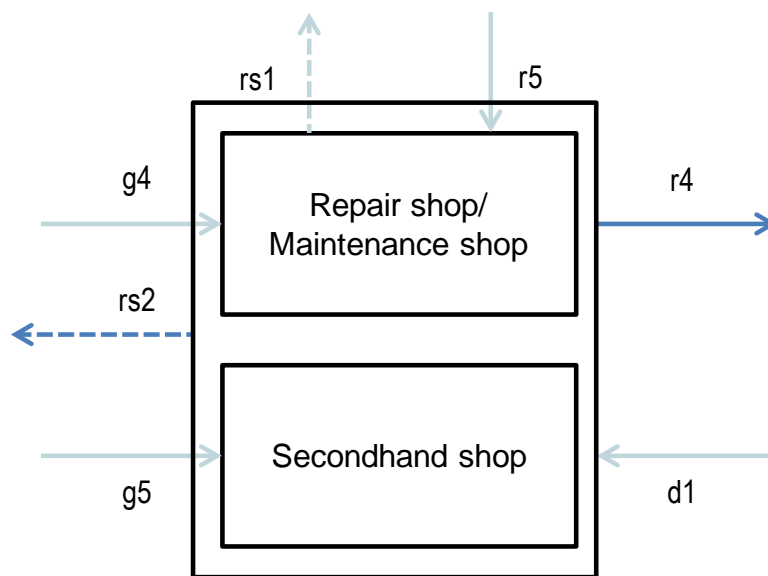
Figure 2-6. Inflow and outflow of repair shops and secondhand shops

The parameter "r4" is obtained by the following equation and data from the e-waste survey.

- $r4 = (g4 + g6) * l$
  where

- $l: Ratio\ of\ e - waste$ passed out from repair shops or secondhand shops to collectors or dismantlers.

Because some of the repair shops also do business of secondhand, "r4" and "rs2" are integrally computed for the boxes of Repair shops/ Maintenance shops and Secondhand shops.

The parameter "rs2" is obtained by the following equation.

- $rs2 = g4 + g5 + d1 - r4$

  Estimation of parameter "d1" is explained in the next section.

(5) Estimation of Parameters d1, d2 and d3

E-waste flow model for waste collectors and dismantlers is shown in the following figure.
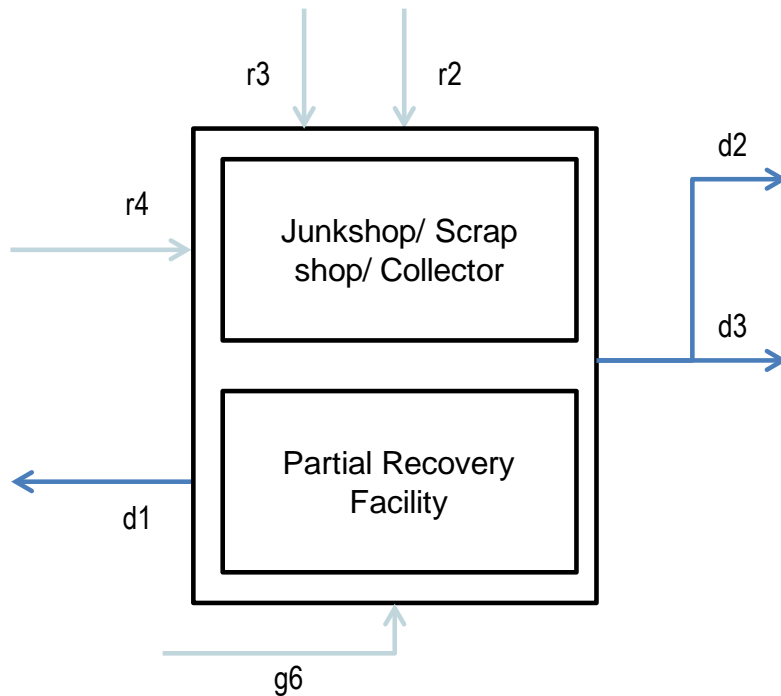
Figure 2-7. Inflow and outflow of dismantler or collector

The parameters "d1", "d2" and "d3" are obtained by the following equations.

- $d1 = (g6 + r2 + r3 + r4)*m$
- $d2 = (g6 + r2 + r3 + r4)*n$
- $d3 = (g6 + r2 + r3 + r4)*o$

  where

- *m:* Ratio of reusable e-waste send to Repair shop/ Maintenance shop or Secondhand shop
- *n:* Ratio of e-waste sent to Full Recovery Facility
- *o:* Ratio of reusable e-waste sent to Dealer/ Trader

  The parameters "m", "n" and "o" are estimated by using the outflow data from Junk shops/ Scrap shops/ Collectors and Partial Recovery Facilities in the e-waste flow survey. Actually these parameters can also be obtained from the inflow data is the survey but the outflow data are used because the parameters "g3", "r2", "r3" and "r4" are already obtained.

  The parameter "m" is calculated in consideration of the cases that e-wastes are passed over from junk shops or collectors to repair or maintenance shops as not reusable ones but repair parts. It is then difficult to specify the weight of the parts in the survey. Therefore, to calculate

the ratio of "m", only 50% of the weight obtained in the e-waste flow survey is counted as e-wastes passed over to Repair shops/ Maintenance shops or Secondhand Shops. In addition, the parameter "m" even includes a small portion of e-wastes sold directly as secondhand ones to households or businesses by junk shops or collectors in order to make the e-waste flow model simpler.

3. OUTPUTS FOR E-WASTE FLOWS IN EACH TARGET ITEM

3.1 E-WASTE FLOW RATIOS

Calculated ratios for e-waste flows in each target item are shown in the flowing table, and Figure 3-1 shows the comprehensive structure of e-waste flow in Penang Island.

Table 3-1. E-waste flow rations in each target item (%)

Signs	Television set (CRT and non-CRT)	Refrigerator	Washing Machine	Air-conditioner	Personal Computer (Desktop)	Personal Computer (Laptop)	Mobile Phone
g1	0.0	0.0	0.0	0.0	4.5	0.0	0.0
g2	12.5	8.5	13.7	0.0	31.8	0.0	5.6
g3	15.0	29.8	33.3	37.5.	4.5	10.0	36.1
g4	23.8	21.3	9.8	25.0	4.5	40.0	11.1
g5	8.8	12.8	11.8	0.0	13.6	30.0	36.1
g6	40.0	27.7	31.4	37.5	40.9	20.0	11.1
r1=g1	0.0	0.0	0.0	0.0	4.5	0.0	0.0
r2=g2	12.5	8.5	13.7	0.0	31.8	0.0	5.6
r3=g3*k	0.2	0.0	0.0	0.0	0.4	0.7	0.4
r4=(g4+g6)+l	2.9	3.8	3.5	0.0	3.9	2.8	0.8
r5=g3-r3	14.9	29.8	33.3	37.5	4.2	9.3	35.8
rs1=r5	41.3	29.8	33.3	37.5	4.2	9.3	35.8
rs2=g4+g5+d1-r4	14.9	35.0.	25.3	25.0	15.0	67.4	46.4
rs3=r5	41.3	29.9	33.3	37.5	4.2	9.3	35.8
d1=(g6+r2+r3+r4)*m	11.7	4.8	7.3	0.0	0.8	0.2	0.0
d2=(g6+r2+r3+r4)*n	3.9	1.2	1.0	0.0	11.6	3.3	0.0
d3=(g6+r2+r3+r4)*o	40.0	34.0	40.4	37.5	64.7	20.0	17.9
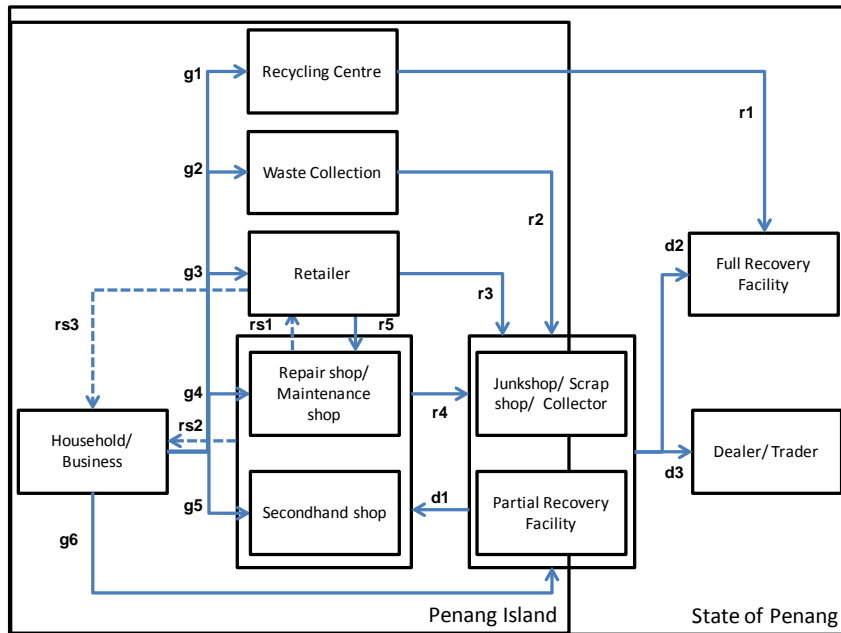
Figure 3-1. Comprehensive structures of e-waste flow in Penang Island (reinsertion)

3.2 E-WASTE FLOW CHARTS

E-waste flow charts with ratios are shown below in each target item.

(1) Television set (CRT and non-CRT)
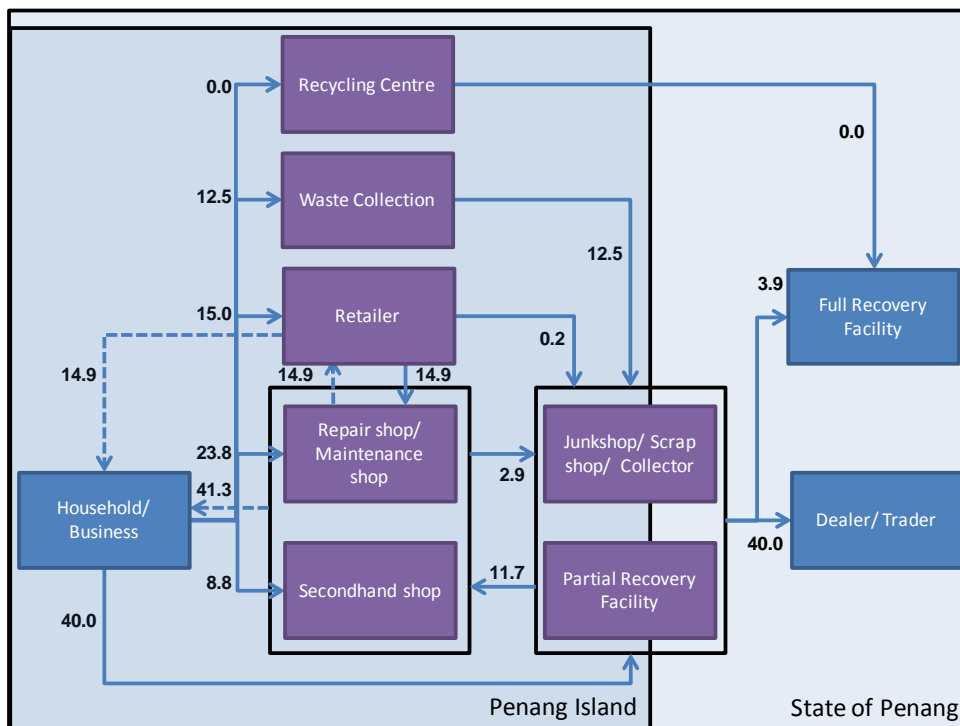
Figure 3-2. E-waste flow of television set (CRT and non-CRT)

(2)　Refrigerator
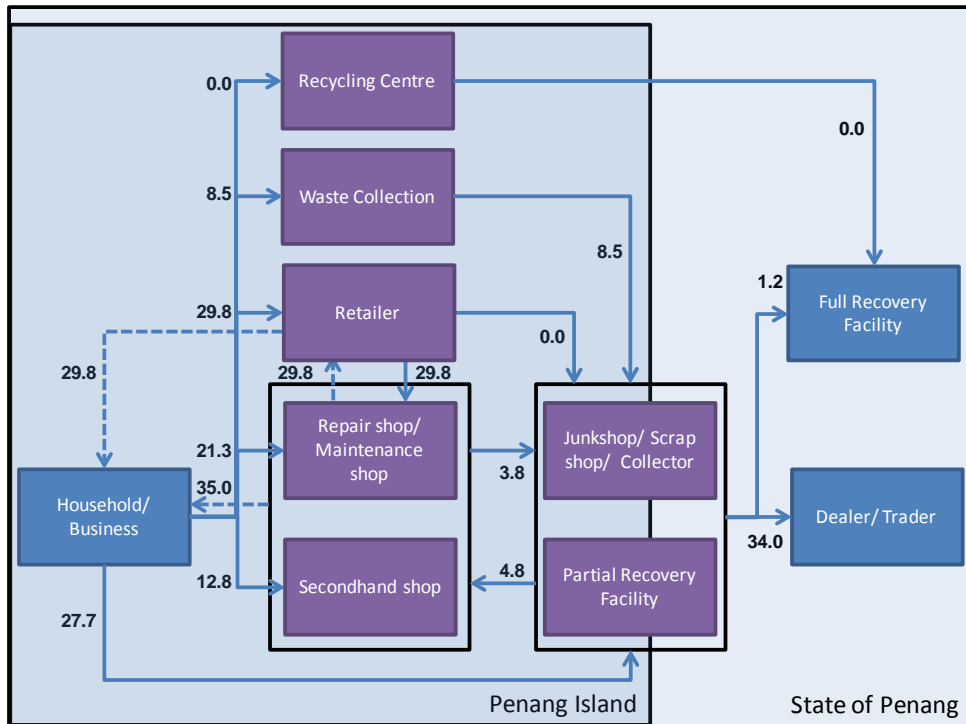
Figure 3-3. E-waste flow of refrigerator

(3)　Washing machine
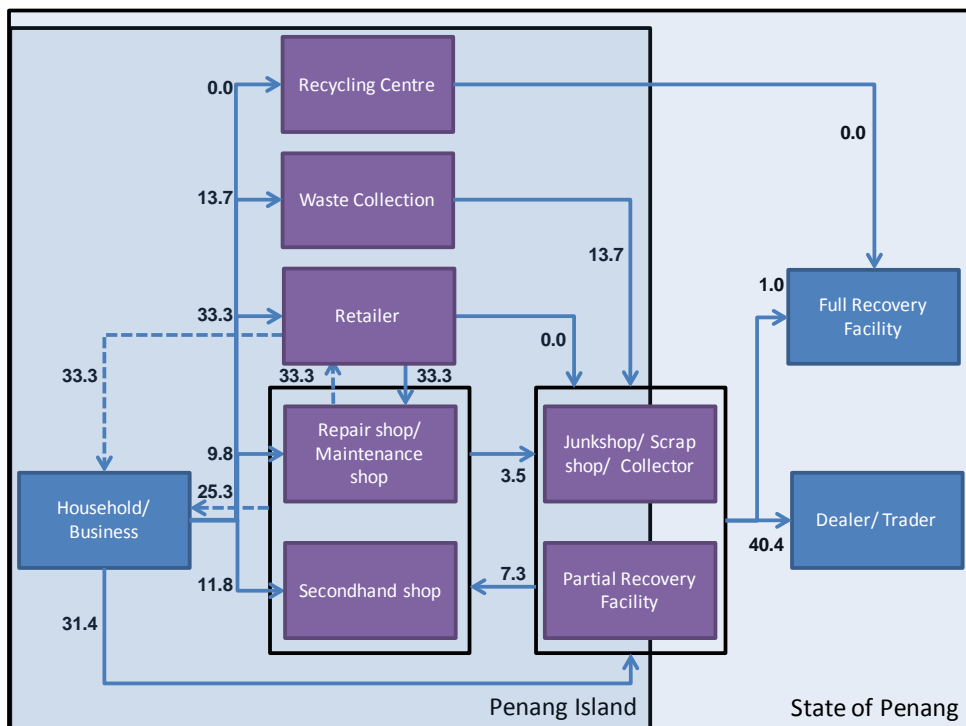
Figure 3-4. E-waste flow of washing machine

(4) Air-conditioner
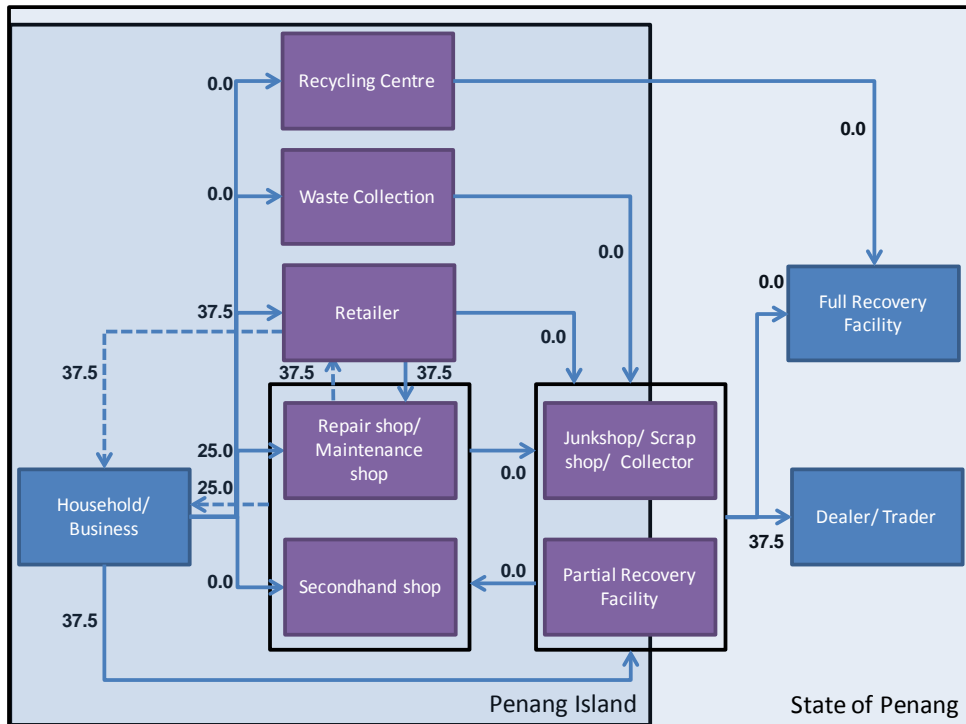
Figure 3-5. E-waste flow of air-conditioner

(5) Personal computer (desktop with CRT and non-CRT)
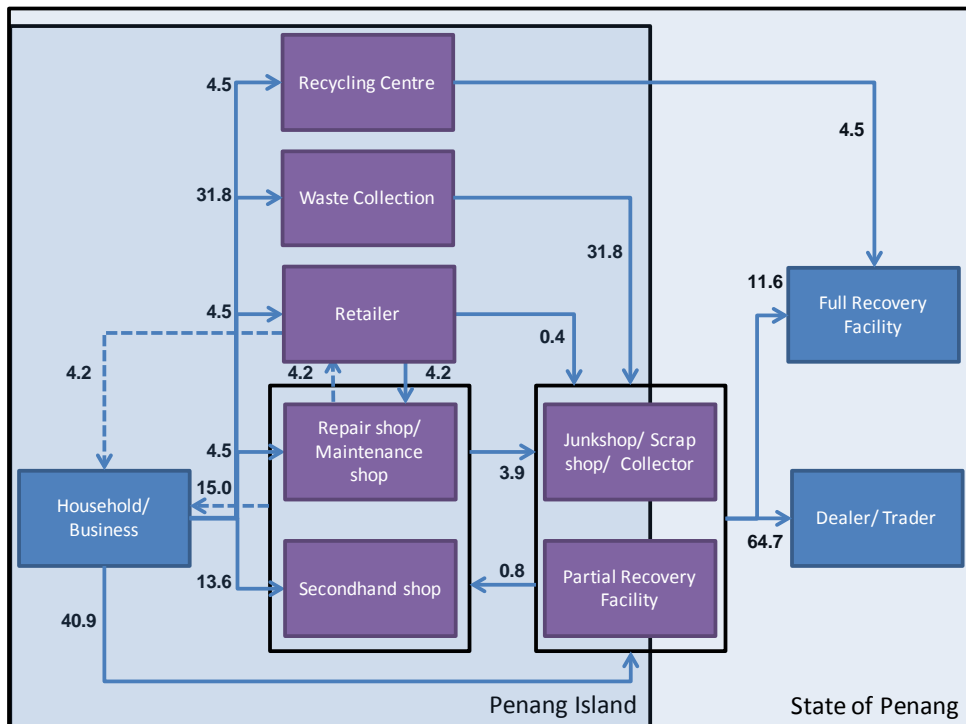
Figure 3-6. E-waste flow of personal computer (desktop with CRT and non-CRT)

(6)   Personal computer (notebook)
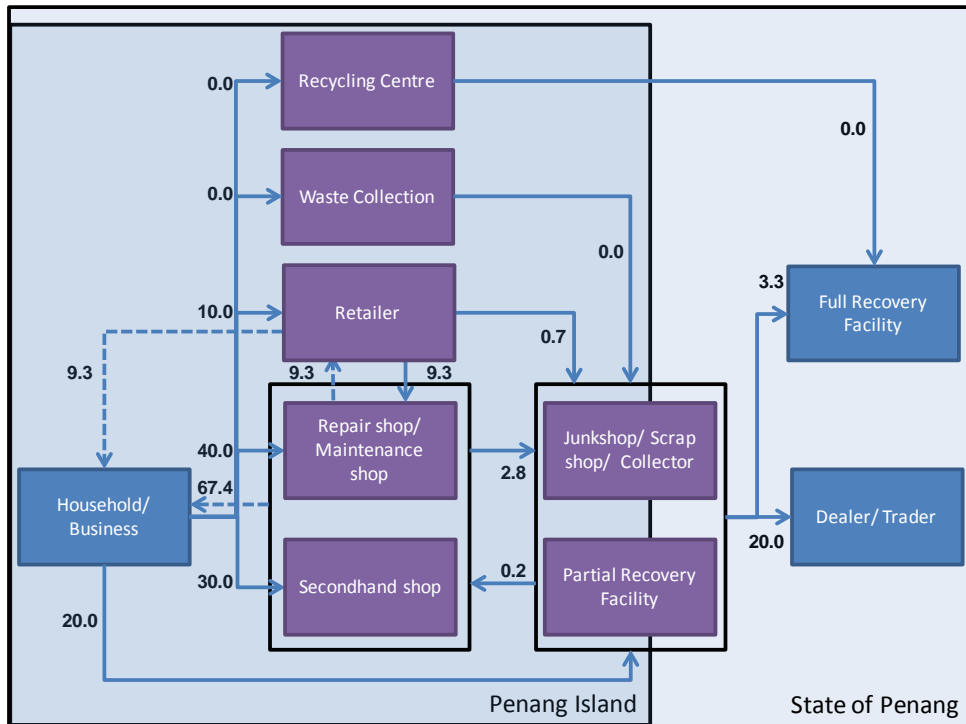
Figure 3-7. E-waste flow of personal computer (notebook)

(7)   Mobile phone
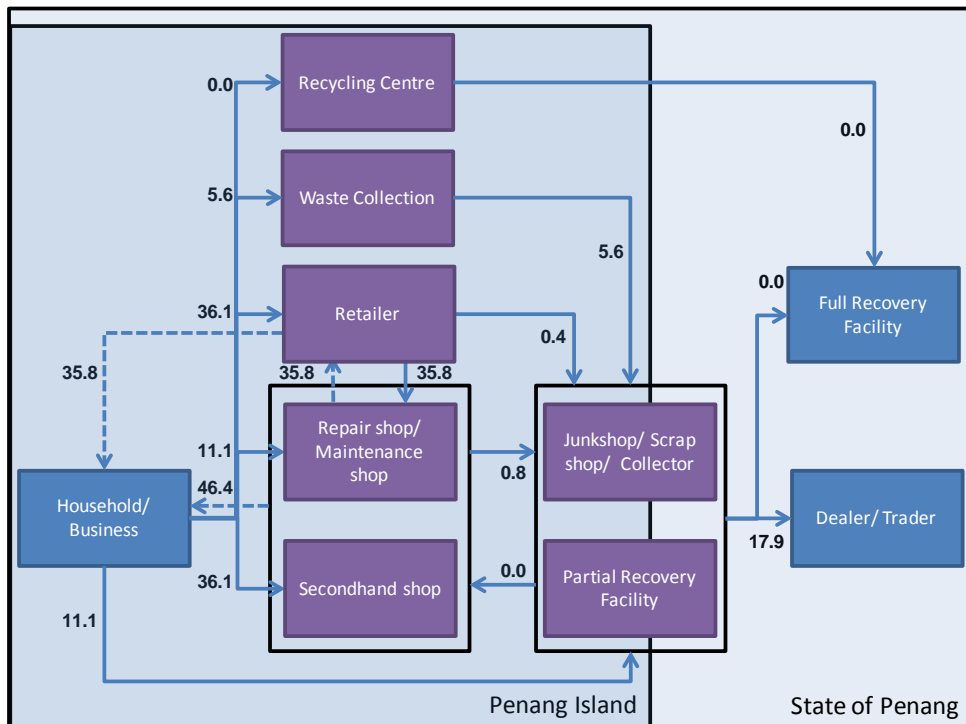
Figure 3-8. E-waste flow of mobile phone

Pilot Project Plan with Evaluation

Contents

Abbreviations

AC	Air-conditioner
CRT	Cathode Ray Tube
DOE	Department of Environment
EEE	Electrical and Electronic Equipment
EPR	Extended Producer's Responsibility
e-waste	Electrical and Electronic Equipment Waste
JICA	Japan International Cooperation Agency
LCD	Liquid Crystal Display
MPPP	Majlis Perbandaran Pulau Pinang
	(Municipal Council of Penang Island)
PC	Personal Computer
Fridge	Refrigerator
TV	Television
WTP	Willingness To Pay

1. PILOT PROJECT PLANNING

1.1 OBJECTIVES AND STRATEGIES

(1) Objectives

a) Objective of the Project

The Project aims at developing an appropriate, effective and efficient e-waste collection system from households. The developed system is expected to be used as a model for expanding it to the nationwide collection system. At the same time, it is expected for DOE to derive policy implications for the future expansion.

b) Objective of the Pilot Project

The Pilot Project aims at testing an appropriate, effective and efficient e-waste collection system from households. The tested system shall supply the data which can be used for discussing a nationwide model for an e-waste collection system as well as a new policy by DOE.

(2) Assumptions and strategies

Some sorts of incentives to the customers are required in order to collect e-wastes from households, where e-wastes are traded as economic goods in the conventional recycling market.

E-waste flow might be controlled by:

- giving economic incentives to consumers,
- giving a convenient and timely e-waste collection service (collecting e-wastes   upon delivery of purchased good and/or upon handing it over at the shop) and
- giving regular buy back service.

1.2 TARGETS

(1) Target e-wastes

The target e-wastes are as stated in the Inception Report, but were classified in detail through the discussions with the related full recovery facilities as follows.

- Television set (Brown Tube Type)
- Television set (Flat Type)
- Refrigerator

- Washing machine
- Air-conditioner (Full set)
- Personal computer (Desktop)
- Personal computer (Notebook)
- Printer
- Mobile phone
- DVD player, VCD player and etc.
- Others (Battery charger, Mobile phone battery, mouse, keyboard, etc.)

(2) Target groups

DOE and the Team discussed and set the target groups as follows.

- MPPP and related governmental organizations
- Local home electric appliance shops
- Local mobile phone shops
- Local hypermarkets
- Local full recovery facilities
- E-products manufactures
- Local NGOs

1.3 COLLABORATION MECHANISM

(1) Collaboration mechanism

a) **"E-waste Alam Alliance – Penang"**

The Pilot Project is discussed in "Local Working Group" chaired by the state government, as shown in the following figure. The Local Working Group was upgraded to "E-waste Alam[1] Alliance –Penang" for the management of the system in the future. This concept can be used for other states in the expansion stage.

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[1] "Alam" means "Environment" in Malaysian.
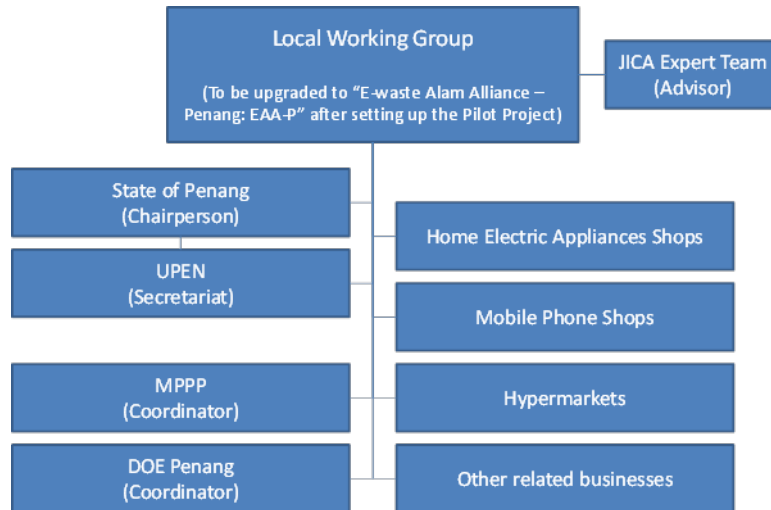
Figure 1-1. Collaboration Mechanism for the Pilot Project

b) Initial members of "E-waste Alam Alliance – Penang"

MPPP and DOE Penang discussed and invited the following companies to "E-waste Alam Alliance – Penang".

Table 1-1. Participants' lists of "E-waste Alam Alliance – Penang"

Business	Company
Home electric appliances shop	Ban Hin Bee
	BEST DENKI
	Loo Soon Seng Electrical
Hypermarket	Giant
	Sunshine
	Tesco
Mobile carrier	Channel Communication & Electronics Centre
	Sun Win Phone Shop
NGO	SPASTIC (The Chrebal Palay Children's Association of Penang)
Full recovery recycling company	Reclaimtek
	Shan Poornam Metals
	TES-AMM

c) Logo

"E-waste Alam Alliance – Penang" discussed the logo as follows. This logo is usable in other area by replacing the symbolic mark on it.

Figure 1-2. Logo of "E-waste Alam Alliance – Penang"

(2) Participation from manufactures

a) **Two types of contributions**

For the Pilot Project, two types of participation were offered. One was "Official Supporter" and the other is "Project Cooperator". The contents of these contributions are shown in the following table. The difference between the two is that "Official Supporter" is publicized, while "Project Cooperator" is not.

The common role of these two types of contributors is to provide the data on their domestic sales in the past, so that the Project Team could calculate the collection rate for each brand of e-products.

Table 1-1. "Official Supporter" and "Project Cooperator"

Item	1. Official supporter	2. Project Cooperator
Contribution to the Pilot Project	- The company is allowed to use the logo that shows the company is one of the official supporters (The Project Team consults a way of usage case-by-case.) - Provision of the data on the past supplies of the related e-products in Malaysia (e.g. number of television sets supplied in Malaysia for the past decade)	- Provision of the data on the past supplies of the related e-products in Malaysia (e.g. number of television sets supplied in Malaysia for the past decade.)
Benefit of participation	- The participants can obtain the data of how much amount of e-waste of its brand was collected in the Pilot Project. - The participants can appeal to the customers, where the Project Team publicizes the participating companies' names to the mass media.	- The participants can obtain the data of how much amount of e-waste of its brand was collected in the Pilot Project.
Others	- Supporters who attended the opening event held on June 2, 2012 at TESCO were appreciated. In the event, some promotion goods were distributed to the general public.	-
Cost	None	None

b) **Participants from manufactures (as of 31 Dec., 2012)**

i) Official Supporter

- Toshiba
- Epson
- Dell
- Another one company

ii) Project Cooperator

- Three project cooperators participated as of 31 Dec., 2012

1.4 CONCEPT OF PILOT PROJECT SYSTEM

(1) Flow Switching

a) **Current problems**

Currently, e-wastes are majorly dealt with by the conventional recyclers whose handling practices are unsure and not monitored. The e-wastes collected by conventional recyclers are

then going to the scrap dealers, where e-waste flow is again not monitored and unsure.
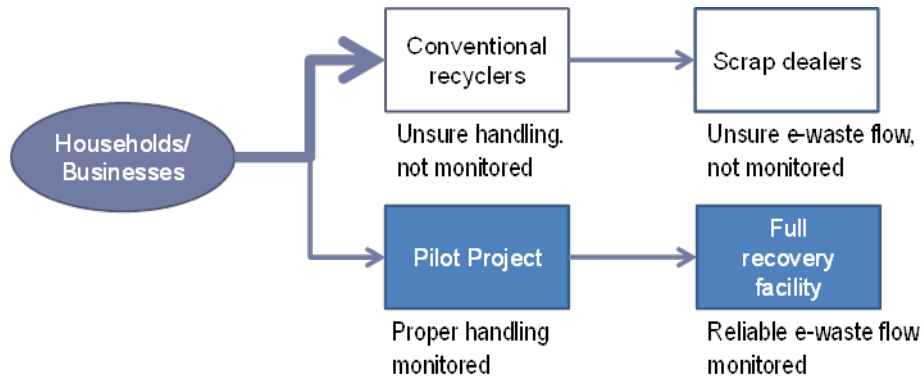
Figure 1-3. Problems of the present major flow of e-waste

b) Flow Switching

For the Pilot Project system to become successful, it is crucial to switch the major e-waste flow from the current flow to a more reliable channel as shown in the following figure.
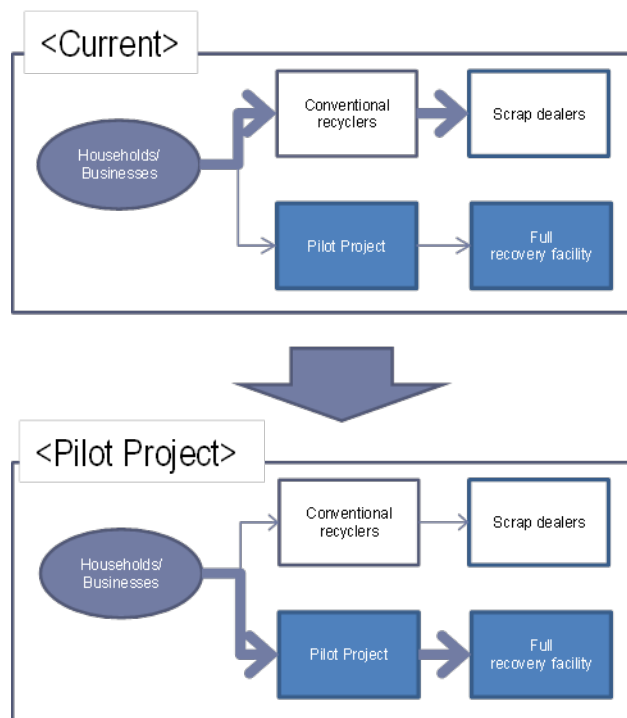
Figure 1-4. Flow Switching in the Pilot Project System

(2) How to switch the flow

To change the e-waste flow means to change the human behavior. The human behavior can be induced by some ways. One of the most effective ways is to use economic incentives.

The reason why e-wastes currently flow to the conventional recyclers is "money". People can get money, when they bring their e-wastes to the nearest conventional recyclers, even the

amount is very small. The new system should include certain economic incentives attractive enough to change the discarders' behavior.

In the Pilot Project System, the buying prices set by the full recovery facilities were offered to the discarders. The prices set by the full recovery facilities are competitive enough compared to the prices shown by the conventional recyclers, because the prices set by the full recovery facilities do not include the trade margins which are taken by the conventional recyclers.

In addition, other incentives were considered in the Pilot Project System. They are labor saving and time saving. People can save their labor to bring their e-wastes to the conventional recyclers, if the e-wastes are collected at their houses. For this, some home electric appliance shops were invited. They can collect e-wastes when they deliver e-products.

Also, as for mobile phones, it is a very good chance to offer end-of-life mobile phones collection upon repurchase at the shop. For this, the cooperation from some mobile phone shops was requested.

Supermarkets are perfect places to collect e-wastes. They have large parking lots and the opening hour is very long. The residents can bring their e-wastes when they come for shopping. This may be very convenient for the customer, which could work as an incentive.
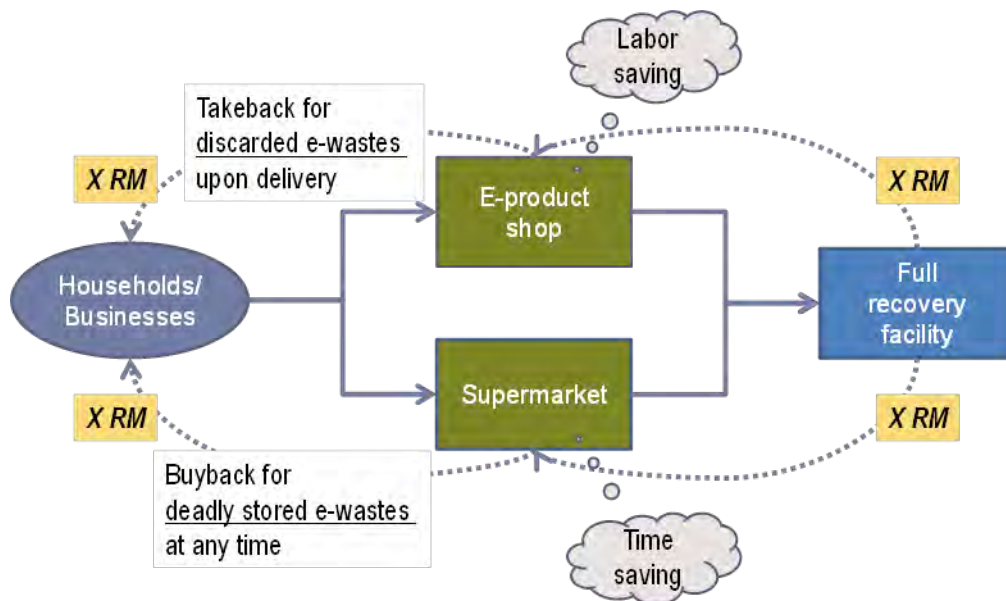
Figure 1-5. Concept of the Pilot Project System

(3) Basic system

a) **E-waste flow**
- Home electric appliances shops collect the e-wastes at customers' houses upon delivery of purchased products. They also receive the e-wastes brought into their shops by customers.

- Mobile phone shops receive end-of-life mobile phones from customers when they repurchase new ones. In addition, even in the case of no repurchasing, they also receive the used mobile phones brought into their shops by customers.
- Hypermarkets receive e-wastes brought by the customers.
- Full recovery facilities collect e-wastes at the shops upon request.
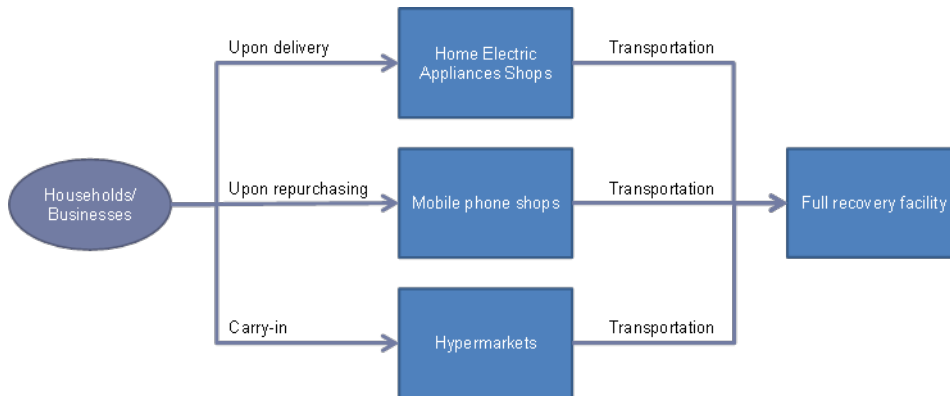
Figure 1-6. E-waste flow in the Pilot Project

b) **Money flow**
- Upon receiving e-wastes from customers, the shop issues e-waste vouchers to the customers.
- The vouchers can be used not only at the shop but also at other shops participating in the Pilot Project.
- Every month, the participating shops can issue the invoices to the full-recovery facility attaching used vouchers.
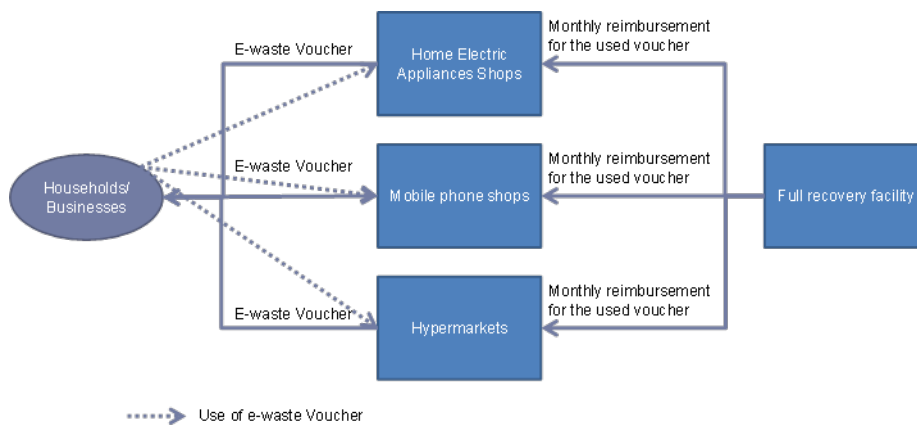
Figure 1-7. Money flow in the Pilot Project

1.5 PILOT PROJECT COMMENCEMENT

(1) Period of the Pilot Project

Period of the Pilot Project was set as follows. MPPP and related organizations are expected to continue it even after the period.

- June 2, 2012 until November 30, 2012 (six months)

(2) Initial participants

The participants who started to collect e-wastes under the new system of the Pilot Project from June 2 were set as follows through the discussions in "E-waste Alam Alliance – Penang". The autonomy of the participating companies was most considered as important.

There was no participation from supermarkets, although it was decided in the "E-waste Alam Alliance – Penang".

"Sunshine" (a nationwide supermarket chain) in Penang Island, SPASTIC (The "Chrebal Palay Children's Association of Penang") and MPPP has conducted a computer collection system. This existing collection system remains in parallel with the new system.

Table 1-2. Participants to start collection of e-waste from June 2

Company name	Business category	Number of shops in Penang Island
Ban Hin Bee (BHB)	Home electric appliance shop	5 (BHB Outlets) 2 (Kitchentech Outlets)
Loo Soon Seng Electrical (LSS)	Home electric appliance shop	3
Channel Communication & Electronics Centre (CCEC)	Mobile phone shop	1
Sun Win Phone Shop	Mobile phone shop	1

(3) Full recovery facility

Full recovery facilities of Shan Poornam and TES-AMM (Malaysia) were selected as recyclers in the meeting of "E-waste Alam Alliance – Penang". Also, it was confirmed that Reclaimtek would continue to support the existing computer collection system.

Shan Poornam and TES-AMM took turns for the transportation weekly, while the invoices from the local businesses were sent to TES-AMM. The two companies collaborated with each other in the financial arrangement.

(4) Initial prices of the common vouchers

a) Price of voucher

The prices of the voucher were set out at what was considered reasonable by the full recovery

facilities by considering the assumed metal concentration depending on the types of the e-wastes, as shown in the following table. It was concluded to use the prices as tentative ones, because the data on the metal concentration of the e-wastes to be collected from households are not well accumulated yet, as well as the prices of the metals are fluctuating according to the metal market. These initial prices are to be reconsidered later after the commencement of the Pilot Project.

Table 1-3. Initial prices of e-wastes

E-waste	Price	Remarks
Television set (Brown Tube Type)	RM12/Unit	
Television set (Flat Type)	RM15/Unit	
Refrigerator	RM10/Unit	
Washing machine	RM10/Unit	
Air-conditioner	RM20/Unit	Full set
Personal computer (Desktop)	RM5/Unit	
Personal computer (Notebook)	RM5/Unit	
Printer	RM1/Unit	
Mobile phone	RM40/Unit	By a lucky draw with 10% hits
DVD player, VCD player and etc.	RM2/Unit	
Others	RM0/Unit	Battery charger, Mobile phone battery, mouse, keyboard, etc.

b) Design of voucher

Vouchers were designed so as not to be forged. Special stickers were used on the voucher for this purpose.
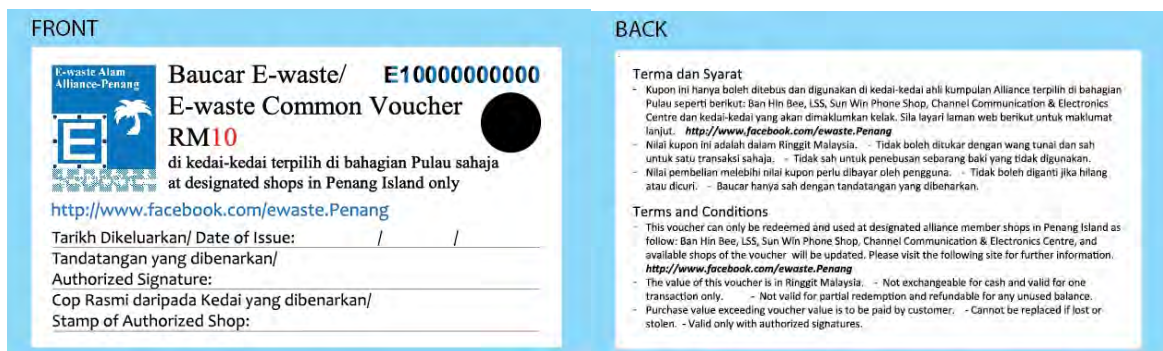
Figure 1-8. Common Voucher (Left: front, Right: rear)
(Note) The dot means a special sticker so as not to be forged.

1.6 INFORMATION MANAGEMENT

(1) Information management system
- Shops issue the receipt with four-ply. The four-ply receipts are given to 1) the customer, 2) shops, 3) full recovery facility and 4) "E-waste Alam Alliance".

- When the collected e-wastes are sent to full recovery facilities, the transportation slip is issued by the shops. The three-ply transportation slips are given to 1) shops, 2) full recovery facilities and 3) "E-waste Alam Alliance".
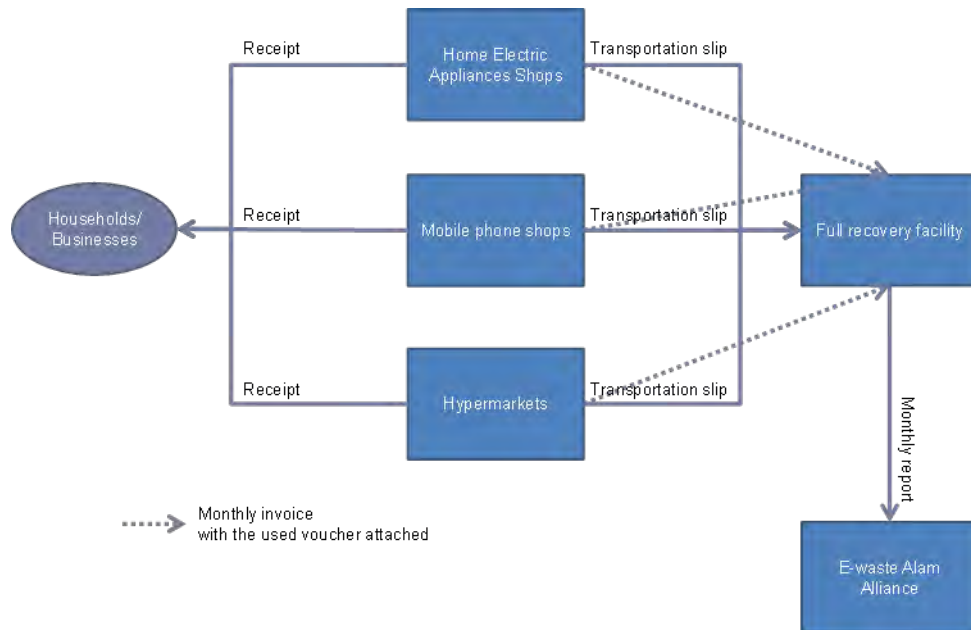
Figure 1-9. Information flow in the Pilot Project

(2) Information forms

a) E-waste receipt

There are two kinds of e-waste receipts. One is for home electric appliance shops and supermarkets, and the other is for mobile phone shops which collect only mobile phones.

The e-waste receipts comprise 1) purchased units of new products, 2) number of e-wastes applied and 3) brands of the e-wastes. By using the information on brands of e-wastes, the data of amount of e-wastes by brands can be collected.

Figure 1-10. E-waste receipt for home electric appliance shops and supermarkets

Figure 1-11. E-waste receipt for mobile phone shops

b) Transportation slip

The transportation slip shown in the following figure is commonly used by the different types of shops.

Figure 1-12. E-waste transportation slip

c) **Other data to be collected**

In addition to the abovementioned data, the following data are to be collected, though not continuously.

- Required time and cost for e-waste collection by home electric appliance shops
- Required time and cost for e-waste transportation by full recovery facilities

(3) Data compilation

a) **The amount of e-waste collected**

For the environment, certain amount of e-waste shall be guided to the appropriate recycling routes. Collection percentage of e-waste supplied in the past can be calculated for each brand.

b) **Cost structures of the participants in the Pilot Project**

Certain amount of money is needed for collecting e-wastes properly. How much money is required and how it is borne among the participants will be calculated[2].

1.7 ADVERTISEMENT

(1) Events

Two kinds of events are planned for celebrating the launching of the Pilot Project. The mass media were invited to widely announce the Pilot Project.

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[2] This does not necessarily mean the direct cost bearing. For example, the home electric appliance retailers can contribute by providing the takeback service to the customers upon delivery of the new products. The labor cost can be converted in terms of money.

a) Launching workshop

i) Date and place

- June 1, 2012 (Friday) from 9:00 to 12:00 at E&O Hotel

ii) Program

- Speeches by the related organizations for celebrating the launching
- Explanation of the concept of the Pilot Project
- Presentation by the participating local businesses

b) Launching outdoor event

i) Date and place

- June 2, 2012 (Saturday) from 16:00 to 17:30 at Straits Quay
- Exhibition from 12:00 until 21:00

ii) Program

- Speeches by the related organizations for celebrating the launching
- Traditional dance and songs for celebrating the launching
- Lucky draw of latest e-products (gifts were provided from e-products manufactures)
- Stamp rally in the exhibition booths for a small gift

iii) Exhibition booths

- Related organizations
- Participating local businesses
- Full recovery facilities
- Official Supporters from e-products manufactures
- Project Team

(2) Promotion Goods

One of the most difficult points regarding promotion goods to advertise the Pilot Project is its flexibility. The promotion goods cannot be used longer, if the information changes, e.g., replacement of participating local businesses, project period, etc. For this reason, only general information was printed on the promotion goods.

Utilization of "Facebook" page was proposed by a local business in order to provide further information. The promotion goods were designed so as to guide the customer to the Facebook page.

Figure 1-13. Promotion goods for guiding the Facebook page

2. EVALUATION PLAN AND THE PRE-EVALUATION

2.1 EVALUATION SYSTEM

(1) Evaluation Criteria

Five criteria from No. 1 to 5 shown in Figure 2-1 below are commonly used for evaluating the JICA projects. The sixth criteria "Applicability" was added this time by considering that one of the objectives of the Pilot Project is to develop a model applicable to the other area in Malaysia.

Evaluation Aspects		
	1. Validity	Does the system work?
	2. Effectiveness	Is the performance of the system effective?
	3. Efficiency	Is the cost for the system low enough?
	4. Impact	Does the system give any positive/negative impacts?
	5. Sustainability	Is the system sustainable in the future?
	6. Applicability	Can the system applied to other areas?
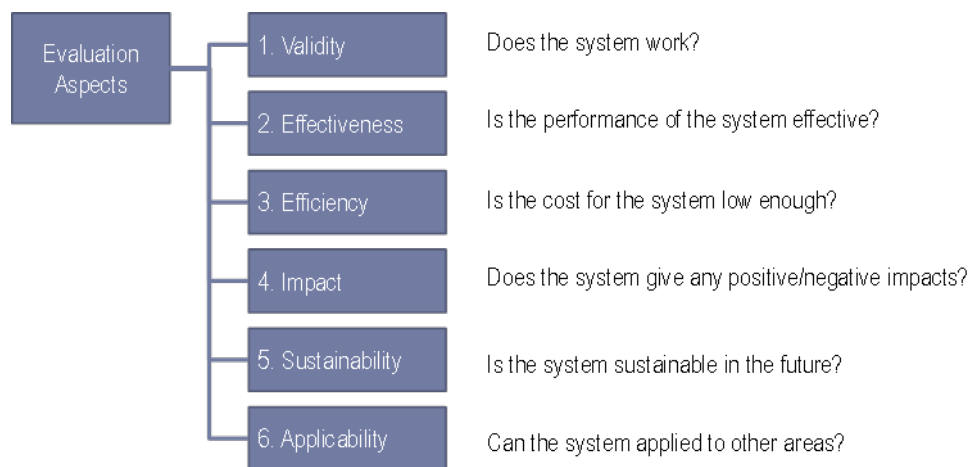
Figure 2-1. Evaluation Criteria of the Pilot Project

(2) Evaluation indicators

Twelve indicators based on the criteria were set as shown in Figure 2-2.

Validity
1. Physical validity
2. Economic validity

Effectiveness
1. Change of discarding behavior
2. Collection rate
3. Policy effect

Efficiency
1. Required cost

Impact
1. Effect on EPR policy making
2. Influence to the informal and conventional recyclers

Sustainability
1. Autonomous management after the Pilot Project
2. Budget after the Pilot Project

Applicability
1. Planning and implementation in other areas without Japanese Experts
2. Any unique factors of the Pilot Project in Penang

Figure 2-2. Evaluation indicators

(3) Explanation of evaluation indicators and measuring method

Evaluation indicators and measuring methods are summarized in Table 2-1.

Table 2-1. Evaluation Indicators and Measuring Methods

Evaluation Criteria	Evaluation indicators	Explanation of the evaluation indicators	Measuring methods
1. Validity	1.1 Physical validity	This indicator expresses the requirements from the consumers and the capacities of the local businesses participating in the Pilot Project.	- By interviews and observations
	1.2 Economic validity	Among many economic aspects regarding the Pilot Project, the price of common voucher shown to the consumer are to be used in evaluation from the viewpoint of validity. If the price is not attractive for the customer compared with the price shown by the conventional recyclers, the e-waste collection by the Pilot Project does not work well.	$P_{pp} \cong P_{cr}$ *where:* P_{pp}:*Price of the common vouchers used in the Pilot Project* P_{cr}:*Price in the conventional recyclers* *This means that anyone will not discard to the Pilot Project System, if the price of it is much lower than the price shown by the conventional recyclers.*
2. Effectiveness	2.1 Change in the discarding behavior	The Pilot Project System was designed so as to change the e-waste flow from the conventional route to the new route. This indicator expresses how many people changed their behavior.	"Participation Rate" to the Pilot Project route is defined as: Participation Rate=$\dfrac{X_{pp}}{X_{purchased}*(1-r_r)}$ *where:* X_{pp}: *Amount of e-waste collected by the Pilot Project* $X_{purchased}$: *Amount of e-products purchased by the customers* r_r: *Rate of e-waste to be repaired and reused* *The reason why r_r was considered is that the Pilot Project System was designed so as not to change the flow of e-waste to be repaired. The Pilot Project System is not competitive to the repaired route, because the price of e-waste to be repaired is very high compared with the price shown in the Pilot Project.*
	2.2 Collection rate	This is one of the most basic indicators that show the performance of the System, where the e-waste flow change was set as the objective. This can be calculated for each manufacture.	Collection rate is defined as: Collection rate=$\dfrac{X_{pp}}{X_{past}*(1-r_r)}$ *where:* X_{pp}: *Amount of e-waste collected by the Pilot Project* X_{past}: *Amount of e-products sold in the past (the years considered depend on the types of e-waste)* r_r: *Rate of e-waste to be repaired and reused*
	2.3 Policy effect	The change of e-waste flow can be interpreted from the context of new policy introduction by using three indexes: 1. Hazardousness, 2.	Three indexes are defined as: 1. Hazardousness=$1-\dfrac{FR}{W}$ (in terms of lead) 2. Resource recovery=$\dfrac{FR}{W}$ (in terms of

Evaluation Criteria	Evaluation indicators	Explanation of the evaluation indicators	Measuring methods
		Resource recovery and 3. Traceability.	precious metals) 3. Traceability=$\frac{FR}{W}$ (in terms of e-waste). *where:* *W: the amount of discarded e-waste (excluding repair)* *FR: the amount of e-waste going to the full recovery facilities*
3. Efficiency	3.1 Required cost	This is one of the most basic indicators. The required cost can be evaluated by comparing with the alternative system cost. Collection service provided by MPPP was set as the alternative system.	$C_{pp} < C_{cc}$ *where :* *C_{pp}: Required cost for the Pilot Project* *C_{cc}: Required cost by the conventional collection method*
4. Impact	4.1 Effect on EPR policy making	If the manufactures are involved in the Pilot Project, the consensus making on EPR policy would be easier. This indicator expresses how the implementation of the Pilot Project affects the consultation with the manufactures.	- By interviews and observations
	4.2 Influence to the informal and conventional recyclers	This indicator expresses how the change of e-waste flow affects the informal and conventional recyclers.	- By interviews and observations
5. Sustainability	5.1 Autonomous management after the Pilot Project	This indicator expresses whether the system can be managed by the related local organizations autonomously even after the Pilot Project.	- By interviews and observations
	5.2 Budget after the Pilot Project	This indicator expresses that the system is not financially sustainable, if the system require certain amount management cost.	$C_m << C_t$ *where:* *C_m: Management cost* *C_t: Total money flow in terms of the issued common voucher* *Here, the management cost was compared with the total money flow. This means the management cost is much cheaper than the total money flow, the system itself might be affordable to cover the management cost.*
6. Applicability	6.1 Planning and implementation in other areas without Japanese Experts	This indicator expresses the human resource availability when expanding to other areas.	- Capacities of counterparts ("Capacity Assessment Sheet" will be used.) *If the counterparts got the know-how, they can provide advices to other areas.*
	6.2 Any unique factors of the Pilot Project in Penang	This indicator expresses whether the system is replicable to other areas. If the system contains any unique factors of Penang, the replicabilitiy is low.	- Capacities of counterparts ("Capacity Assessment Sheet" will be used.) - Distance to the nearest full recovery facilities *Two factors were selected as ones which might be unique to Penang area.*

2.2 PRE-EVALUATION BEFORE THE COMMENCEMENT

The pre-evaluation of the Pilot Project before its commencement can be summarized as shown in the following table.

Table 2-2. Pre-evaluation of the Pilot Project before the commencement

valuation aspect	Evaluation indicators	Pre-evaluation
1. Validity	1.1 Physical validity	As shown below, the "Physical Validity" is considered as acceptable except the supermarkets. However, the measures to have supermarkets participate would be sought, because it is very convenient for the customers. <Consumer> The following results have been obtained from the questionnaire survey on households. - Utilization rate of the existing MPPP's collection centers is about 7%. The main reasons why people don't use the center are described as "too heavy to carry", "limited opening time" and "distance". - Approximately 70% of the people answered that they would participate in the system if the condition such as "Service taking away from inside the house", "The collection center is located near to my house" and "exchangeable with high value coupon" are met. <Home electric appliance shops and mobile phone shops> Based on the discussion in the working group, this system was selected from among multiple alternatives that were presented, and two home electric appliance shops and two mobile phone shops participated in the Pilot Project. <Supermarkets> Supermarkets might be afraid of occurrence of additional costs such as labor costs for operation of collection centers and the costs of keeping e-wastes. Some supermarkets tried to reduce this additional cost by out-sourcing it to a recycler, but so far supermarkets have not decided to participate in the Pilot Project. Participation of supermarkets is still awaited, because it is convenient for customers. Also the common voucher will be more attractive, if it can be used in supermarkets. <Full recovery facilities> Full recovery facilities showed a positive attitude towards the Pilot Project, such as an interest in the increased opportunities to access technological improvement and better knowledge for recycling.
	1.2 Economic validity	As shown below, the prices of the common voucher P_{pp} are generally lower than the prices P_{cr} shown by the conventional recyclers, which might be resulted in lower participation rate. However, "WTP" (willingness-to-pay) distribution will be drawn, which tells us how much amount of incentive is required to attain the certain rate of collection. Also, the labor-saving and time-saving aspects of the Pilot Project will be considered. Table. Comparison of the prices of the conventional recyclers and the Pilot Project

	Price (RM/kg)		Price (RM/unit)	
	CR		Pilot Project	CR		Pilot Project
Television (CRT)	0.32	<	0.38	10	<	12
Television (Non-CRT)	0.32	<	0.48	10	<	15
Refrigerator	0.28	>	0.19	15	>	10
Washing machine	0.39	>	0.27	15	>	10
Air-conditioner	1.39	>	0.45	62	>	20
PC (Desktop/ CRT)	1.04	>	0.48	11	>	5
PC (Desktop/ Non-CRT)	1.04	>	0.48	11	>	5
PC (Notebook)	4.25	>	1.75	12	>	5

valuation aspect	Evaluation indicators	Pre-evaluation

Mobile phone	2.00	<	17.02	0	<	4
Printer	ND	-	0.20	ND	-	1
DVD player, etc.	ND	-	0.50	ND	-	2
Others	ND	-	0	ND	-	0

(Note) CR: Conventional Recycler

2. Effectiveness

2.1 Change of discarding behavior

"Participation Rate" of each product can be calculated as shown below by assuming the WTP distribution is linear. As shown later, the average "Participation Rate" is estimated as 37%. Necessary incentive for attaining higher target rate will be considered by analyzing the data obtained from the Pilot Project.

Expected "Participation Rate" to the Pilot Project can be estimated shown in the following table by setting some assumptions shown in Appendix 1.

Table. Expected participation rate to the Pilot Project

	Price in the Pilot Project (RM/unit)	Price of the conventional recyclers (RM/unit)	Expected participation rate to the Pilot Project (%)
Television (CRT)	12	10	59
Television (Non-CRT)	15	10	74
Refrigerator	10	15	33
Washing machine	10	15	34
Air-conditioner	20	62	16
PC (Desktop/ CRT)	5	11	23
PC (Desktop/ Non-CRT)	5	11	23
PC (Notebook)	5	12	21
Mobile phone	4	0	100
Printer	1	ND	ND
DVD player, etc.	2	ND	ND
Others	0	ND	ND

2.2 Collection rate

The collection rate can be calculated by using the figures shown in the above table. The total collection rate is 37%.

Table. Expected collection rate

	Discarded amount (excluding repair) (ton/year) (Year 2012)	Expected participation rate to the Pilot Project (%)	Expected amount from the Pilot Pr (ton)
Television (CRT)	2,274	59	
Television (Non-CRT)	336	74	
Refrigerator	774	33	
Washing machine	354	34	
Air-conditioner	1,385	16	
PC (Desktop/ CRT)	1,080	23	
PC (Desktop/ Non-CRT)	727	23	
PC (Notebook)	81	21	
Mobile phone	21	100	
Total	7,032	38	

The expected amount of e-waste collected by the local businesses participating in the Pilot Project is 144ton/year (12 ton/month) corresponding to 2% of the total e-waste discarded in Penang Island in year 2012 (See Appendix 2).

2.3 Policy effect

By using the substance flow analysis explained in "ANNEX I" of the "Progress

valuation aspect	Evaluation indicators	Pre-evaluation
		Report (1)", the three indexes can be estimated as below. 1. Hazardousness=$1 - \frac{FR}{W}$ ($in\ terms\ of\ lead$)=42% (Present value=88%) 2. Resource recovery=$\frac{FR}{W}$ ($in\ terms\ of\ precious\ metals$)=40% (Present value=19%) 3. Traceability=$\frac{FR}{W}$ ($in\ terms\ of\ e-waste$)=43% (Present value=9%)
3.Efficiency	3.1 Required cost	Required cost C_{pp} for the Pilot Project is nearly zero, because it can be pressed by the retailers, while the current collection cost C_{cc} by MPPP requires RM270 per ton. Then, $C_{pp} < C_{cc}$. Rem: RM270=$\dfrac{Cost\ for\ outsourcing\ to\ private\ companies\ (\frac{RM}{year})}{Total\ weight\ collected\ by\ the\ private\ companies\ (\frac{ton}{year})}$
4. Impact	4.1 Effect to EPR policy making	As shown below, the Pilot Project is giving positive impacts to the policy making on EPR. Two kinds of participation were offered for the manufactures. One is "Official Supporter" and the other one is "Project Cooperator". As of May 31, five brands participated in two participation scheme. Manufacturers also have a great interest for EPR policies that the government will consider. Manufacturers are taking an active part in the Pilot Project by participating in the workshop, sharing information and also joining "Official Consultative Meeting" coordinated by DOE.
	4.2 Influence to the informal and conventional recyclers	As shown below, the negative impacts on the informal and conventional recyclers are considered to be small. Personal recyclers and conventional recyclers dealing with recyclables are existent. However, many of them are collecting paper, plastic and iron. Therefore, the impact of the Pilot Project focusing on collecting e-waste is considered not significant.
5.Sustainability	5.1 Autonomous management after the Pilot Project	The "E-waste Alam Alliance – Penang", which was coordinated by the local businesses is capable of taking the responsibility of conducting continuous monitoring and maintenance.
	5.2 Budget after the Pilot Project	As shown below, the total amount of the common vouchers C_t to be issued will be much higher than the management cost required C_m. The total amount of the common vouchers to be issued can be estimated as 1,426 thousand RM. Table. Total amount of the common vouchers issued annually
6. Applicability	6.1 Planning and implementation in	The capacity assessment sheet tells that the counterparts understand the progress of the Pilot Project very well so far.

Table. Total amount of the common vouchers issued annually

	Price of voucher (RM/kg)	Expected amount (ton)	Total amount of voucher issued (1000RM/year)
Television (CRT)	0.38	1,342	510
Television (Non-CRT)	0.48	249	120
Refrigerator	0.19	255	48
Washing machine	0.27	120	32
Air-conditioner	0.45	222	100
PC (Desktop/ CRT)	0.48	248	119
PC (Desktop/ Non-CRT)	0.48	167	80
PC (Notebook)	1.7	17	29
Mobile phone	17	21	357
Total	0.54	2,641	1,426

valuation aspect	Evaluation indicators	Pre-evaluation
	other areas without Japanese Experts	
	6.2 Any unique factors of the Pilot Project in Penang	According to the capacity assessment sheet, the capacities of MPPP and DOE Penang are very high. This might be an obstacle when the Pilot Project will be copied to other areas as a model. However, this means that they can help related organizations in other areas introduce the similar system. The distance of the Pilot Project area from the full recovery facilities in charge of transportation is around 20 km. This is not considered one of the unique factors in Penang Island.

2.3 EVALUATION PLAN

The evaluation indicator will be monitored as shown in the following table.

Table 2-3. Evaluation plan

Evaluation Aspect	Evaluation indicator	Evaluation plan
1. Validity	1.1 Physical validity	- Continuous interviews and observations
	1.2 Economic validity	- Discussion with the full recovery facilities in charge on the prices
2. Effectiveness	2.1 Change in the discarding behavior	- Data from the monitoring sheets - "Willingness-To-Pay" Analysis - "Questionnaire Survey" to customers (September 2012)
	2.2 Collection rate	- Data from the monitoring sheets
	2.3 Policy effect	- Data from the monitoring sheets with the substance flow analysis model
3. Efficiency	3.1 Required cost	- "Questionnaire Survey" to the related retailers and the full recovery facilities
4. Impact	4.1 Effect to EPR policy making	- Continuous interviews and observations
	4.2 Influence to the informal and conventional recyclers	- Continuous interviews and observations
5. Sustainability	5.1 Autonomous management after the Pilot Project	- Continuous interviews and observations
	5.2 Budget after the Pilot Project	- Data from the monitoring sheets
6. Applicability	6.1 Planning and implementation in other areas without Japanese Experts	- "Capacity Assessment Sheet"
	6.2 Any unique factors of the Pilot Project in Penang	- "Capacity Assessment Sheet" - Transportation data of the full recovery facilities

3. PILOT PROJECT IMPLEMENTATION

3.1 PARTICIPATING RETAILERS

As explained in 1.5(2), the Pilot Project was commenced with 12 shops and the participants increased to 25 shops as shown in the following table. Some official supporters were quite active in introducing the shops to participate and the Project Team tried to ask the initial retailers to introduce the other potential retailers which may participate in the Pilot Project.

Table 3-1 Participating retailers (as of December 2012)

Business type	Company name	Number of shops
E-products retailers (Trade-in and Walk-in)	LSS (Loo Soon Seng Electrical)	3
	BHB (Ban Hin Bee)	7
	TC Electrical Centre	1
	Wah Lee Chain	1
Total 15 shops	Chop Seng Hock Electrical (CSH)	3
Mobile phone shop (Walk-in)	Channel Communication & Electronics Centre	1
	Sun Win Phone Shop	1
	Innomax Telecommunication Centre	1
	Impian Communication	1
Total 5 shops	Multi Communication Enterprise	1
Personal Computer Shop (Walk-in)	Gadgetzone	2
	NC Computer / Nanyang Digital	1
	Mind Maker	1
Total 5 shops	E-Tech Computer	1
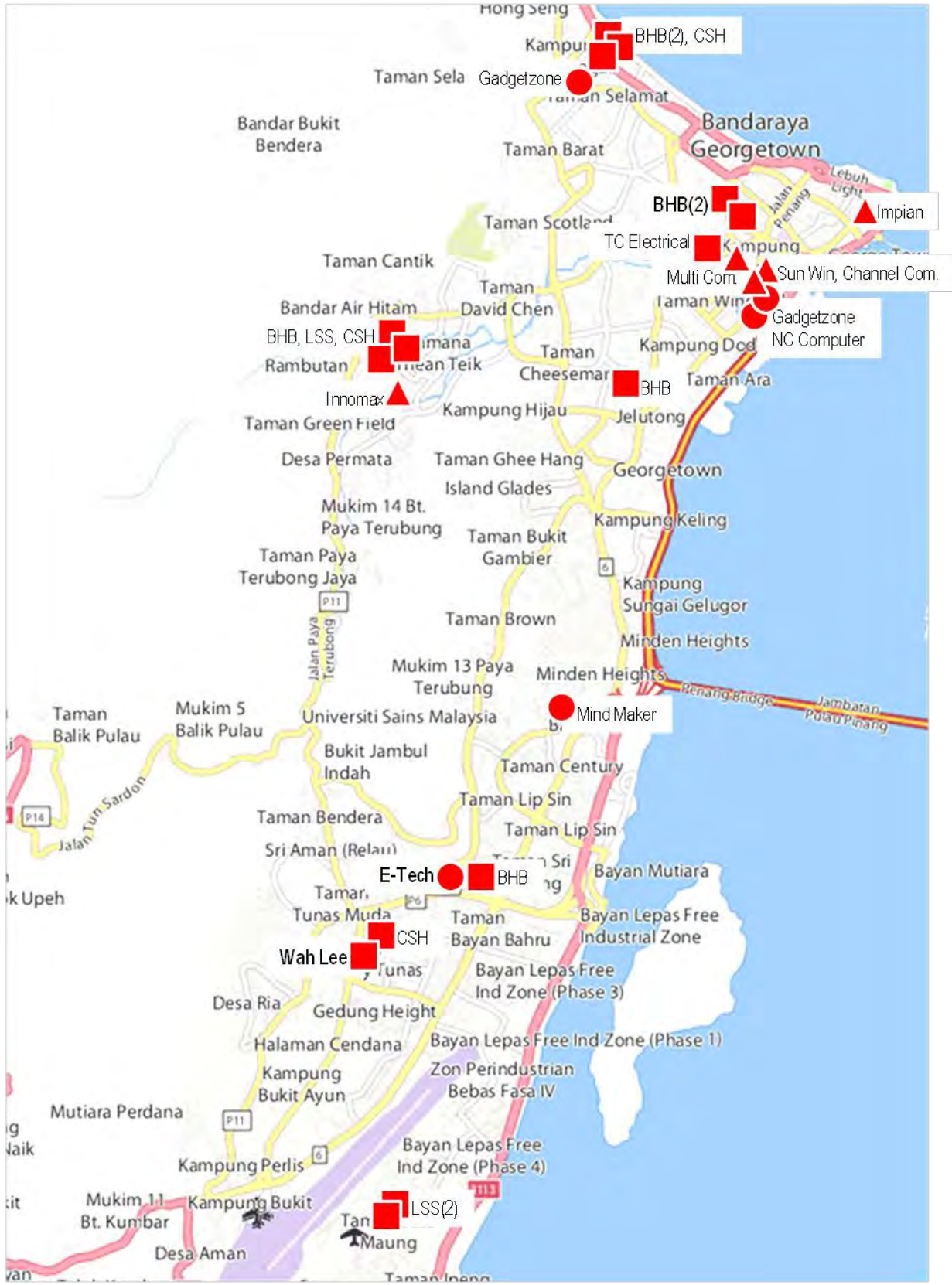
Figure 3-1. Location of the participating retailers

Legend) Square: Home electric appliance shop, Triangle: Mobile phone shop, Circle: Computer shop

3.2 COLLECTED E-WASTES

(1) Collected e-wastes in terms of number and weight

The raw data of collected e-waste in terms of unit and weight are shown in Figure 3-2 and Figure 3-3. Mobile phones collected was the most in terms of number, and bulky e-wastes such as television sets, refrigerators and washing machines were major in terms of weight.
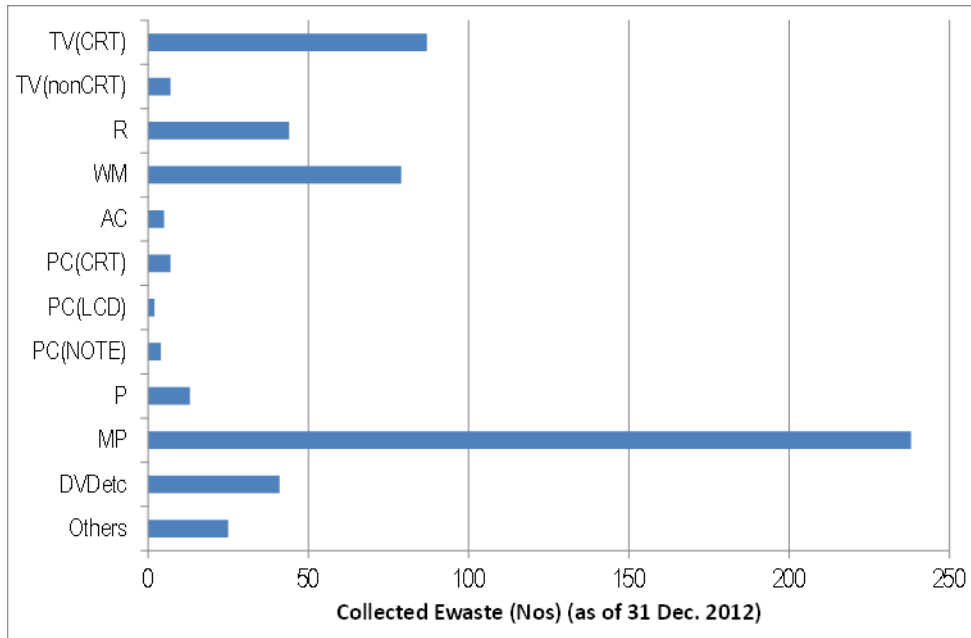
Figure 3-2. Number of collected e-waste (as of 31 Dec. 2012)
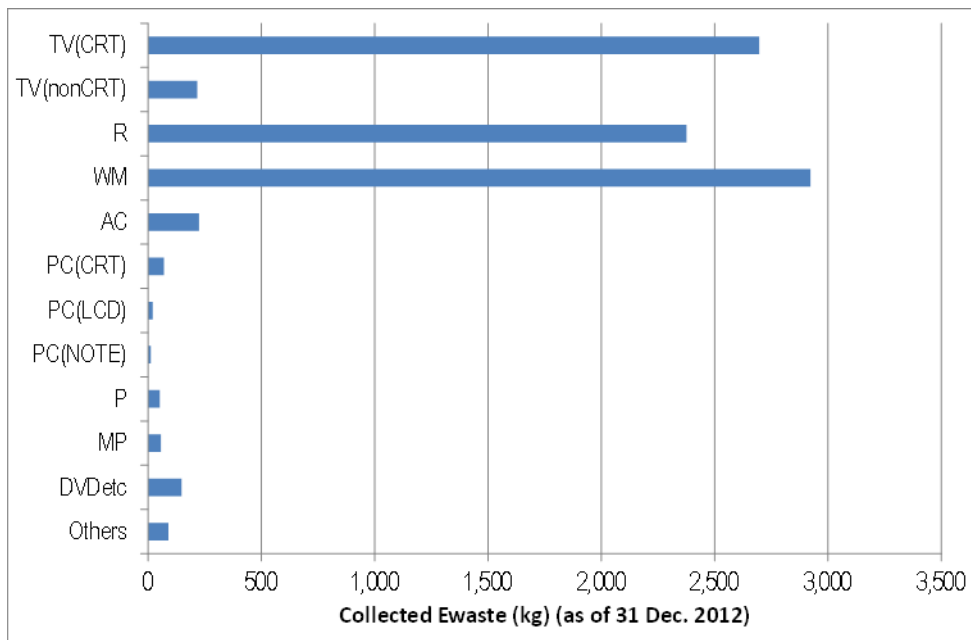
Figure 3-3. Weight of collected e-waste (as of 31 Dec. 2012)

(2) Scenes of e-waste collection

The following photographs are the scenes of the Pilot Project.

Figure 3-4. E-waste collected by "Walk-in" (LSS)

Figure 3-5. E-waste stored (LSS)

Figure 3-6. Mobile phones collected (Sun Win Phone Shop)

Figure 3-7. E-waste stored (BHB)

Figure 3-8. E-waste transportation by the full recovery facility (at LSS transported by TES-AMM Malaysia)

3.3 INTERPRETATION OF THE AMOUNT OF E-WASTES COLLECTED

(1) Cooperation rate

Here, the raw data are interpreted into the cooperation rate defined by the following expression.

- $CR = \frac{Q}{W*MS} * \frac{1}{r}$.

Where

- Q : Quantity of e-waste collected
- W : Number of e-waste discarded in Penang Island in a year
- MS : Market share of the participating retailer
- r : recognition rate of the Pilot Project (the rate of people who know about the Pilot Project)
  As for television sets and air conditioners, the cooperation rates were calibrated by several factors explained in Appendix 3.

The calculated cooperation rates are shown in the following figure. The expected cooperation rates obtained from the questionnaire survey conducted in October 2012 were also shown in the same figure.

The cooperation rate of air conditioners is much lower than the questionnaire survey. One of the reasons for this is that the shops outsource installation of air conditioners to other companies and cannot ask them take back old air conditioners.

In the Pilot Project, no computer or printer was collected in the participating five computer shops, although they started the collection from October 2012. The data used for computers and printers was taken in home electric appliance shops which do not trade any computer or

printer. The cooperation data of computers and printers are tentative.
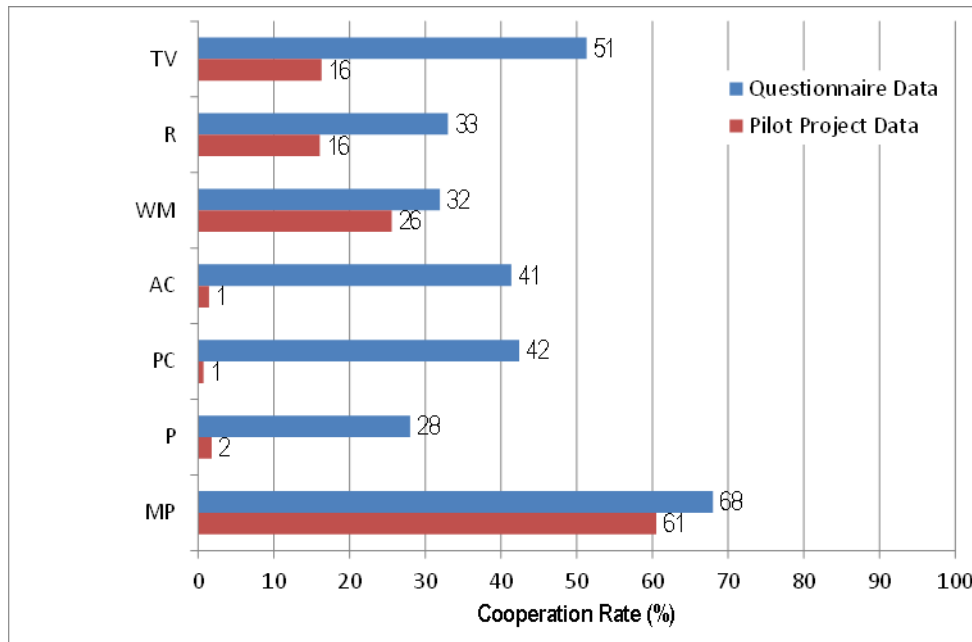
Figure 3-9. Comparison of the cooperation rates obtained from the Pilot Project and the questionnaire survey

(2) Willingness to be paid curve

The willingness to be paid (WTP) curve can be drawn by using the cooperation rates and the market prices as shown in the following figure.

The WTP curve gives us the appropriate voucher price needed for achieving the target collection rate.

As for television sets and air conditioners, people do not respond to the change in the voucher prices, while people are affected by the voucher prices as for other e-wastes. This means that the collection rate can be controlled by changing the voucher prices for items other than television sets and air conditioners. For television sets and air conditioners, it is not wise to control the collection rates by the voucher prices. Instead, any other measures for increasing the collection rates are necessary.

In addition, the tentative data were used especially for personal computers and printers. It is advisable that data accumulation is very important for further analysis especially for personal computers and printers.
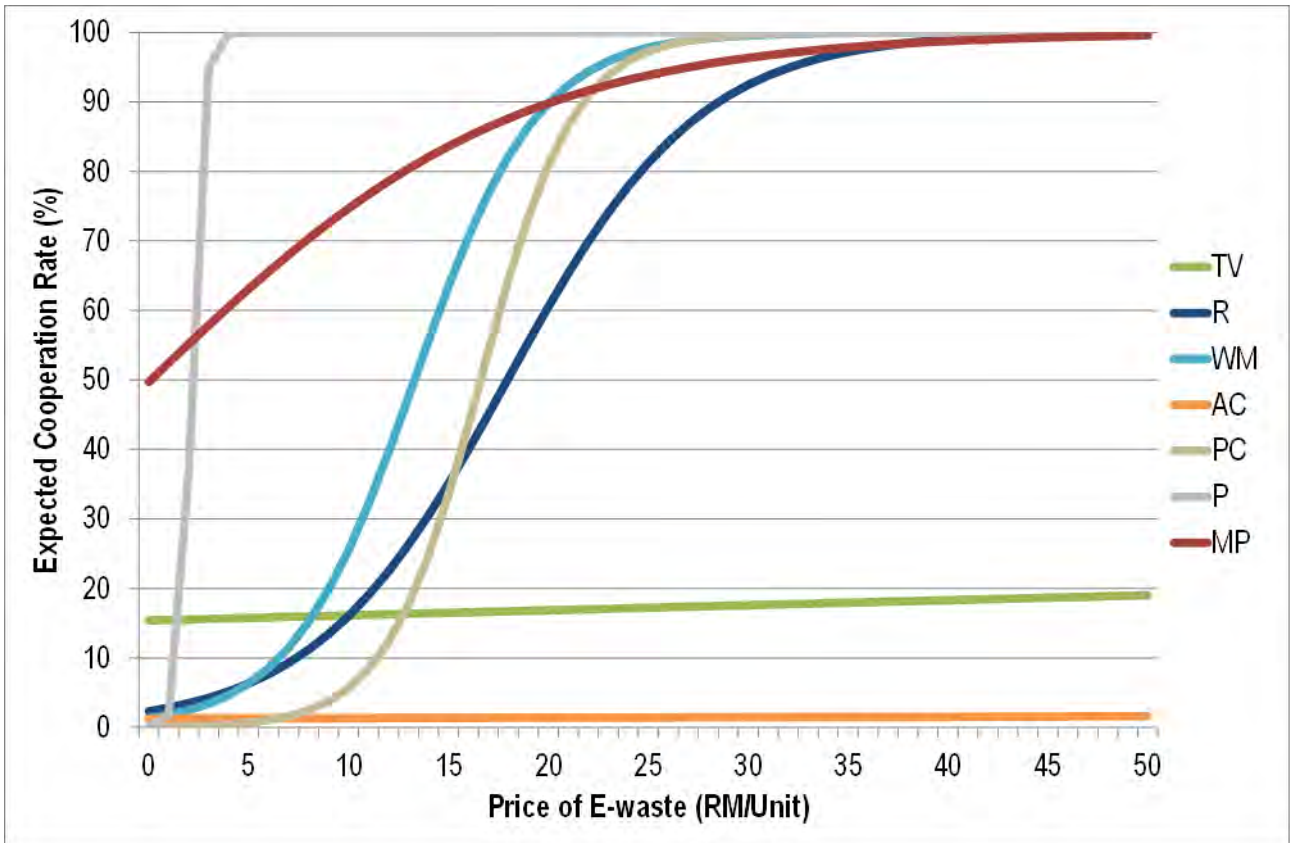
Figure 3-10. Willingness to be paid for each type of e-wastes obtained from the collected e-wastes
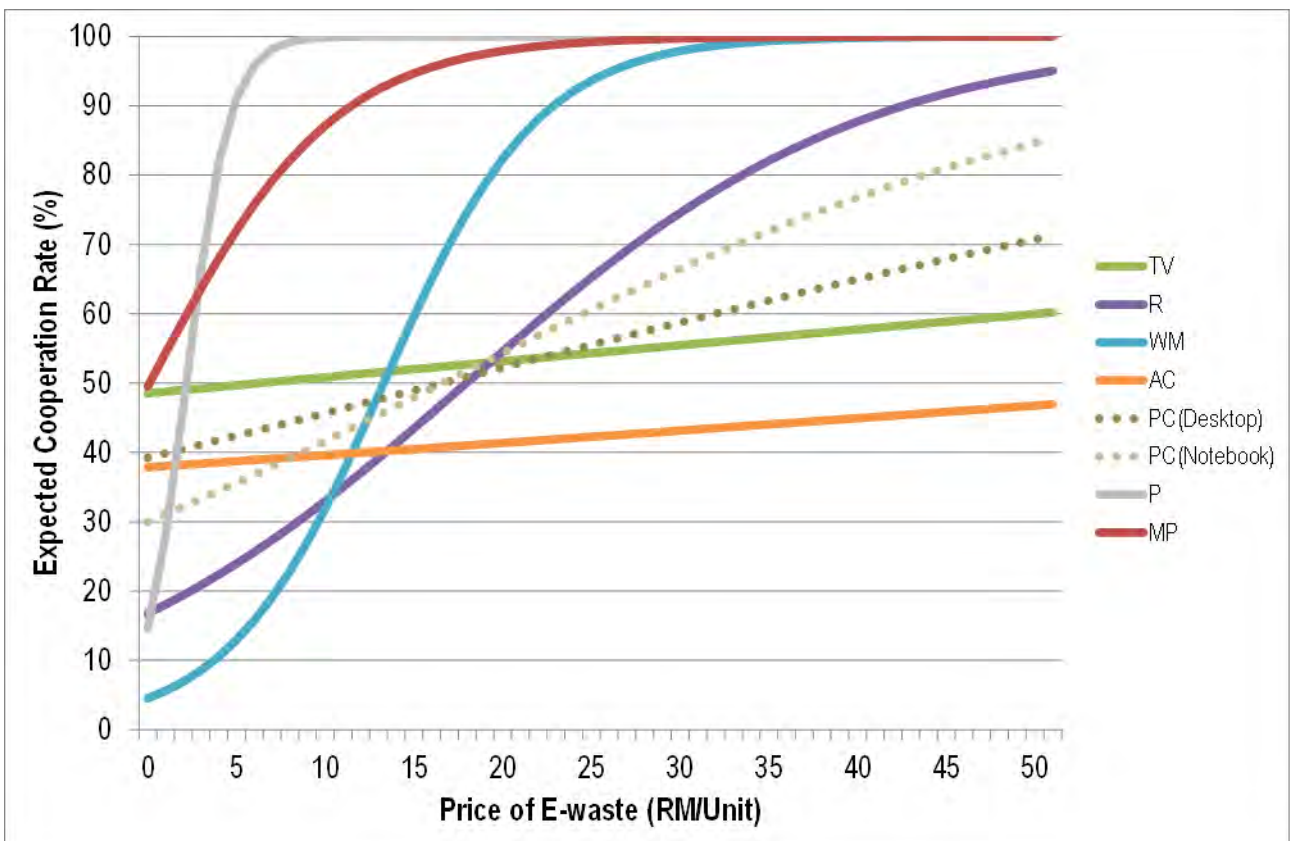
Figure 3-11. Willingness to be paid for each type of e-wastes obtained from the questionnaire survey

3.4 FINDINGS FROM THE PILOT PROJECT

(1) Advantage and disadvantage of each type of e-wastes

a) Measures for improving cooperation rates of television sets

The cooperation rate of television sets was lower than expected. Theoretically, it should be higher than 50%. Actually, according to the questionnaire survey, the expected cooperation rate was higher than 50%. People might like to keep their old television sets inside their houses even after they are broken or people might think that the old television sets can be sold with higher prices in the secondhand market.

For attaining higher collection rate, it is advisable to have the participating retailers explain to the customers that they can collect all types of e-wastes kept in their houses when the customers buy some bulky e-products at the shops.

b) Potential high collection rate for refrigerators and washing machines

The take back system from households worked the most effectively for refrigerators and washing machines. Almost all refrigerators and washing machines were collected in a "Trade-in" manner, because they are too heavy for the consumers to bring to any collection points or to the conventional recyclers. This means that high collection rates are possible for refrigerators and washing machines as far as shops explain about the e-waste collection service to the customers, if the voucher prices are attractive enough for the customer.

One of the effective measures to ensure the explanation to the customers was taken during the Pilot Project. The stickers shown in the following picture were distributed and the Project Team asked the shops to put the stickers on e-products with the voucher prices on it. Customers became curious to know what the prices are and shop staff was often asked about the take back services.

Figure 3-12. One trial for improving the collection of bulky e-waste

c) Structural problem for improving air-conditioner collection

The cooperation rate of air-conditioners was so low. One of the major reasons is outsourced installation. Air-conditioners are installed by the special installing teams. It is very common that the installing teams take back the old air-conditioners and recycle them by themselves. So it is difficult to control the outsourced installing team. It is necessary to solve this structural problem for improving the cooperation rate of air-conditioners.

d) Improvement of the system in personal computer shops

No computer or printer was collected in five computer shops for three month from October 2012. The reasons are: 1) some computer shops in malls are located in upper floor and it bothers customers to bring computers and printers to the shops; 2) the voucher prices are much lower than their expectation; and 3) there are many competitors which collect computers coordinated by NGOs. Unlike bulky e-wastes, the shops cannot offer e-waste collection services to their customers; instead the customers should bring their old equipment to the shops.

The computer collection can be improved by offering higher voucher prices and more advertisement of the existence of the Pilot Project.

e) Win-win e-waste collection for mobile phones

Mobile phone shops and households have incentives for mobile phone collection.

Mobile phone shops had been asked by the customers whether they have a collection service for old mobile phones, while households who kept old mobile phones cared that some hazardous substances might be leaked from the mobile phones, but they could not find any discarding channel so far. By starting the collection, the shops could increase customers' satisfaction and some customer found a discarding channel.

As mobile phones do not need a large storage space, it is easy for mobile phone shops to start the collection. It is possible to expand the mobile phone collection further by inviting more mobile phone shops widely and advertising about the collection system more actively at the participating shops.

(2) Other findings

a) Retailers' difficulties

Retailers had two major difficulties. One is to do with the relationships with conventional recyclers, and the other is regarding the difficulty in securing the storage spaces. Retailers sold their e-wastes to conventional recyclers before the Pilot Project upon request from their customers, and the staff of the retailers got some margin for it. The managers of the participating retailers had to persuade their employees to quit this convention, when they joined in the Pilot Project.

As for securing the storage spaces, retailers tried to solve this constraint by asking the full recovery facilities to transport the collected and stored e-wastes more often. However, due to the limitation of the resource of the full recovery facilities, the full recovery facilities could not provide enough transportation services to the retailers. It was easy for the retailers to ask the conventional recyclers to come and pick up the collected e-wastes upon their request.

Due to above two difficulties, some retailers wanted to go back to the conventional trade from the Pilot Project. It can be pointed out that asking the retailers to understand the significance of the Pilot Project is very important for getting their continuous cooperation.

b) Difficulty in paper works

Some retailers had a trouble in managing the receipts and the transportation slips. The logistics of their delivery services are not simple. A shop in a retailing chain does not necessarily have the product stock. Such a shop just orders to the head office to deliver the e-products to the customer and the delivery staff starts from the warehouse. Some such shops had a difficulty in how to manage the e-waste receipt so as to fit in their original procedure, where the receipts are supposed to be handled by the delivery staff.

Each shop has its original paper work procedure and logistic system. The paper works should be designed so as to fit to their system.

c) Lucky draw for mobile phones

From June to October, a lucky draw was used to issue the e-waste voucher only for mobile phones. RM4 for a mobile phone was thought not to be attractive and RM40 with 10% hits in the lucky draw would be more attractive to motivate people to bring their mobile phones. But managing such a lucky draw system proved to be not so easy. Some shops could not manage the 10% of hit probability.

Finally, the lucky draw was cancelled after confirming that it might not affect the attractiveness.

3.5 COST ANALYSIS

(1) Direct cost

The running cost was designed to be minimal by considering the financial sustainability. The required materials for the Pilot Project are 1) printing of the vouchers, 2) printing of the receipt and transportation slips and 3) any advertisement tools if necessary.

Assuming that one voucher is given and one piece of the receipt is used for one e-waste, the cost is only RM0.3 for printing. Production of advertisement tools can be considered as a fixed cost and the price for one shop is around RM200 – 300.

(2) Additional cost for retailers

The participating retailers have to bear the additional cost for delivery. Delivery staff has to deliver not only new products to the consumers but also e-wastes collected from the customers to their storage space in the Pilot Project. The additional cost for e-waste delivery can be estimated to be RM0.37 per e-waste as shown in Appendix 4.1.

(3) Voucher reclaiming

The total value of collected e-wastes correspond to nearly RM2500 as of 31 Dec. 2012 as shown in the following figure, while the reclaimed vouchers from the participating retailers are less than RM2000. Only 76% of the issued voucher was reclaimed. This gap between the collected e-waste and the voucher reclaimed could be used for the direct system management cost.
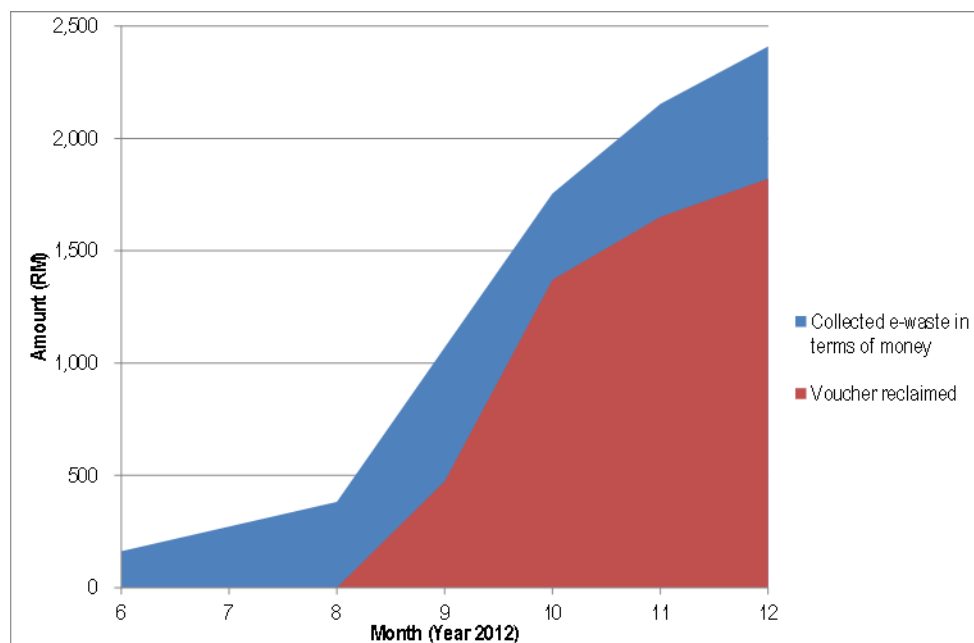
Figure 3-13. Collected e-waste in terms of money and voucher reclaimed

3.6 TRIAL ANALYSIS FOR FUTURE EXPANSION

(1) Required voucher price and prevalence rate for achieving a target collection rate

When a target collection rate is set, two strategies can be taken. One is putting more advertisement for raising the prevalence rate, and the other is using a higher voucher price. The following figures which were drawn by the definition explained in Appendix 5 are the equivalent curves for achieving a target collection rate. The prevalence rate in the figures can be calculated by multiplying geographical coverage (or market share of the participating retailers) and people's recognition rate.

For example, for refrigerators shown in Figure 3-14, when the target collection rate of 10% is given, and if 30% of the prevalence rate is expected, then RM15 of the voucher price is enough. When the target collection rate of 30% is given, and if the voucher price can be set at RM18, then the prevalence should be ensured at 60%.

These figures should be reviewed and revised by using more data. Among the figures, as for television sets and air conditioners, the WTP curves obtained from the questionnaire survey were used. These equivalent curves are just tentative, but these were described for further discussion.
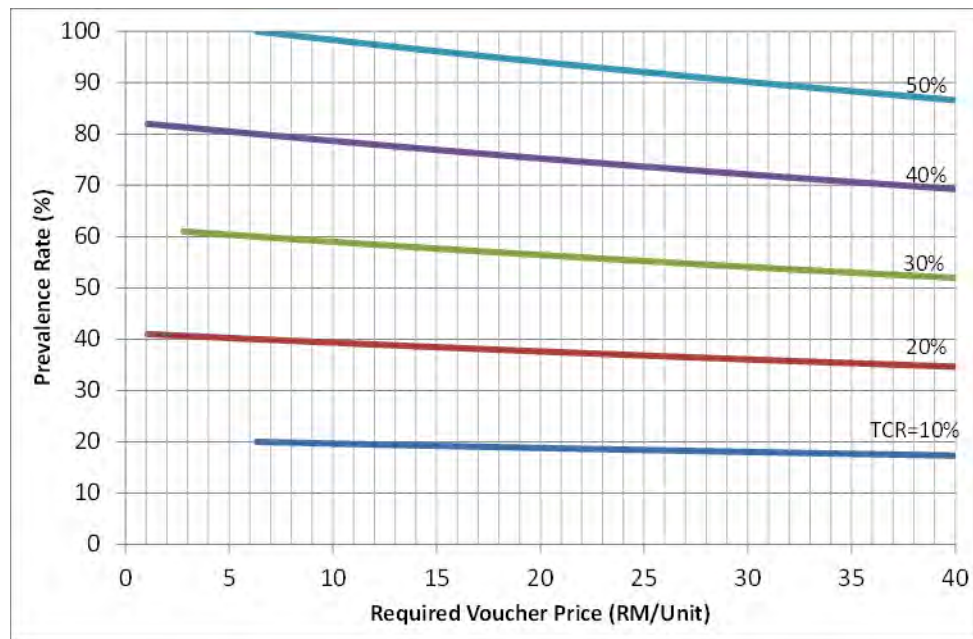
Figure 3-14. Required voucher price and prevalence rate so as to achieve target collection rates (TV)
Note: the WTP curve obtained from "Questionnaire survey" was used.
TCR: Target Collection Rate
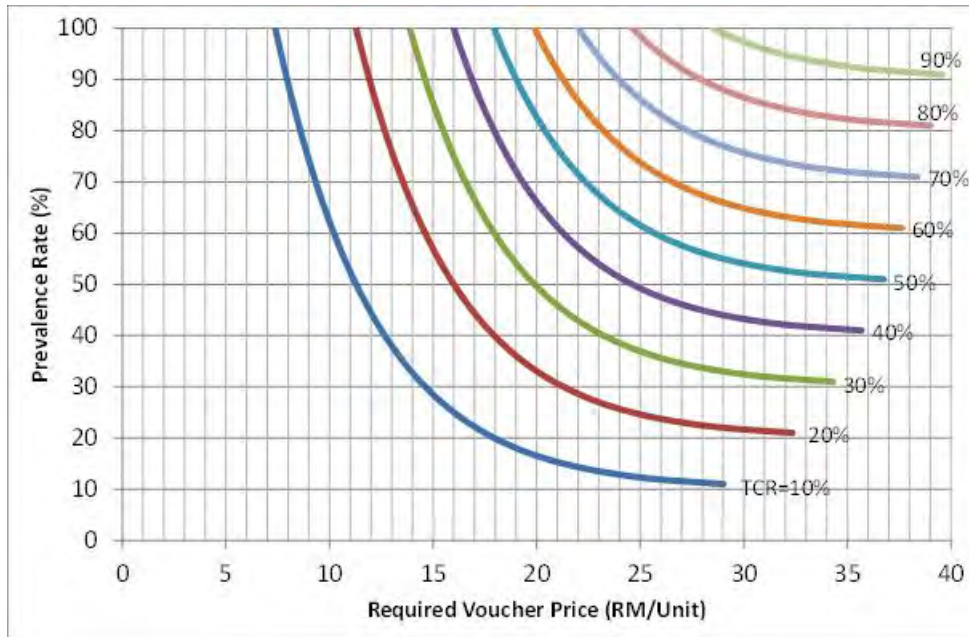
Figure 3-15. Required voucher price and prevalence rate so as to achieve target collection rates (Refrigerator)

Note: TCR: Target Collection Rate
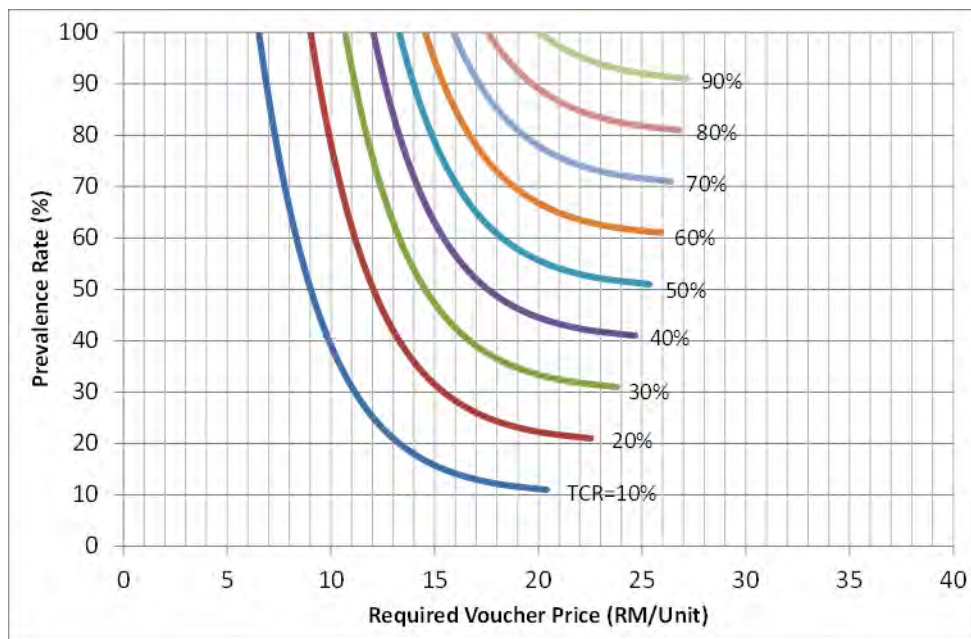
Figure 3-16. Required voucher price and prevalence rate so as to achieve target collection rates (Washing machine)

Note: TCR: Target Collection Rate
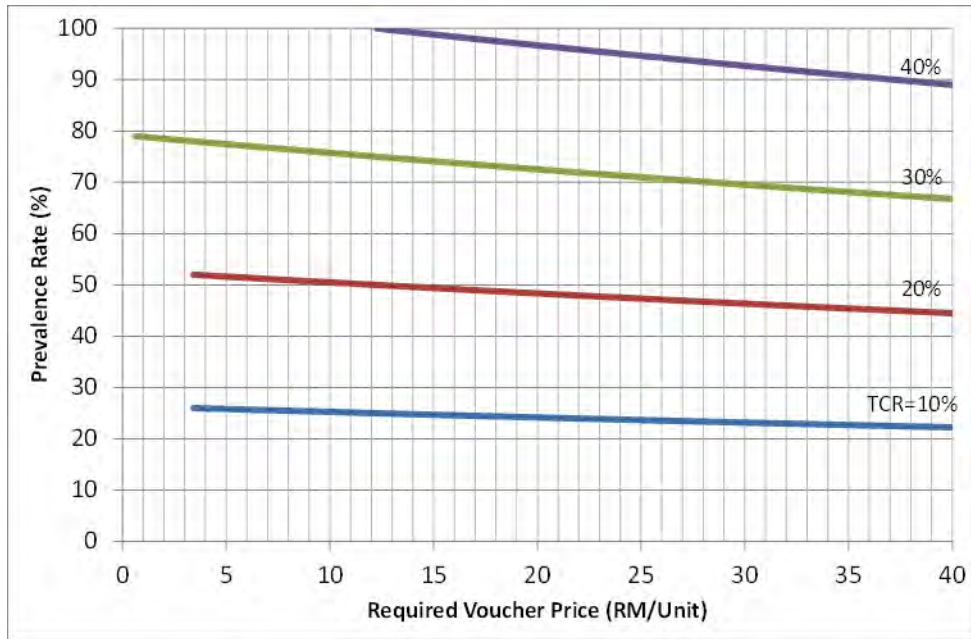
Figure 3-17. Required voucher price and prevalence rate so as to achieve target collection rates (Air-conditioner)

Note: the WTP curve obtained from "Questionnaire survey" was used.
TCR: Target Collection Rate
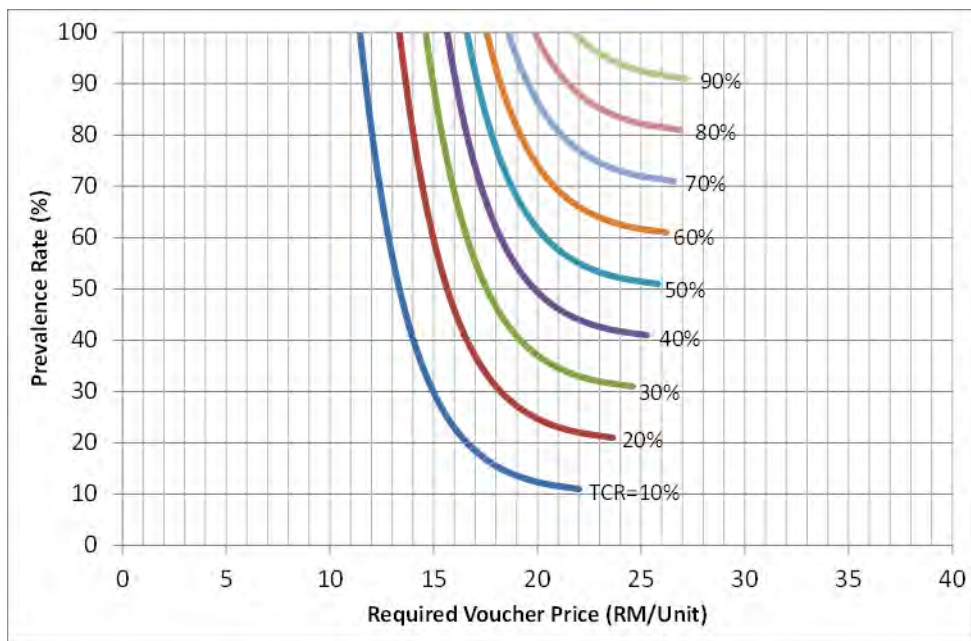
Figure 3-18. Required voucher price and prevalence rate so as to achieve target collection rates (Personal computer)

Note: TCR: Target Collection Rate
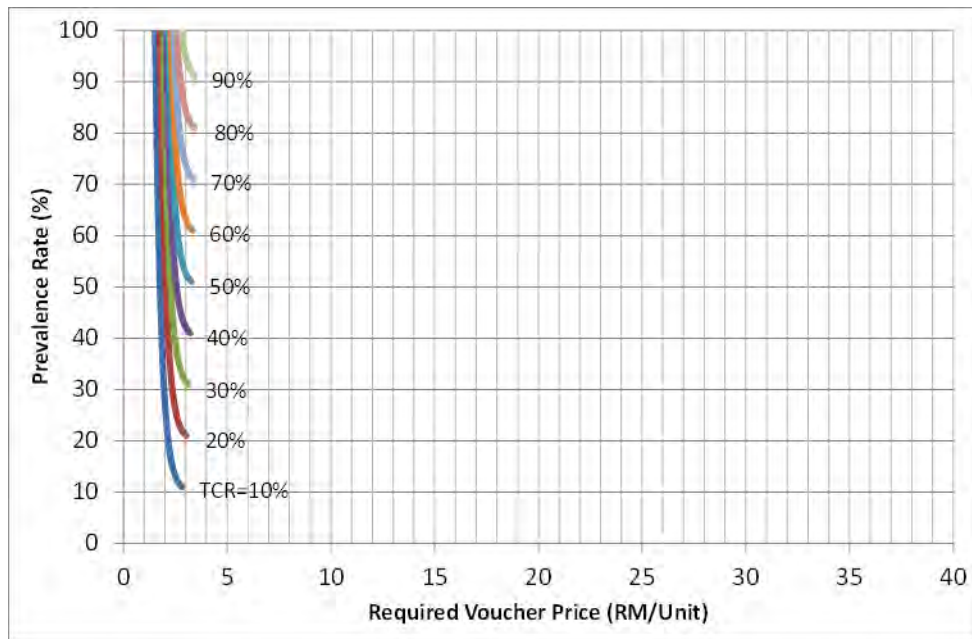
Figure 3-19. Required voucher price and prevalence rate so as to achieve target collection rates (Printer)

Note: TCR: Target Collection Rate
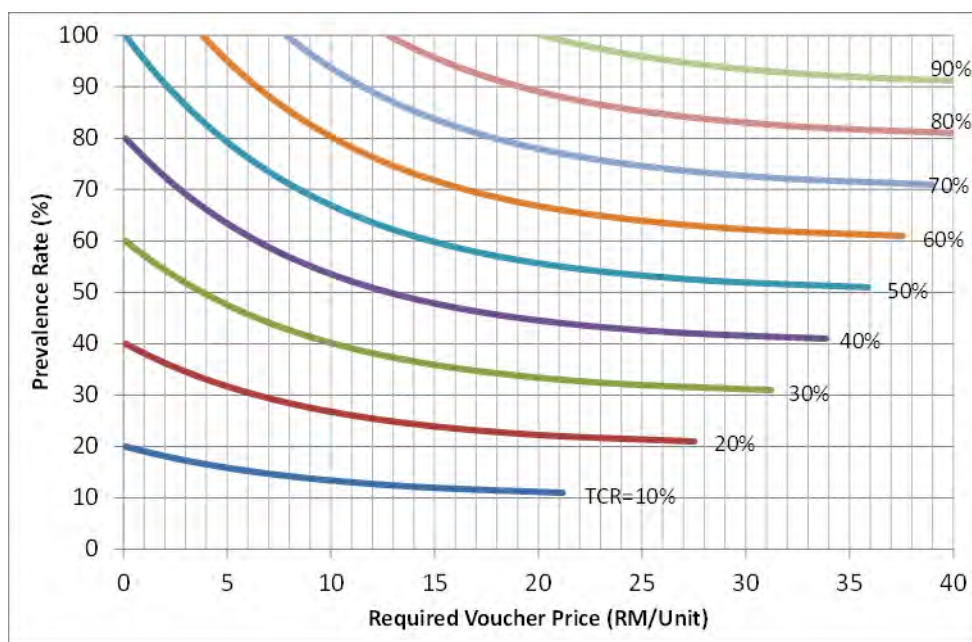
Figure 3-20. Required voucher price and prevalence rate so as to achieve target collection rates (Mobile phone)

Note: TCR: Target Collection Rate

(2) Required budget for additional voucher prices

Total required budget can be estimated by the following equation when the target collection rate and the expected prevalence rate are set.

- $RB(TCR, PR) = W * TCR * (Pv(TCR) - Pf)$

Where

- TCR: Target collection rate (%)
- PR: Prevalence rate (%)
- RB(TCR, PR): Required budget for achieving the TCR when the expected prevalence rate=PR.
- W: the amount of discarded e-waste in a year (fresh e-waste)
- Pv(TCR): Required voucher price for achieving the TCR
- Pf: Price shown by the licensed recycler

The following figure is an example of the total required budget for achieving some target collection rate when the expected prevalence rate is set as 75%.
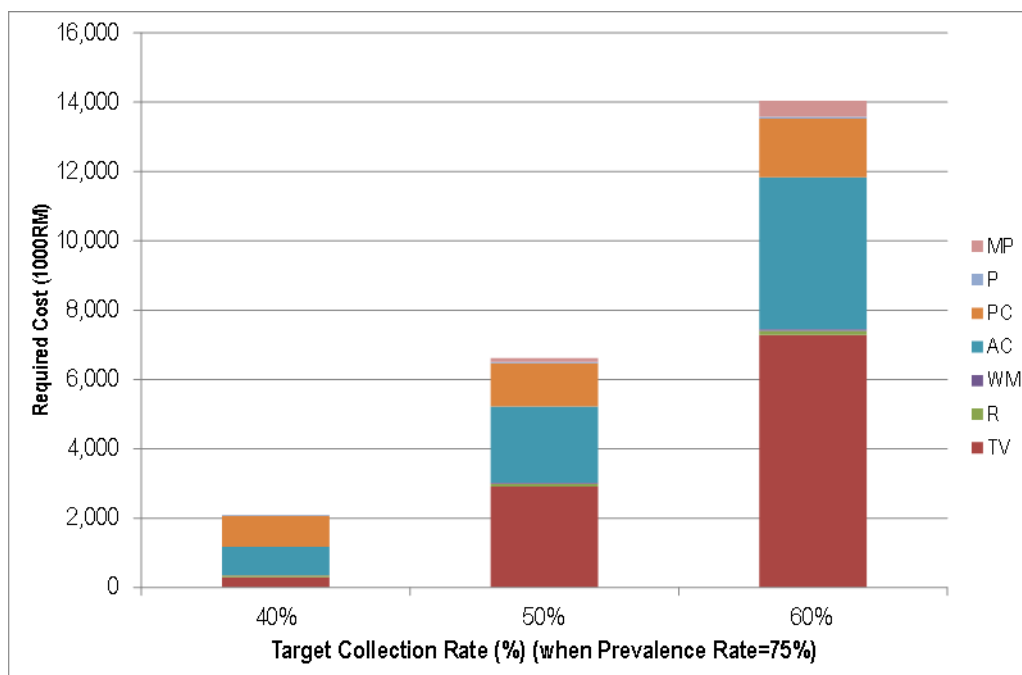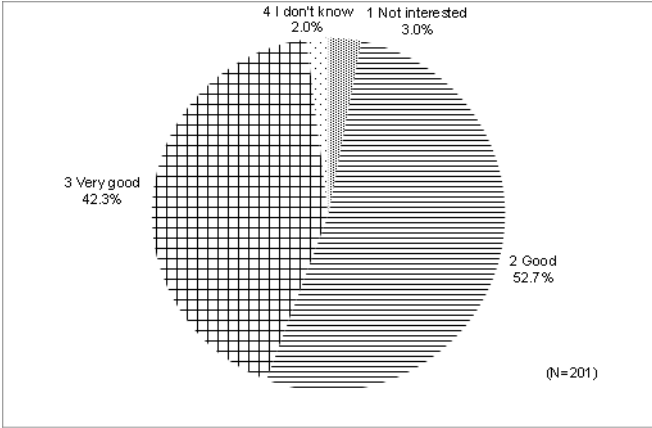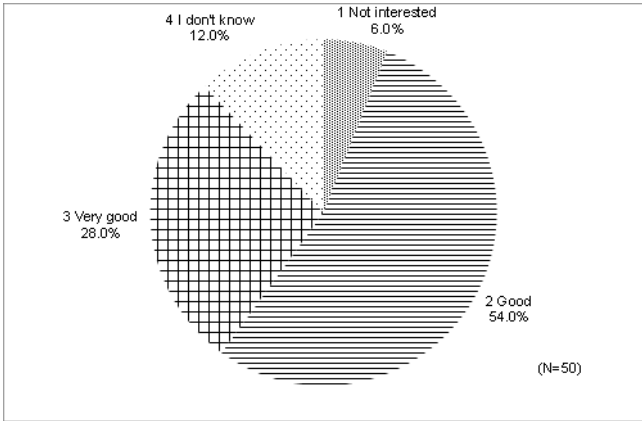
Figure 3-21. Total required budget for achieving some target collection rates

4. POST-EVALUATION ON THE PILOT PROJECT

The post-evaluation of the Pilot Project after its implementation as of December 2012 can be summarized as shown in the following table.

Table 4-1. Post-evaluation of the Pilot Project after the implementation

valuation aspect	Evaluation indicators	Post-evaluation
1. Validity	1.1 Physical validity	As shown below, the "Physical Validity" is considered acceptable except for the supermarkets. However, the measures to have supermarkets participate would be sought, because it is very convenient for the customers. <Consumer> According to the questionnaire survey to households conducted in Oct. 2012, the Pilot Project was evaluated positive as shown in the following figures. - 95% of respondents marked more than "Good" for the collection of home electric appliances. - 82% of respondents marked more than "Good" for the collection of personal computers. - 71% of respondents marked more than "Good" for the collection of mobile phones. Figure. Overall evaluation on the Pilot Project by customers <Home electric appliance> Figure. Overall evaluation on the Pilot Project by customers <Personal computer>

valuation aspect	Evaluation indicators	Post-evaluation
		Figure. Overall evaluation on the Pilot Project by customers <Mobile Phone>

The reasons why the customers evaluated the e-waste collection positive were different by the types of e-wastes as shown below. Economic incentives for households by giving the e-waste vouchers could motivate people to discard their e-wastes to the Pilot Project. Besides, as for home electric appliances, space consumption factor could be a motivation to discard the e-waste to the Pilot Project.
- As for home electric appliances, the major reason why the respondents evaluated the e-waste collection positive was "The used electrical goods are consuming space in my house".
- As for personal computers, the respondents evaluated the e-waste collection positive, because it contributes the environment and ensures human health as well as the e-waste voucher is given to discarders.
- As for mobile phones, the reason motivated respondents most was the voucher.

 Figure. The reason why the respondents evaluated the e-waste collection positive <Home electric appliance> |

valuation aspect	Evaluation indicators	Post-evaluation

Figure. The reason why the respondents evaluated the e-waste collection positive <Personal computer>
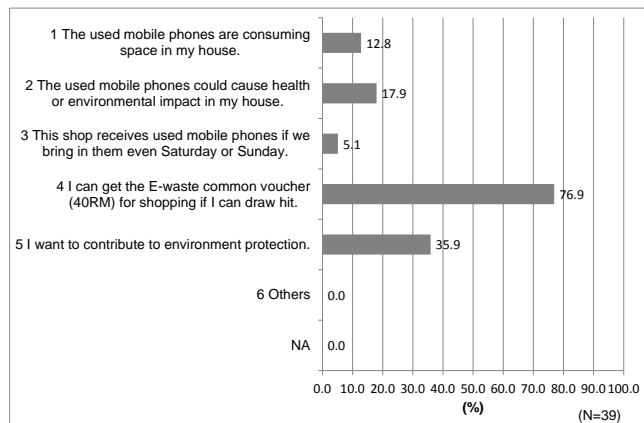
Figure. The reason why the respondents evaluated the e-waste collection positive <Mobile phone>

<E-product retailers>
The Pilot Project was started on June 2, 2012 with 12 retailing shops. The number of the participants increased to 25 after the commencement of the Pilot Project. This increase in the number of participants shows the high physical validity for e-product retailers.
One of the active retailers utilized the e-waste collection as their company strategy by publishing their advertisement in the newspaper. Participating in the e-waste collection itself could provide a strategic motivation to the retailers. Also the retailers are often asked by their customers whether they provide e-waste collection or not. This is also a motivation for the retailers to participate in the Pilot Project.
Thus the physical validity of the e-waste retailers can be estimated high.
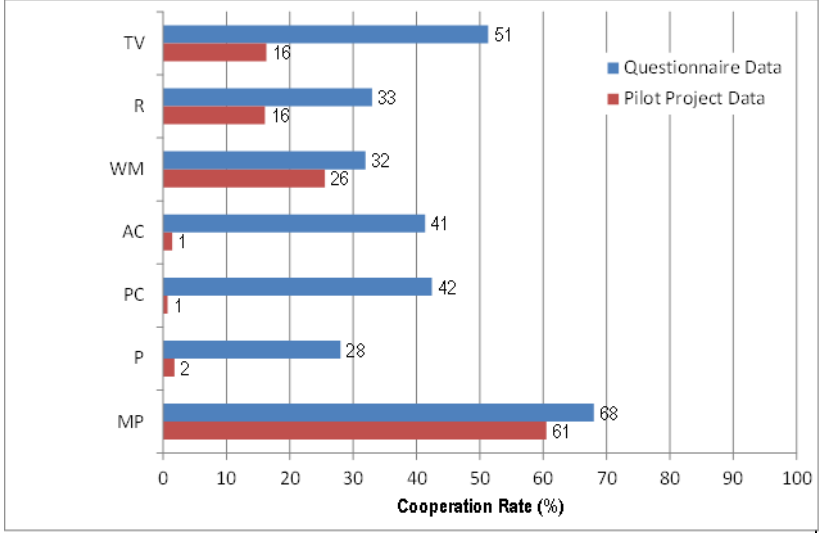
<Supermarkets>
Supermarkets did not participate in the Pilot Project. One of the obstacles was assignment of staff for e-waste receiving. Unlike e-product retailers which talk with the customers face to face, supermarkets would have to assign at least one person to receive e-wastes from their customers.
Participation of supermarkets is still awaited, because it is convenient for customers and the common voucher will be more attractive, if the vouchers can be used in supermarkets.

<Full recovery facilities>
Full recovery facilities showed a positive attitude towards the Pilot Project, such as an interest in the increased opportunities to access technological

valuation aspect	Evaluation indicators	Post-evaluation
		improvement and better knowledge for recycling.
	1.2 Economic validity	As shown below, the prices of the common voucher P_{pp} are generally lower than the prices P_{cr} shown by the conventional recyclers, which might be resulted in lower participation rate. However, the participation rate was not zero. "WTP" (willingness-to-pay) distribution was drawn, which tells us how much amount of incentive is required to attain the certain rate of collection. As for the bulky e-waste such as refrigerator and washing machine, takeback service upon delivery of new purchased e-products increased the willingness of the customer by adding the incentive on the voucher prices.

Table. Comparison of the prices of the conventional recyclers and the Pilot Project

	Price (RM/kg)			Price (RM/unit)		
	CR		Pilot Project	CR		Pilot Project
Television (CRT)	0.32	<	0.38	10	<	12
Television (Non-CRT)	0.32	<	0.48	10	<	15
Refrigerator	0.28	>	0.19	15	>	10
Washing machine	0.39	>	0.27	15	>	10
Air-conditioner	1.39	>	0.45	62	>	20
PC (Desktop/ CRT)	1.04	>	0.48	11	>	5
PC (Desktop/ Non-CRT)	1.04	>	0.48	11	>	5
PC (Notebook)	4.25	>	1.75	12	>	5
Mobile phone	2.00	<	17.02	0	<	4
Printer	ND	-	0.20	ND	-	1
DVD player, etc.	ND	-	0.50	ND	-	2
Others	ND	-	0	ND	-	0

(Note) CR: Conventional Recycler

Figure. WTP curve

| 2. Effectiveness | 2.1 Change of discarding behavior | "Cooperation Rate" for each product was observed as shown in the figure.

As for television sets and air conditioners, the cooperation rates were rather low. Further improvement is needed for higher cooperation rates.
For computers and printers, the performance was quite low. Further improvement such as more advertisement is needed. |

valuation aspect	Evaluation indicators	Post-evaluation
		Figure. Cooperation rate obtained from the Pilot Project
	2.2 Collection rate	The collection rate can be calculated by using the figures shown in the above table. The total collection rate is 9%. Table. Collection rate in the Pilot Project Note: The discarded amount of printers was calculated assuming that 30% of total number of computers is accompanied by a printer when discarded.
	2.3 Policy effect	By using the substance flow analysis explained in "ANNEX I" of the "Progress Report (1)", the three indexes can be estimated as below. 1. Hazardousness=$1 - \frac{FR}{W}$ $(in\ terms\ of\ lead)$=77% (Present value=88%) 2. Resource recovery=$\frac{FR}{W}$ $(in\ terms\ of\ precious\ metals)$=21% (Present value=19%) 3. Traceability=$\frac{FR}{W}$ $(in\ terms\ of\ e-waste)$=18% (Present value=9%)
3.Efficiency	3.1 Required cost	Required cost C_{pp} for the Pilot Project is nearly zero, because it can be pressed by the retailers, while the current collection cost C_{cc} by MPPP requires RM270 per ton. Then, $C_{pp} < C_{cc}$. Rem: RM270=$\dfrac{Cost\ for\ outsourcing\ to\ private\ companies\ (\frac{RM}{year})}{Total\ weight\ collected\ by\ the\ private\ companies\ (\frac{ton}{year})}$ The pressed cost borne by the retailers were estimated by the cost survey explained in Appendix 4.1. The additional cost for the retailers taking back e-waste from their customers was estimated at RM0.37 per unit of e-waste.

Table. Collection rate in the Pilot Project

	Discarded amount (excluding repair) (ton/year) (Year 2012)	Expected participation rate to the Pilot Project (%)	Expected amount from the Pilot Project (ton)
Television	2,610	16	425
Refrigerator	774	16	124
Washing machine	354	26	90
Air-conditioner	1,385	1	20
PC	1,888	1	13
Printer	2	2	10
Mobile phone	21	61	13
Total	7,598	9	696
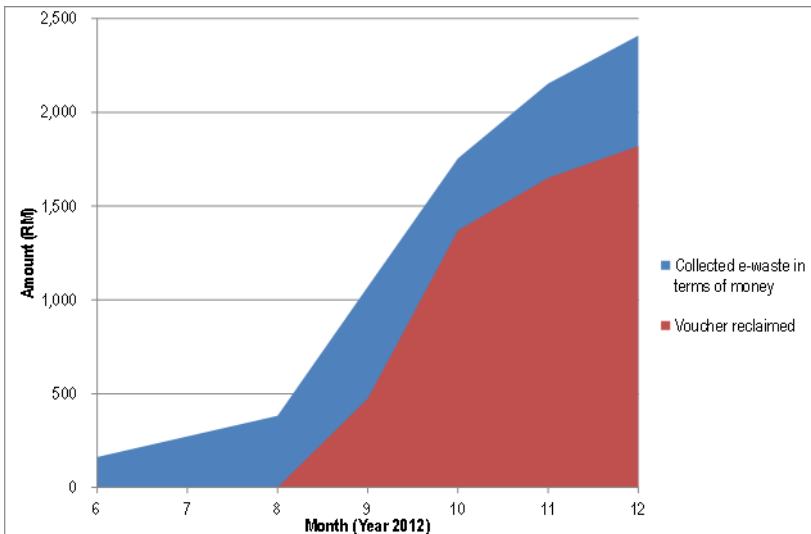
valuation aspect	Evaluation indicators	Post-evaluation
		This additional cost can be considered small enough compared with the voucher prices.
4. Impact	4.1 Effect to EPR policy making	As shown below, the Pilot Project gave positive impacts to the policy making on EPR.
		Two kinds of participation were offered for the manufactures. One is to participate as "Official Supporter" and the other one as "Project Cooperator". As of Dec. 31, 2012, five brands participated in two participation scheme. Some of them were quite active in contributing to the Pilot Project. They introduced some retailers in their business network and the retailers participated in the Pilot Project. Manufacturers took an active part in the Pilot Project by participating in the workshop, shared information and also joined "Official Consultative Meeting" coordinated by DOE. The Official Consultative Meetings were held three times until Dec. 31, 2012 and the Progress of the Pilot Project was introduced. The report on the Pilot Project contributed to realize constructive discussions.
	4.2 Influence to the informal and conventional recyclers	As shown below, the negative impacts on the informal and conventional recyclers can be evaluated small.
		Personal recyclers and conventional recyclers dealing with recyclables are existent. However, many of them are collecting paper, plastic and iron. Complains from such actors were not heard regarding the Pilot Project.
5.Sustainability	5.1 Autonomous management after the Pilot Project	The "E-waste Alam Alliance – Penang", which was formed by the local businesses and coordinated by MPPP and DOE Penang, may take the responsibility of conducting continuous monitoring and maintenance.
		DOE, DOE Penang and MPPP discussed the future formation of the Pilot Project. MPPP showed their intention to support the Pilot Project in the future by collaborating with DOE Penang. A "Standard Operating Procedure" with management formation was developed.
	5.2 Budget after the Pilot Project	As shown below, the total amount of the common vouchers C_t issued was 76% of reclaimed voucher. The gap can be used as the budget for management as the management cost C_m=RM0.3 per e-waste is small enough. Figure. Comparison of collected e-waste in terms of money value and

valuation aspect	Evaluation indicators	Post-evaluation
		reclaimed voucher
6. Applicability	6.1 Planning and implementation in other areas without Japanese Experts	<u>The capacity assessment sheet tells that the counterparts understood the progress of the Pilot Project very well so far.</u> Series of "Taskforce" meetings were held for discussing the Pilot Project. This was effective in developing the capacities of the counterparts.
	6.2 Any unique factors of the Pilot Project in Penang	<u>Any unique factors were not found. The model developed in Penang Island could be used in other areas.</u> The resources required for the Pilot Project are existence of e-product retailers and licensed recyclers. These can be available in all areas. Any contribution from the state governments and local councils may increase the possibility on the e-waste collection in their areas.

5. RECOMMENDATIONS

(1) Succession of the Pilot Project

The Pilot Project was designed by considering project sustainability. It does not need a lot of management cost. It is expected that MPPP, DOE and other related agencies will succeed the Pilot Project.

(2) More participation from retailers

The number of the participating retailers is just 25 shops as of 31 December 2012. More participation is needed for further e-waste collection. It is advisable to plan an expansion plan with increased number of participants in the future.

(3) Data accumulation and update of WTP curves

The duration of the Pilot Project was only for several months and some retailers just joined in last October. Longer data accumulation is needed. By using more data, the WTP curves can be updated for further improvement.

Appendices

Appendix 1. Expected cooperation rate defined for the pre-evaluation before commencement

1. Definition of WTP (Willingness To be PAID) distribution

   The following model shows how the discarders change their behavior. If the price of the Pilot Project is the same as the price shown by the conventional recyclers, the expected participation rate to the Pilot Project will be 50%. In case that the price in the Pilot Project is lower than the price of the conventional recycler, then the expected participation rate to the Pilot Project will be lower than 50%.
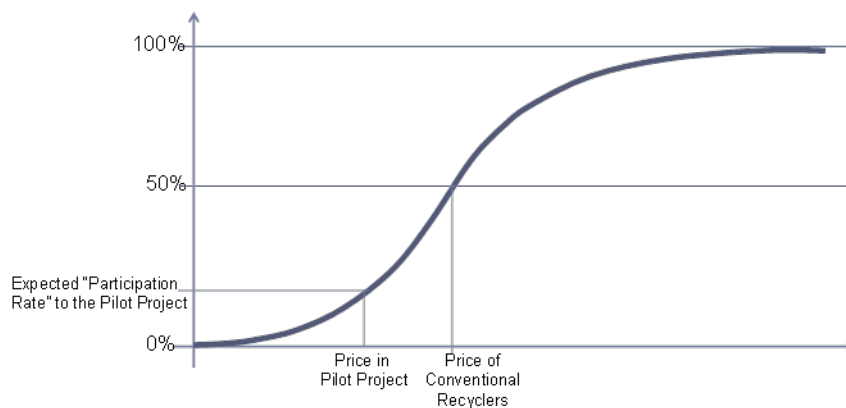
Figure. WTP model of the discarding behavior

However, in the timing before the Pilot Project commencement, no one knows the WTP distribution curve. So here, simply, it was assumed that the WTP distribution is linear.

Figure. Assumed WTP model of the discarding behavior

2. Other assumptions
   - The convenience of the Pilot Project or the opportunity cost of the occupied space by the e-waste in the house is not considered.
   - The announcement effect of the Pilot Project is not considered. This model assumes that peoples' behavior is determined only by the prices.

3. Expected "Participation Rate"

The expected participation rate to the Pilot Project is shown in the following Table.

Table. Expected participation rate to the Pilot Project

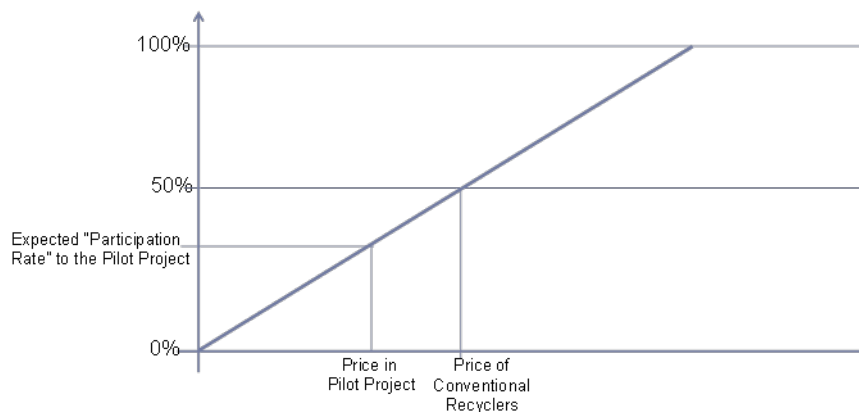|	Price in the Pilot Project (RM/unit)	Price of the conventional recyclers (RM/unit)	Expected participation rate to the Pilot Project (%)
Television (CRT)	12	10	59
Television (Non-CRT)	15	10	74
Refrigerator	10	15	33
Washing machine	10	15	34
Air-conditioner	20	62	16
PC (Desktop/ CRT)	5	11	23
PC (Desktop/ Non-CRT)	5	11	23
PC (Notebook)	5	12	21
Mobile phone	4	0	100
Printer	1	ND	ND
DVD player, etc.	2	ND	ND
Others	0	ND	ND

4. Expected amount of e-waste to be collected by using the Pilot Project System when expanded to the whole Penang Island

The expected amount of e-waste to be collected by using the Pilot Project System assuming that the system is expanded to the whole Penang Island can be calculated as below, by multiplying the discarded amount with the expected participation rate shown in the section 3 above. Average participation rate results in 38%.

Table. Expected amount of e-waste to be collected by using the Pilot Project System when expanded to the whole Penang Island

	Discarded amount (excluding repair) (ton/year) (Year 2012)	Expected participation rate to the Pilot Project (%)	Expected amount from the Pilot Project (ton)
Television (CRT)	2,274	59	1,342
Television (Non-CRT)	336	74	249
Refrigerator	774	33	255
Washing machine	354	34	120
Air-conditioner	1,385	16	222
PC (Desktop/ CRT)	1,080	23	248
PC (Desktop/ Non-CRT)	727	23	167
PC (Notebook)	81	21	17
Mobile phone	21	100	21
Total	7,032	38	2,641

Appendix 2. Expected amount of e-waste to be collected by the Local Businesses

The expected amount of e-waste to be collected by the following local businesses was calculated.

1. Participating local businesses (as of June 2)

Company name	Business category	Number of shops in Penang Island
Ban Hin Bee (BHB)	Home electric appliance shop	5
Loo Soon Seng Electrical (LSS)	Home electric appliance shop	3
Channel Communication & Electronics Centre (CCEC)	Mobile phone shop	1
Sun Win Phone Shop	Mobile phone shop	1.

2. Equation for calculating the expected amount of e-waste collected by the participating local businesses

The expected amount of e-waste in the Pilot Project can be calculated by

$$X_e = N_s * w * r$$

where

- X_e: Expected amount to be collected in the Pilot Project (ton)
- N_s: Number of units sold by the local businesses[3]
- w: Weight of e-waste per unit
- r: Participation rate of customers.

By using this equation X_e was calculated as:

X_e=144 ton/year. (12 ton/month)

This corresponds to 2% of the total amount of e-waste discarded in Penang Island in year 2012.

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[3] This data is confidential.

Appendix 3. Definition of "Cooperation Rate"

1. Thoughts for defining "Cooperation Rate"
    - The market shares of the participating retailers should be considered for normalizing the data.

2. Definition

(1) Definition of raw cooperation rate
    An expression of the cooperation rate by considering the market shares of the participating shops is

    - $CR = \dfrac{Q}{W * MS}$.

    Where

    - Q : Quantity of e-waste collected
    - W : Number of e-waste discarded in Penang Island in a year
    - MS : Market share of the participating retailer

    Here the market share can be defined as

    - $MS = \dfrac{SL}{D}$.

    Where

    - SL : Sales of the participating retailer
    - D : Present domestic supply to Penang Island

(2) Calculation of raw cooperation rate
    The cooperation rate calculated by using the definition above can be shown as below.
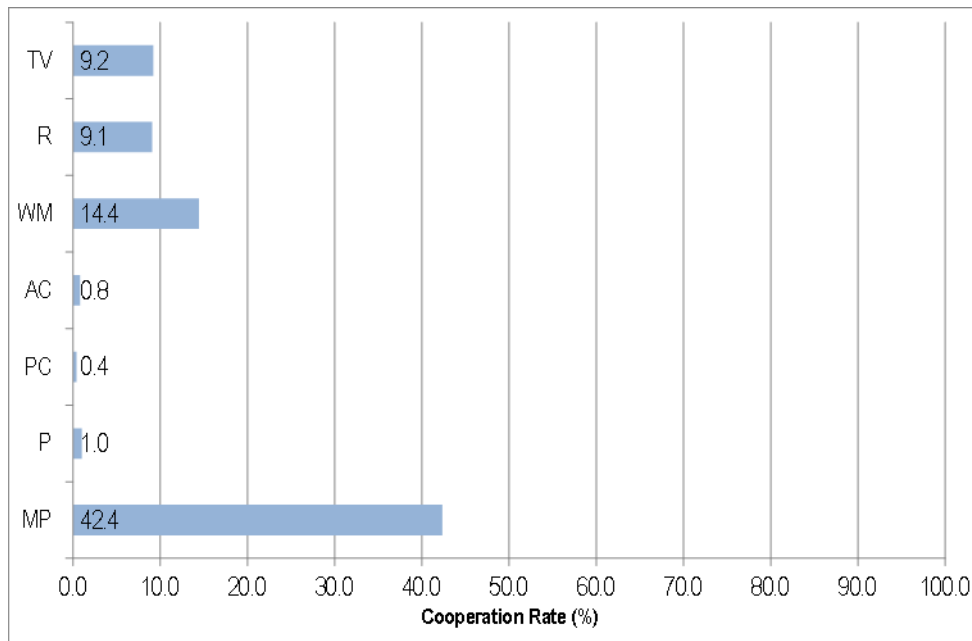
Figure. Raw cooperation rate

(3) Consideration of recognition rate

The raw cooperation rate is lower due to the low awareness among the people. It should be calibrated by using the people's recognition rate on the Pilot Project, as the pricing model can work under the condition that all discarders know the presence of the Pilot Project. The raw cooperation rate should be blown up by considering the recognition rate.

The recognition data can be obtained from the questionnaire survey conducted in Oct. 2012. There are two kinds of the recognition rates shown in the following figure. One is the recognition rate before visiting the retailers, and the other is the one after visiting the retailers. Here, the recognition rate after visiting the retailers was used.
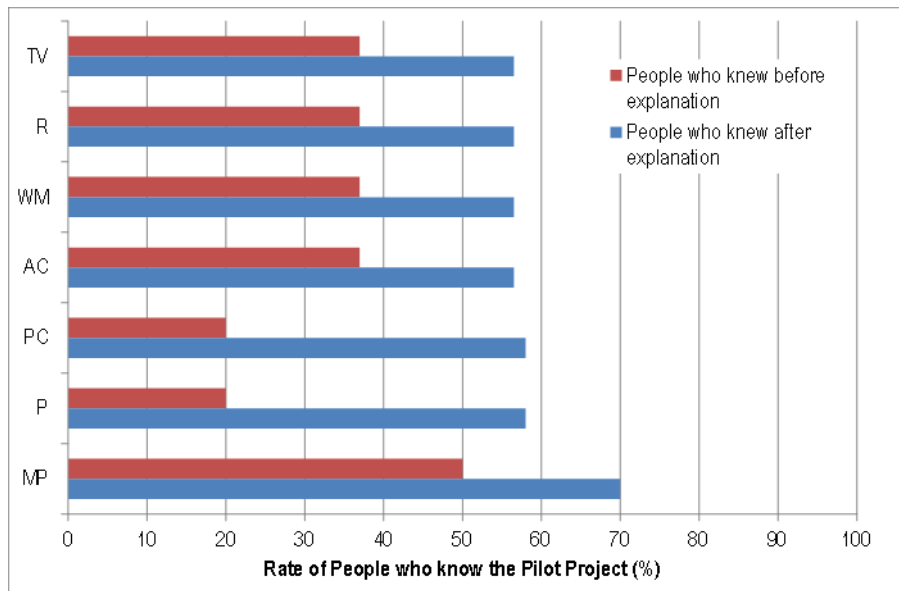
Figure. Rate of people who know the Pilot Project (Recognition rate)

(4) Definition of cooperation rate by considering the recognition rate

Here, the definition of the cooperation rate can be expressed by considering the recognition rate as

- $CR = \frac{Q}{W*MS} * \frac{1}{r}.$

Where

- Q : Quantity of e-waste collected
- W : Number of e-waste discarded in Penang Island in a year
- MS : Market share of the participating retailer
- r : Recognition rate of the Pilot Project (the rate of people who know the Pilot Project)

(5) Calculation of cooperation rate and evaluation

The calculated cooperation rate can be seen in the following figure. The cooperation rates obtained from the questionnaire survey were shown in the same figure for evaluating the cooperation data of the Pilot Project.
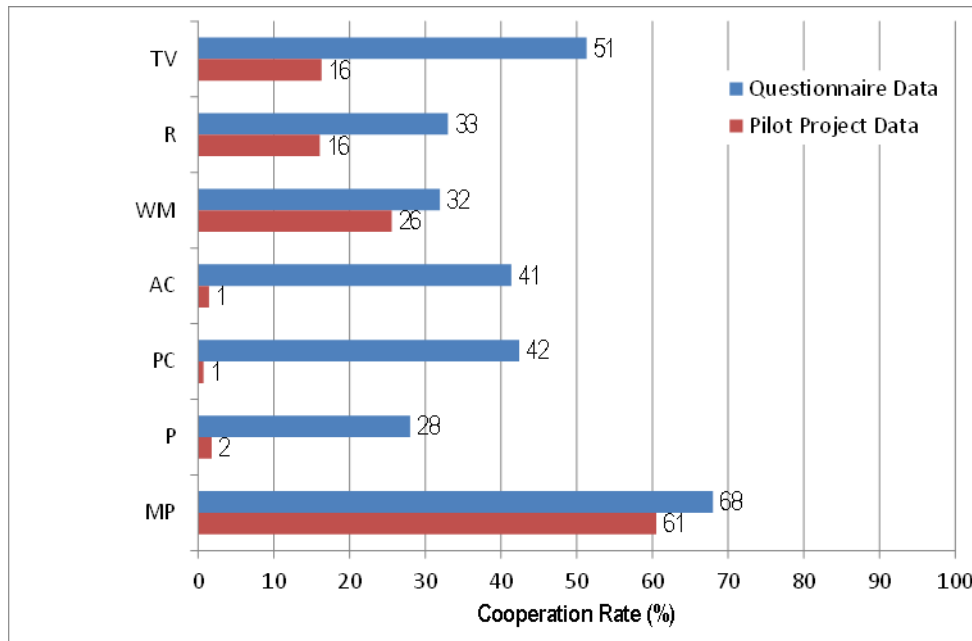
Figure. Comparison of the cooperation rates obtained from the Pilot Project and the questionnaire survey

(6) Evaluation on the cooperation rates

In general, there are gaps between the perceptible willingness to pay and the actual action. The perceptible willingness to pay can be obtained from the questionnaire survey and the actual action can be seen by the cooperation rates in the Pilot Project.

Here, the cooperation rates were evaluated by comparing the two cooperation rates for finding the structural characteristics of e-wastes.

i) Refrigerator, washing machine and mobile phones

The cooperation rates of refrigerator, washing machine and mobile phones seem reasonable, even though the cooperation rate of refrigerator seems a little bit low.

ii) Television sets, air conditioners, personal computers and printers

The cooperation rates of television sets, air conditioners, personal computers and printers are lower than the data obtained from the questionnaire survey. There may be some reasons why these cooperation rates are low. The cooperation rates should be calibrated by the structural characteristics if necessary.

As for television sets, the cooperation rate was lower than 50%, nevertheless the voucher price set for television sets was much higher than the market price. The voucher price used was RM12 for television sets with CRT and RM15 for television sets with non-CRT, while the market price of television sets is RM6. This means the WTP curve cannot be described for television sets. It is concluded that some sort of calibration is needed for the cooperation rate for television sets.

As for air conditioners, the cooperation rate was much lower than the cooperation rate

obtained from the questionnaire survey. According to the interviews with the participating shops, shops outsource installation of air conditioners to other companies. This may cause the low cooperation rate. It is necessary to calibrate the cooperation rate for air conditioners.

Also, as for personal computers and printers, the cooperation rates were much lower than the questionnaire survey. One of the reasons why the cooperation rates were low can be considered that the raw data were obtained from only home electrical appliance shops which do not trade computers and printers, because no computer and printer was collected in the computer shops. However, the cooperation rate for personal computers and printers was not calibrated, because more data are needed for further analysis.

(7) Calibration of data distortion of television sets and air-conditioner

i) Television sets

Television sets might be easier to be kept in households than other products, which results in the low cooperation rate of television sets. This can be called as "Kept-in" factor.

The cooperation rate for television was calibrated by considering this "Kept-in" factor. The equation can be described as:

- $F_{Keptin} = \dfrac{CooperationRate(PilotProject)}{CooprationRate(QuestionnaireSurvey)}$

ii) Air-conditioner

Air-conditioners are installed by the special installing teams. Commonly, retailers outsource installing teams. It is very common that the installing teams take back the old air-conditioners and recycle them by themselves. So it is difficult to control the outsourced installing team. This may be the reason of the low cooperation rate of air-conditioners. This can be called as "Taken-out" factor.

The "Taken-out" factor can be defined, as same as television sets, as:

- $F_{TakenOut} = \dfrac{CooperationRate(PilotProject)}{CooprationRate(QuestionnaireSurvey)}$

3. WTP distribution by using the calibrated cooperation rates

(1) Market prices

The market prices are necessary when drawing WTP curves. The market prices provide us the point which shows 50% cooperation in WTP figures.
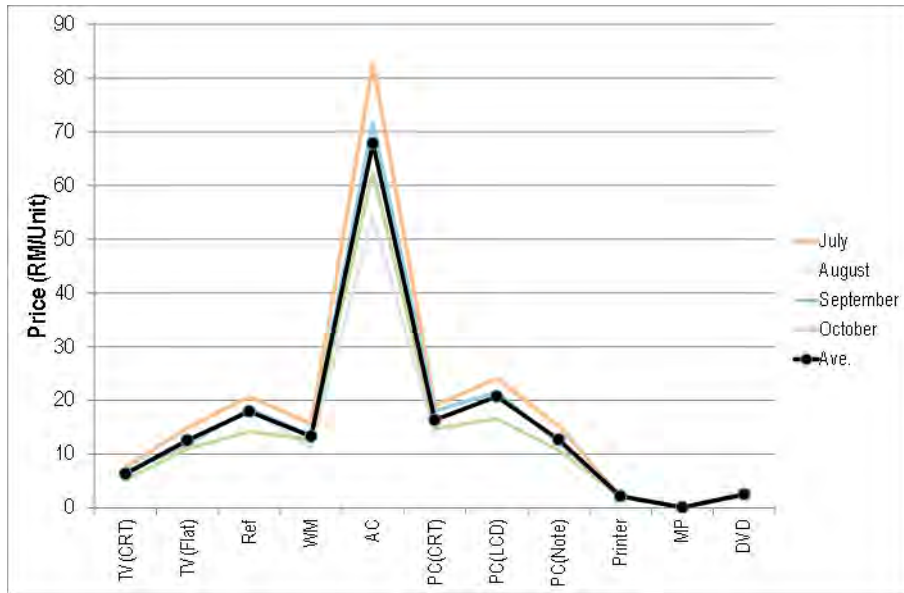
Figure. Market price of each type of e-wastes

(2) WTP (Pilot Project)

The WTP curves by using the cooperation rate including calibrated ones and the market prices can be shown in the following figure.
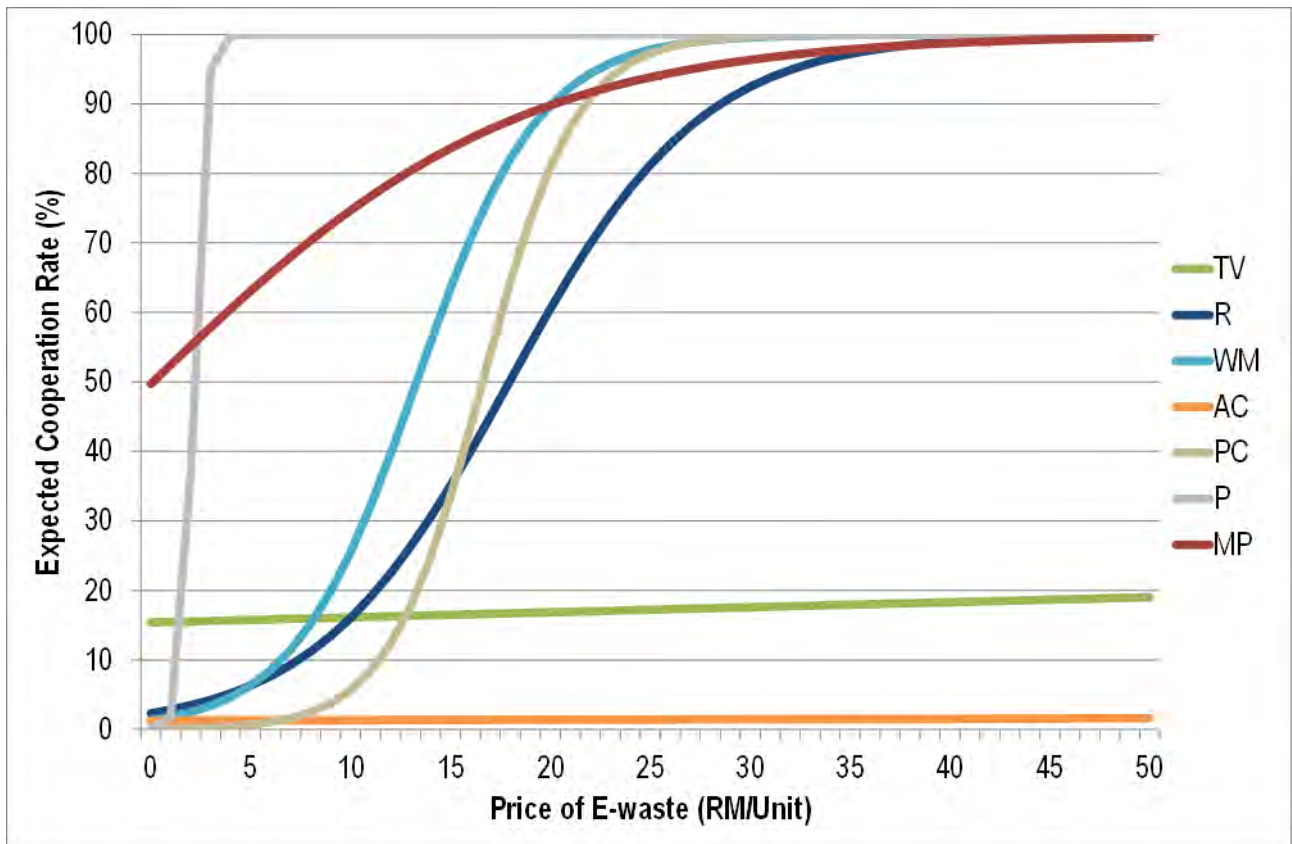

Figure. Willingness to be paid curves in the Pilot Project

Appendix 4. Cost analysis

1. Collection cost borne by the participating retailers

(1) Cost items to consider

The participating retailers bear the following costs regarding e-waste collection.

- Personnel cost for explaining to customers
- Personnel cost for paper works such as receipt management
- Transportation cost for taking back e-wastes from households

Among these items, only transportation cost was considered, because the personnel costs can be negligible compared with the time use for the original business as well as it could be too much burden for the participating retailers to separate their time uses from the original ones and the additional ones for e-waste collection.

(2) Model

The transportation cost was modeled as bellow.

- $TC = D * pf/ef + T * ps$

Where

- TC : Transportation cost by the participating retailers (RM/year)
- D : Travel distance (km/year)
- pf : Fuel price (RM/liter)
- ef : Fuel efficiency (km/liter)
- T : Total required time (hr/year)
- ps : Salary for staff (RM/person/hr)

Here, change of "T" can be focused, because e-waste collection does not change traveling distance. E-wastes were taken back from only households who bought some new products.

The required time "T" for collection can be expressed as:

- $T = a * P + b * E + c$

Where

- P : Number of delivered products
- E : Number of collected e-wastes
- a, b : Required time for one unit of products and e-wastes whose dimensions are hr/unit.

Here, the parameters a, b and c can be regressed by using any statistical method such as the least square method. The data were collected from the participating retailers until December 2012.

This gives us:

- $T = 6.67187 + 0.04111 * P + 0.05459 * E$

Now, the additional cost for e-waste collection (ΔC) can be obtained by setting the salary per hour as:

- $\Delta C = b * ps$ (RM/Unit)=0.05459 (hr/Unit)*6.75(RM/hr)=<u>RM0.37/Unit</u>

2. Cost structure of the full recovery facilities

The characteristics of the transportation cost and dismantling cost by the full recovery facilities are different from the cost borne by the participating retailers. The cost of the full recovery facilities are already deducted and considered in their prices for buying the collected e-wastes, while the cost borne by the retailers are additional cost for e-waste collection.

(1) Cost structure

The cost structure of the full recovery facilities were modeled by the following expression.

- $P_i = (1 + r) * (S_i - D_i - T)$
  Where

- r : the indirect cost rate (can be set as 0.1)
- P_i : the expected price by the full recovery facility of e-waste i
- S_i : the expected sales from selling materials contained in e-waste i
- D_i : the personnel cost for dismantling e-waste i
- T : Transportation cost for one e-waste

Here, if both the material component ratio contained in e-wastes in terms of money and the required time for dismantling e-waste are available, the expected buying price can be calculated. The transportation cost can be analyzed as below.

(2) Transportation cost

i) Model

The transportation cost data with some condition data of 1) number of visiting places and 2) number of transported e-wastes. The transportation cost is assumed to be affected by 1) number of visiting places, 2) number of bulky e-wastes and 3) number of non-bulky e-wastes as expressed below.

- $C_T = C + a * M + b * N_B + c * N_{NB}$
  Where

- C_T : Transportation cost (RM)
- M : Number of visiting places in a trip
- N_B : Number of collected bulky e-wastes
- N_{NB} : Number of collected non-bulky e-wastes
- C, a, b, c : Parameters to be given by a regression

ii) Result of regression

By using the data as of December 2012, the model was estimated below.

- $C_T(RM) = 50 + 20 * M + 3.2 * N_B + 0.75 * N_{NB}$

Here, if

- $N_B = 5 * M, N_{NB} = 2.4 * N_B$

Then

$$C_T(RM) = 50 + 20 * \frac{N_B}{5} + 3.2 * N_B + 0.75 * 2.4 * N_B = 50 + 9 * N_B = 50 + 3.75 * N_{NB}$$

If the number of collected e-waste become larger enough in the future, here, $N_{B,} N_{NB}$ can be estimated as below.

- $P_T(B) = C_T(RM)/N_B \rightarrow RM9/\text{Unit}$
- $P_T(NB) = C_T(RM) \rightarrow RM3.75/\text{Unit}$

Appendix 5. Equivalent curve for achieving a target collection rate

Once the WTP curves can be drawn, the equivalent curves for achieving a target collection rate can be defined by taking two factors: prevalence rate and voucher price.

The function form can be expressed by

- $CR = \dfrac{PR}{1+e^{-(a+b*VP)}}$.

Where

- *CR*: Target collection rate
- *PR*: Prevalence rate
- *VP*: Voucher price

Appendix 6. Instruction Manuals for Shops

1. Instruction Manual for Home Electric Appliance Shops

For Home Electric Appliance Shops

Instruction Manual for E-waste Collection

1 Offer of e-waste recycling to the customer upon purchase

(1) Offer recycling to the customer

a) Target customer

- The customers who bought some new products which need the delivery (The shop can offer to the customer to bring their e-wastes from their houses to the shop. – Ask to your manager)

b) Please explain the recycling

- E-waste is potentially hazardous and contains precious metals. Recycling is good for both safety and resource conservation.
- The shop supports the e-waste recycling program by DOE (Department of Environment) and MPPP.

c) Please offer the recycling

- If the customer has e-wastes in your house, the shop can take them back upon delivery of the new products. (The shop can offer to the customer to bring their e-waste from their houses to the shop. – Ask to your manager.)
- The customer can get a voucher. (Show the price list if the customer wants).
- Please explain the voucher can be used in the alliance member shops (The alliance shops will be updated in "www.facebook.com/ewaste.Penang")

(2) Application form

- Please fill in the blanks by asking to the customer.
- The application form has four-ply. Give the customer the first ply and send to the delivery staff the left.

2 Delivery and takeback

- The delivery staff will confirm the customer about the e-wastes when delivery.
- The types and numbers of the collected e-wastes can be changed from the application in the shop. The delivery staff can change the types and numbers in the second ply.
- The delivery staff will receive e-wastes and transport to the designated place (Ask to the manager.)

3 Transportation by the recycling company

- Please fill in the blanks in the transportation slip.
- Telephone to the recycling companies when the transportation is necessary.
  TES-AMM (MALAYSIA): +604-3991896   (Attn : Mohd Soffi –Logistic)
- Please take the first ply of the transportation slip.
- Please give the remained ply of the transportation slip to the recycling company with the all third and fourth ply of the receipts.

4 Common Voucher

- The customer can use the common voucher. The customer cannot get any change money from the voucher.
- How to type in the register should be asked to the manager.
- The voucher used can be reimbursed monthly. Please issue the invoices with the used voucher attached to:

TES-AMM (MALAYSIA) SDN BHD

2005 Tingkat Perusahaan Satu, Prai Industrial Estate, 13600 Prai, Penang.

Tel : +604-3991896   Fax : +604-3993221

Attn : Miss Christine Soh (Finance)

2.   Instruction Manual for Mobile Phone Shops

Instruction Manual for E-waste Collection

1   Offer of e-waste recycling to the customer upon purchase

(1) Offer recycling to the customer

a) Target customer

- The customers who bought some new products. (The shop can offer to the customer to bring their e-wastes from their houses to the shop. – Ask to your manager)

b) Please explain the recycling

- E-waste is potentially hazardous and contains precious metals. Recycling is good for both safety and resource conservation.
- The shop supports the e-waste recycling program by DOE (Department of Environment) and MPPP.

c) Please offer the recycling

- The shop can receive the non-used mobile phones.
- The customer can get an opportunity of a lucky-draw for a voucher. (Show the price list if the customer wants).
- Please explain the voucher can be used in the alliance member shops (The alliance shops will be updated in "www.facebook.com/ewaste.Penang")

(2) Application form

- Please fill in the blanks by asking to the customer.
- The application form has four-ply. Give the customer the first ply and send to the delivery staff the left.

Company		E-waste Receipt
Shop		(For Consumer) M-C
Purchase	☐Newly purchased ☐Model change	
Recycling	☐Agree (_____ unit) (Brand) ☐Later	
	Signature	
Receipt date (DD/MM/YYYY)	Retailer	Customer
E-waste recycling for the future environment! Thank you for your cooperation!		

(3) Lucky-draw

- Please offer a lucky-draw for each unused mobile phone to the customer.
- If the customer gets a "WIN", please give the customer a common voucher.

2 Transportation by the recycling company

- Please fill in the blanks in the transportation slip.
- Telephone to the recycling companies when the transportation is necessary.

  TES-AMM (MALAYSIA): +604-3991896   (Attn : Mohd Soffi –Logistic)
- Please take the first ply of the transportation slip.
- Please give the remained ply of the transportation slip to the recycling company with the all third and fourth ply of the receipts.

Company			E-waste Transportation Slip	
Shop			(For Shop)	T-S

No.	E-waste	Number of units	Recycler	
1	TV-CRT			
2	TV-LCD			
3	Fridge			
4	Washing Machine			
5	Air-conditioner			
6	PC-CRT			
7	PC-LCD			
8	PC-Note		Transportation date (DD/MM/YYYY)	
9	Printer			
10	Mobile phone		Signature (Shop)	
11	DVD player, LCD etc.		Signature (Recycler)	
12	Others			

3 Common Voucher

- The customer can use the common voucher. The customer cannot get any change money from the voucher.
- How to type in the register should be asked to the manager.
- The voucher used can be reimbursed monthly. Please issue the invoices with the used voucher attached to:

  TES-AMM (MALAYSIA) SDN BHD

  2005 Tingkat Perusahaan Satu, Prai Industrial Estate, 13600 Prai, Penang.

  Tel : +604-3991896   Fax : +604-3993221

  Attn : Miss Christine Soh (Finance)