FOREWORD

Basel Convention Regional Centre for South-East Asia (BCRC-SEA) in cooperation with the Secretariat of the Basel Convention (SBC) has developed this Technical Guidelines for Inventory of Electrical and Electronic Waste. This Technical Guidelines Development Project is funded by the Government of Japan through the Basel Convention Trust Fund. A national consultant, namely PT Amar Binaya Karsa, has been retained by BCRC-SEA to undertake the development of these guidelines.

The purpose of the these guidelines is to provide methodological guidelines to all stakeholders particularly parties in region served by the BCRC-SEA in conducting detailed inventories at national level and, eventually, at regional level. The Guidelines will assist Parties in establishment and completion of detailed inventory. Nevertheless, any other parties to the Basel Convention outside the Region and any other interested parties are welcome to use these Guidelines and give feedback for future revisions in order to make them more useful to all users.

The first Draft Guidelines were submitted in early March 2007 for review by all stakeholders in order to get suggestions and or comments as input for the development of the Final Guidelines. In a group work session during the Regional Workshop on the Environmentally Sound Management of E-Waste on March 2007 in Siem Reap, Cambodia, the first draft Technical Guidelines was comprehensively reviewed by a group of participants representing all stakeholders. A number of constructive recommendations for the improvement and finalisation of the Technical Guidelines have been received and accommodated under this final version of the Guidelines.

BCRC-SEA would like to express its thanks to the SBC, the Government of Japan, PT Amar Binaya Karsa, and to the countries in the region and all stakeholders involved for their comments, support and good cooperation in this Technical Guidelines Development Project. Appreciation is also addressed to the others, whose names are not mentioned in this document, who have also contributed to this Project.

Aboejoewono Aboeprajitno
Director of BCRC-SEA

TABLE OF CONTENTS

I. INTRODUCTION

1.1. Background Information

The increasing electronics and electrical equipment (EEE or, throughout these Guidelines is referred to as, **e-products**) use in daily life of human being has also resulted in the generation of waste electronics and electrical equipment (WEEE or, throughout these Guidelines is referred to as, **e-waste**). In the same time the ever advancing technology behind the manufacture of e-products has also increased the obsolescence of the products. Hence, it has also increased the rate of e-waste generation.

However, if improperly managed throughout its life cycle, e-waste can cause environmental problems due to the content of potentially hazardous waste such as heavy metals, halogenated substances, PCBs, et cetera. Therefore, an environmentally sound management of e-waste is strictly required to protect human health and the environment.

This matter became the subject at the Conference of Parties to the Basel Convention COP 6. It was agreed that e-waste waste considered a priority waste stream and environmentally sound management should continue to be given a high priority under the work programme of the Basel Convention. It was also recognized that there is a lack of reliable data on the generation, collection, import and exports, and management schemes in general as well as implementation problems.

Although e-waste is one of the hazardous waste streams covered by the Basel Convention, transboundary movement of e-waste, e.g. importation by a company into a country which is a party to the Basel Convention, may not always be properly controlled nor noticed by a national focal point to the Basel Convention and not in accordance to the Basel Convention as well. This problem may happen due to some reasons such as:

- False declaration of importers;
- Lack of intersectoral coordination;
- Lack of international cooperation.

The root cause(s) of the abovementioned and the other e-waste management problems within the South-East Asian region may be country specific in nature. However, they are commonly related to one or more of the following factors:

- Level of economic development;
- Legal basis for e-waste management;
- Intersectoral coordination;
- Law enforcement;
- Monitoring and evaluation.

Therefore, some common and more specific approaches to the environmentally sound management (ESM) of E-Waste in the Region may be required. One of the strategic approaches to the ESM of e-waste is establishing a national inventory of hazardous waste covering the e-waste stream.

BCRC-SEA as one of the regional centres for training and technology transfer also serves as facilitator to provide assistance and support to Parties in its region. As it is, BCRC-SEA has proposed a project to assist the Parties in South East Asia to overcome these problems concerning e-waste management. One of the expected output of the Project is documented technical guidelines for conducting national inventory of e-waste in the Region.

The Secretariat of Basel Convention has issued a methodological guide for conducting national inventories of hazardous waste within the framework of the Basel Convention (the Guide). BCRC-SEA has also conducted a demonstration project in conducting a national inventory of hazardous waste based on the Guide in one of the Party countries in the Region. However, both the Guide and the demonstration project focused on common industrial hazardous waste streams.

In fact, e-waste stream generation inventory is relatively more complex/difficult to perform accurately comparing to the common industrial hazardous waste streams due, among others, to the following factors:

- Broad range of lifetime of e-products;
- Longer chain of ownerships and uncertain fate;
- Involvement of repair or refurbishment processes;

- Economic value of e-waste components;
- Scarcity or lack of records or reliable information;
- No single estimation method appropriate for all cases.

Based on the abovementioned situation, a set of technical guidelines for inventory of e-waste, at least in the Southeast Asian region, is needed. The Technical Guidelines is primarily intended to help the Parties develop initial national inventory of e-waste. It has been also identified that it is important to target those types of electronic and electrical equipment (e-products) that have the greatest potential for impacting on human health and the environment, and at the same time have a greatest economic potential for refurbishment and recycling.

1.2. Objectives

The guidelines should be considered a supplement to the Methodological Guide for the Undertaking of National Inventories of Hazardous Wastes Within the Framework of the Basel Convention (First Version, Series/SBC No: 99/009 (E) Geneva, May 2000) in conjunction with the Basel Convention Regional Centre South-East Asia's Reports on National Inventories of Hazardous Waste Demonstration Project (2005) for e-waste.

More specifically, the Guideline is developed in order to provide technical guidelines as well as to provide information to the Parties to the Basel Convention in the Southeast Asian Region in designing and implementing a national e-waste inventory program. It is intended to promote environmentally sound management of e-waste in the Region.

The users of this Technical Guidelines should also refer to the other information and guidelines related to the objectives of the national inventory provided in the SBC's Methodological Guides under the following sections:

- The role of the national inventory in the context of a national policy on hazardous waste;
- The transmission of information to the Secretariat of the Basel Convention (SBC);
- Specific objectives.

I.3. Scope of the Guidelines

I.3.1. Target Users

- National Focal Points and Competent Authorities of the Parties to the Basel Convention in the Region
- Others assigned to or interested in conducting e-waste inventory

I.3.2. Scope of E-Waste Streams

Basel Convention does not specify all forms of e-waste, but, the hazardous contents of it instead. For example, Annex VIII of the Convention designates the Waste Code "A1180" as "Waste electrical and electronic assemblies or scrap containing components such as accumulators and other batteries included on list A, mercury-switches, glass from cathode-ray tubes and other activated glass and PCB-capacitors, or contaminated with Annex I constituents (e.g., cadmium, mercury, lead, polychlorinated biphenyl) to an extent that they possess any of the characteristics contained in Annex III." Therefore, the Parties have to determine the forms of e-waste that satisfy the definition of hazardous waste as covered in the Convention and its applicable Annexes.

Currently, the e-waste types selected under the scope of the E-Waste Inventory Technical Guidelines Development Project consist of two main groups of electronics and electrical home appliances as listed hereunder.

- Electronics
  - Personal Computer Central Processing Units (CPUs)
  - Personal Computer Monitors made of Cathode Ray Tubes (CRT)
  - Television Sets made of CRT
  - Mobile Phones

- Electrical Home Appliances
  - Refrigerators
  - Home Air Conditioners
  - Dry Cell Batteries
  - Fluorescent Lamps

I.3.3. Applications of the Technical Guidelines

This Guideline is applicable for both setting up an initial or pilot national e-waste inventory program and upgrading an existing national e-waste inventory program.

I.3.4. Scope of Methods for Inventory

1.3.4.1. Basic Methodology

This guideline covers basic methodology for hazardous waste inventory similar to that provided in the SBC's Guide. It is adapted for application to the inventory of e-waste as a specific hazardous waste stream and reorganised as listed hereunder.

- Preparatory Works
- Inventory Database Development, Use and Maintenance
- Inventory Program Evaluation and Improvement

1.3.4.2. Methods

These Guidelines also focuses on the methods that use or optimise the use of available secondary data pertaining to e-waste inventory. The methods for primary data collection are mentioned, but, not provided with detailed descriptions. Users can also refer to other technical guidelines for e-waste inventory in the Asian region under development by another institution such as that developed by EX Corporation which focuses on survey methods and provides technical details.

I.4. Guidelines Development Notes

This guideline is not intended to replace nor duplicate the existing SBC's Methodological Guide for the Undertaking of National Inventories of Hazardous Wastes within the Framework of the Basel Convention. It should rather be regarded as supplement to the current Guide. While the Guide provides methodological guidelines for national inventories of hazardous waste in general, these regional guidelines emphasize the technical aspect of inventory of a specific hazardous waste group, e.g. e-waste.

The SBC's Guide provides useful guidelines and information on the establishment of an inventory program. Users of this Technical Guidelines should also consider the important principles in developing an e-waste inventory program which have been underlying, and also stated in, the abovementioned SBC's Guide and as cited below.

- A national inventory of hazardous wastes is an indispensable preliminary step for the development and implementation of a national management policy for hazardous wastes, within the framework of the implementation of the Basel Convention.
- Setting up of a national inventory is based on a specific methodology.
- Responsibility for establishing the inventory falls on the official and competent administrative authority, which appoints persons responsible for the environment.
- The establishment of an inventory should also be time-related. The first activities of the inventory are to collect the data, which will be completed and fine-tuned regularly. This process of the inventory will be periodically updated (annually, biannually, etc.).
- The setting up an inventory of hazardous wastes requires a legal, institutional and technical arsenal, which each country must continue to develop: regulations, institutional structure, infrastructure, awareness-raising policy, etc.
- A national inventory of hazardous wastes fits in to a strategy of environmentally sound management of wastes and requires the cooperation of all the actors concerned.

Since this Technical Guidelines have also been developed with reference to the Guide, the methodology for setting up an e-waste inventory has also taken the abovementioned guiding principles into account. However, these guidelines do not restrict the applicability of them only to industrial sources.

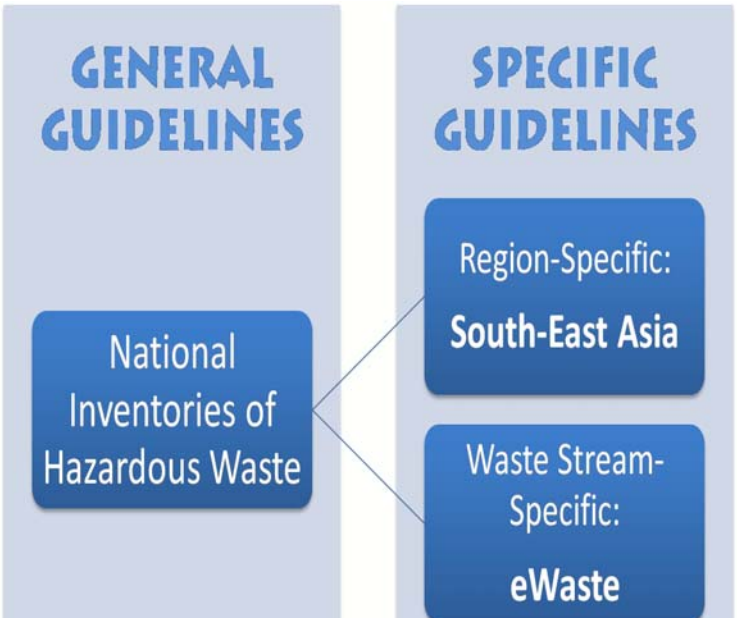


Figure 1- Relationship between these Technical Guidelines for Inventory of E-Waste with the existing SBC's Methodological Guide for Conducting National Inventories within the Framework of Basel Convention.

Figure 1 illustrates the relationship between the existing SBC's Guide and this Technical Guidelines. This Technical Guidelines serve as both region-specific and waste streams-specific guidelines. Therefore, users of the Guidelines should also refer to the current SBC's Guidelines for Hazardous Waste Inventories for basic information and methodology. The users should also ensure that they seek and use only the current version of the Guidelines document.

The SBC's Methodological Guide had been tried out and reviewed under the BCRC-SEA's NIHW Demonstration Project (NIHWDP) in 2005. The results of the

Project have been documented under the following titles:

- Final Report of the NIHWDP;
- Report of a Review on Methodological Guide for the Undertaking of National Inventories of Hazardous Wastes Within the Framework of the Basel Convention Based on Existing Conditions and Case Study.

In addition, the Consultant of the Project has also presented its paper as a supplement to the two reports mentioned above under the title of A Generic Guideline for Hazardous Waste Streams Generation Estimation Methods in the Context of Hazardous Waste Inventory.

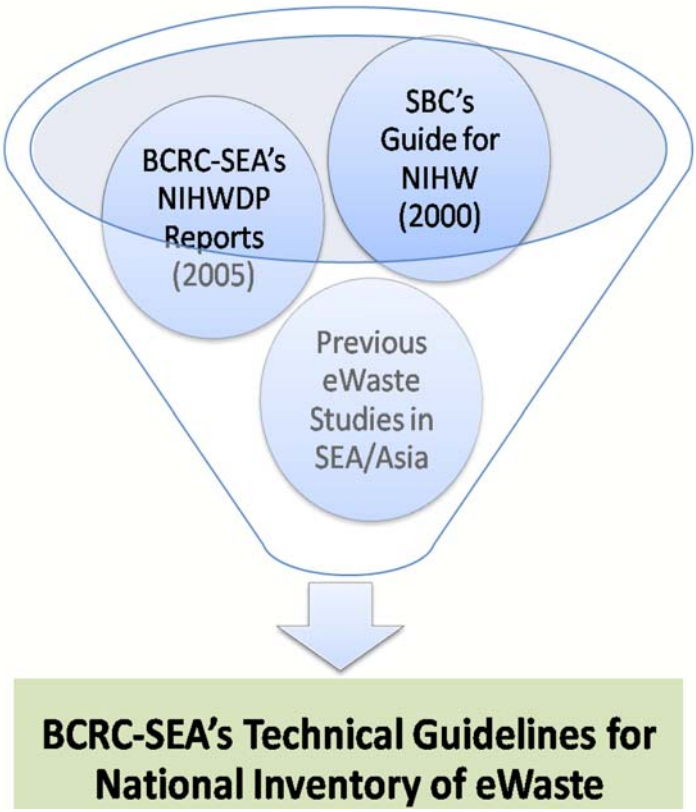
The abovementioned documents are intended as input to the revision of the first version of the SBC's Methodological Guide (2000). It was expected that the second version of the document will be issued thereafter. However, up to the time this Draft Technical Guidelines is written, there is no information available on the current status of the Guide document. Therefore, the users of this Guideline are also suggested to examine the above listed document in conjunction to the SBC's Guide.

II. TECHNICAL GUIDELINES DEVELOPMENT BASIS

II.1. Overview

The guideline has essentially been developed with reference to the existing SBC's Methodological Guide for Undertaking National Inventory of Hazardous Waste under the Framework of the Basel Convention and the BCRC-SEA's National Inventories of Hazardous Waste Demonstration Project Reports. It has also been substantially developed by taking into account the results of literature review and field observations as essential basis as illustrated in Figure 2.

Figure 2 - The basis for the development of these Technical Guidelines



A number of relevant documents have been reviewed in order to identify and assess the existing e-waste studies pertaining to inventories ever conducted within the region of Southeast Asia or Asia for reference. There was, however, not so many literatures directly related to e-waste inventory ever identified during the course of the Project.

Literature reviews were then further focused on the identification of e-waste actors, e-waste flow or movement and quantities whenever possible, the methodology and any estimation methods ever used in the inventories as well as the current results of the inventories. Common issues and any constraints in performing e-waste inventory have also been identified for consideration in developing the Guidelines.

Based on review on the currently available literature, there were six e-waste management study projects, including e-waste inventory, conducted in Southeast Asia and the rest of the Asia region. Specifically, the projects were conducted in the following countries:

1. Cambodia
2. Malaysia
3. Thailand
4. China
5. India
6. Sri Lanka

The existing literature on e-waste studies in the Southeast Asia region indicates that the previous e-waste studies were only conducted in the countries of Cambodia, Malaysia, and Thailand (BCRC China, 2005 and Thailand Electrical and Electronics Institute, 2005). In the Asia region, other than the Southeast Asia, e-waste studies were conducted in China, India and Sri Lanka (BCRC Beijing, 2005 and Swiss State for Economic Affairs, 2004).

Although this Project is budgeted for desk study only, in order to supplement the previous studies in the Southeast Asia region, the Consultant has also conducted field observations in selected cities in Indonesia:

- Surabaya
- Jakarta
- Bandung

II.2. E-Waste Management Actors Information Sources

E-waste management involves actors, original e-products and e-waste types, and certain patterns. There are various actors identified in the e-waste flow that can be refered to as potential sources of information, either directly or indirectly, on e-waste generation quantities. They can be grouped into four subsystems as listed below.

- New E-Product sub-system
  - Domestic Manufacturer
  - Importer New E-Product
  - Distributors/Wholesalers
  - Retailers/Vendors
  - First-hand new E-Product Consumers
- Reuse & Recovery sub-system
  - Importer & Trader used e-product
  - Retailers/Vendors used e-product
  - Second-hand used E-product Consumers
  - Repair/Service shops
  - Used E-components Collectors & Retailers
- Recycling sub-system
  - Waste Collectors (scavengers/scrap dealers)
  - Importer E-waste
  - Recycling/take back Program Operators
  - Recyclers/Extractors
  - Recycling Material/Manufacturer Industries
- Disposal sub-system
  - Disposal/landfill/incinerator operators
  - Exporter to foreign countries

II.3. E-Waste Management Flow

The e-waste flow patterns, in general, can be mapped based on similarity of certain e-waste types. Figure 3 below shows typical flow pattern of e-waste of Type-1 (PCs, TV sets, mobile phones) while Figure 4 shows that of Type-2 (lamps, dry power batteries).

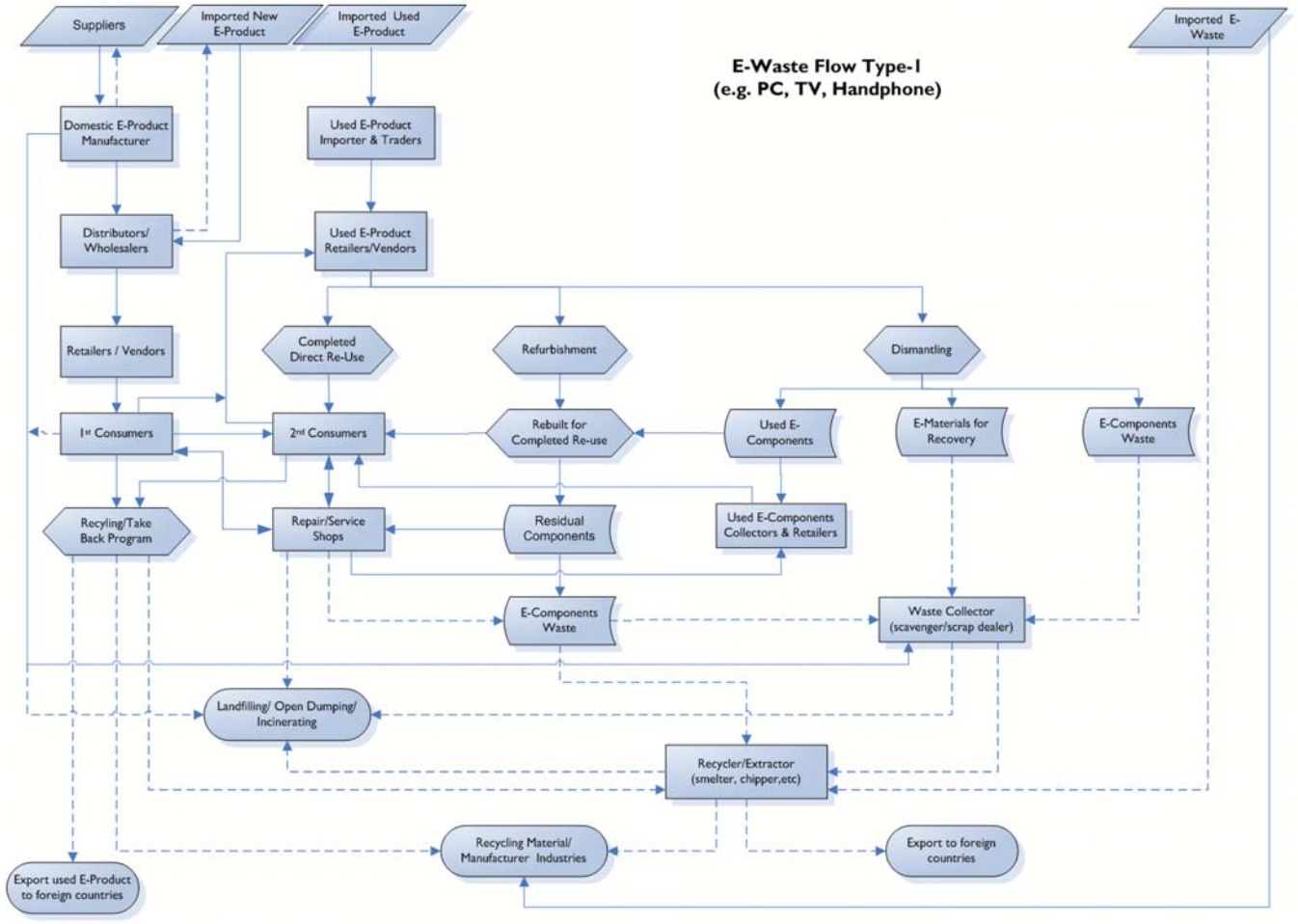
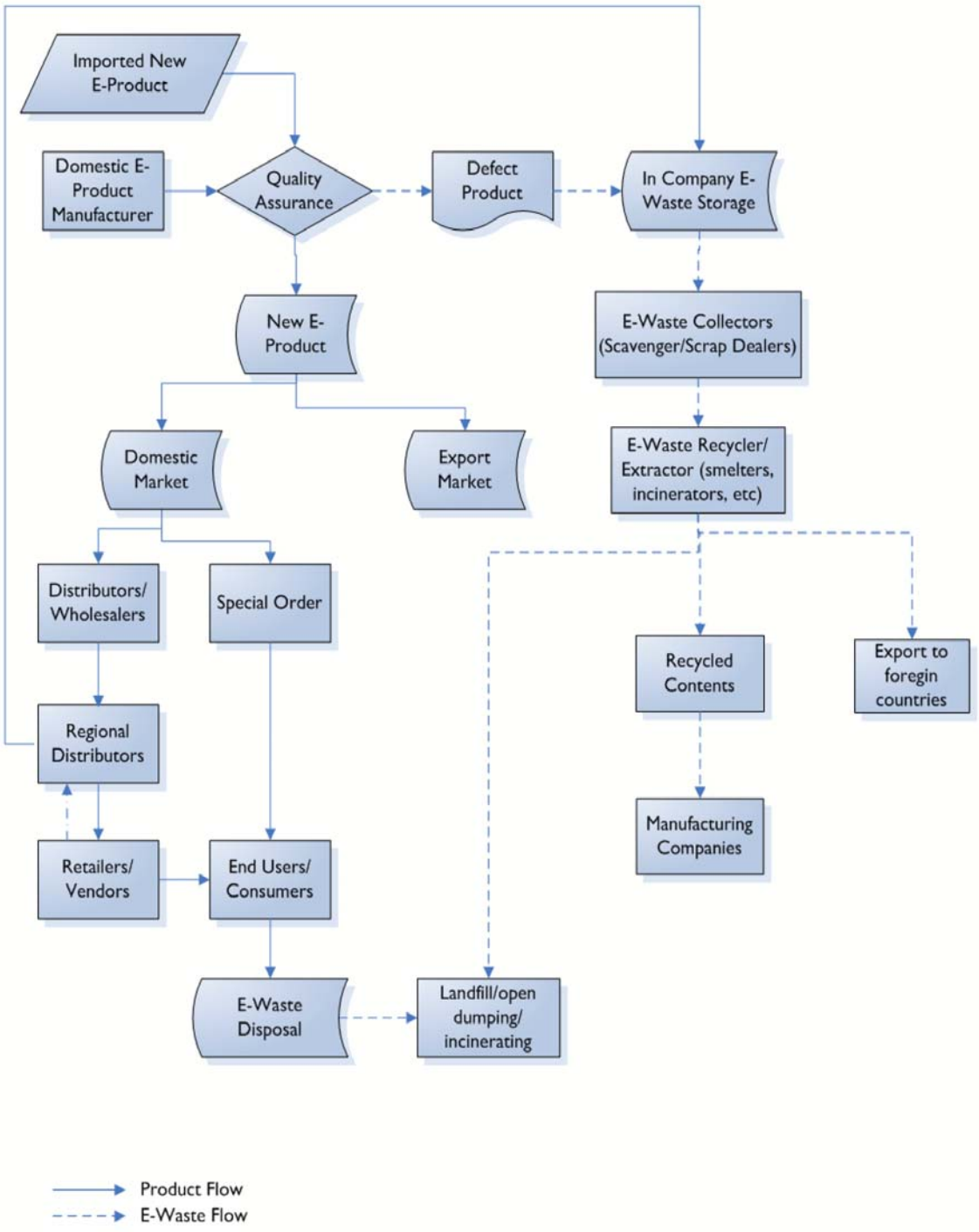


Figure 3 - E-Waste flow for Type-1

E-Waste Flow Type-2
(Electronic Lamp, Dry Battery)



II.4. Commonly Used Inventory Methods

The methods commonly used in the previous studies pertaining to e-waste inventory conducted in the Asian region are summarized under this section. The e-waste streams covered by the methods consist of mobile phones and mobile phones battery, dry cell batteries, fluorescent lamp wastes, personal computers (PC), and some home appliances such as television (TV), washing machines, refrigerators and washing machines. It is concluded that the e-waste streams can be classified into 2 (two) groups based on their reusability/ recyclability as indicated in Figure 5 below.

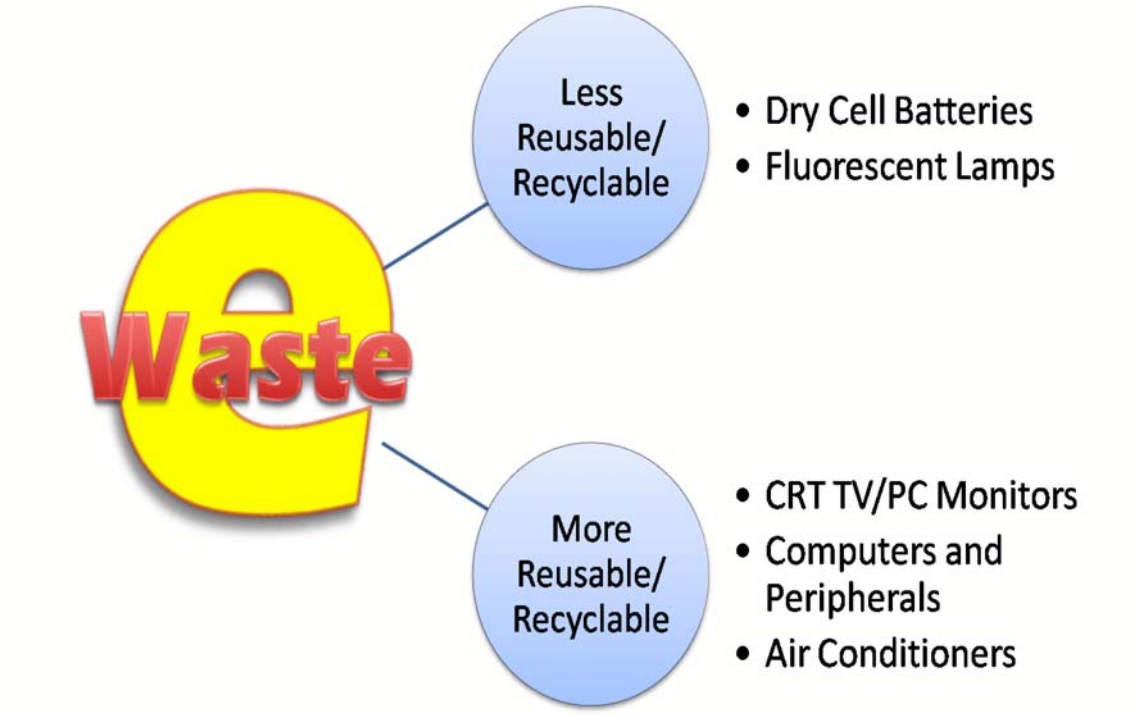


Figure 5 - Two e-waste groups classified under these Guidelines

The methods used for estimating e-waste generation from some selected e-products conducted in the Asian, especially the Southeast Asian, region are selected for reference and summarised in the following sections.

II.4.1. Waste Mobile Phones (WMP)

The e-waste generation estimation methods used in Thailand for mobile phone stream (Thailand Electrical and Electronics Institute, 2005) is selected as a model under this Guidelines since they are considered more advanced compared to those used in the other countries (Cambodia, China, India, Srilanka, Malaysia) based on literature review (BCRC China, 2005 and Swiss State for Economic Affairs, 2004). This section summarizes the methods.

A. Forecast of the quantity of waste mobile phones and batteries

- The average life time or the usage period of mobile phone main units and batteries were determined by conducting survey. Interview using a set of questionnaires was used as survey instrument. 1000 product users in Bangkok Metropolis were interviewed. Results:
    - The life time of most mobile phones is 2 years; and
    - The life time of most batteries is 1 year.
- Data of the quantity of mobile phones users were collected from various sources.
- Forecast of the quantity of mobile phone and battery wastes were developed according to the relationship between mobile phone quantity data and the average using period.

B. Identification of mobile phone components and weight

- Data on the proportion of raw materials that form the MP components were collected from a MP agent in Thailand. The mobile phone components were grouped based on functional components, hazardous substances, and valuable substances. A rough comparison of the components of two models of MP currently existing in the markets (2004) was made.
- The survey team disassembled the parts of 10 WMP having been sold in the market over the past 2-5 years to determine the average weight of the components.

II.4.2. Dry Cell Batteries & Fluorescent Lamp Wastes

A. Forecast of the quantities of dry cell battery and fluorescent lamp wastes

- Interview 1000 dry cell and fluorescent lamp users in general public places in Bangkok Metropolis, using a set of questionnaires.

- Data is collected on the manufacture, import, and export of dry cells battery and fluorescent lamps during the past 10 years from the relevant agencies.
- According to the survey on consumptive behaviors and the dry cell and fluorescent lamp wastes, the quantities of dry cells and fluorescent lamps used (unit/year) are calculated by utilizing the data on import quantities and on domestic sales quantities; after that, the average using period derived from the survey on behaviors of usage and discharge is the using period of the products until they become the deteriorated wastes.
- According to the results of the questionnaire to survey the behaviors of use and discharge of non-rechargeable and rechargeable dry cells, including general and energy-saving fluorescent lamps of 1,000 users,
  The using period of dry cell batteries is approximately 2 months, and
  The using period of fluorescent lamps is approximately 1 year.
- Since the quantities of the products sold in the country per annum are the quantities of total wastes per annum, the quantities of dry cell and fluorescent lamp wastes, the current accumulated quantities, and the forecasted quantities can be concluded.

B. Components of dry cell batteries and fluorescent lamps

- Dry cell Battery. In general, the dry cells used at present can be classified into the following two main categories:
  Non-rechargeable dry cells: Alkaline and Manganese
  Rechargeable dry cells: Nickle-Cadmium, Nickle-Hydride Metal, and Lithium-Ion

The survey team could not find data on the components of non-rechargeable dry cells from the manufacturers in Thailand due to the trade secret status. However, they could refer to the data derived from the experts of JETRO.

II.4.3. PCs and Some Home Appliances

The e-waste streams covered Television (TV), Washing Machines (W/M), Refrigerators (R/F), Indoor Ac (A/C-I), Outdoors AC (A/C-O, PC, CRT). The Model for the Methods are from Thailand and India (Delhi Region). China also has a method similar to Thailand.

Working Methods

- Search and collect 20 samples of WEEE in the areas studied. Take notes on the serial number (S/N), manufacturer, country, model, type, and manufacturing date (if any) of the completely deteriorated electrical and electronic equipment that cannot be recycled (WEEE) and the electrical and electronic equipment that can be recycled in the form of second-hand products whether they are repaired or not (IWEEE).
- Submit the serial numbers recorded to the Federation of Thai Industries to coordinate with the manufacturers of the electrical and electronic equipment, to ask for data on the manufacturing year, and to know the expiration date of each category of products.
- Calculate the average life time of each category of WEEE.
- Collect data on the quantities of the electrical and electronic equipment manufactured, imported, and exported during the life time of products in order to analyze the quantities of products sold in the country.
- Evaluate the quantities of WEEE.
- Dismantle the parts of the WEEE and weighs them to determine the proportion of the parts to be recycled and those that cannot be recycled to find the recyclable proportion of each type of product. The parts of the product wastes shall be in line with the current practices of recycling by covering different brand names, models, sizes, and manufacturing years of the electrical and electronic equipment as much as possible.
- Compute the average weight of each category of electrical and electronic equipment to determine various variables.
- Prepare a figure presenting the processes of origin, usage, and discharge of each category of WEEE.

III. INVENTORY PROGRAM OVERVIEW

As stated in the first chapter, the guidelines should be considered as an extension of or a supplement to the Methodological Guide for the Undertaking of National Inventories of Hazardous Wastes Within the Framework of the Basel Convention (2000) in conjunction with the Basel Convention Regional Centre South-East Asia's Final Report on National Inventories of Hazardous Waste Demonstration Project (2005) for e-waste stream.

Therefore, the development of a national inventory of e-waste also conforms to the national inventory of hazardous waste under the framework of the Basel Convention which has the objectives as stated in the Guide and cited below.

- The collection of elements useful for the development of a national policy on hazardous wastes;
- The obligation to transmit information and reports through the secretariat, in accordance with article 13 of the Basel Convention.
- Some specific objectives as well as the option of adapting the inventory in the future.

Despite the fact that all Parties to the Convention is obliged to transmit information and reports to the Secretariat (SBC), the Parties in the Southeast Asian Region can make use of the BCRC-SEA's functions. BCRC-SEA can facilitate the implementation of BC by providing information, consultation, and training on waste inventories as well as compilation of national inventory databases for various purposes. The e-waste inventory reporting and database management structure beyond national level is depicted in Figure 6 below.

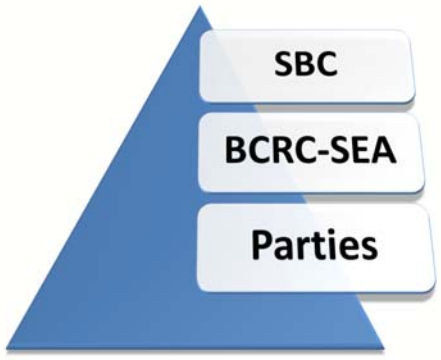


Figure 6 - Expected e-waste inventory database structure beyond national level

For a more common example, an e-waste inventory is mostly aimed at obtaining information on annual quantities of e-waste generated with regard to one or more of the following activities:

- Production;
- Importation;
- Exportation;
- Reparation;
- Refurbishment;
- Recycling;
- Disposal.

An e-waste inventory may also pertain to the identification of e-waste management actors, practices, and costs. The information or data resulted from an inventory may be used to develop or review a policy on e-waste management, set out priority, develop or review some e-waste-related regulations, etc. Regardless the specific objectives and purposes of an e-waste inventory, the inventory itself should be properly managed so as to achieve the objectives in an effective and efficient manner. Appropriate methodology and resources are essential for an effective inventory program.

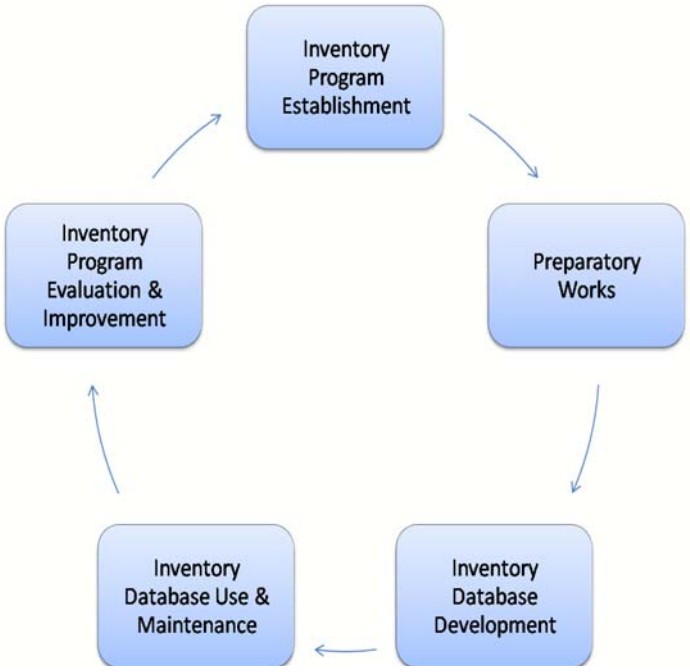


Figure 7 - Waste Inventory Development Methodology.

The Guide provides methodological guidelines for inventories of hazardous waste in general that is also basically applicable to e-waste inventory. Figure 7 (above) presents a simplified inventory process flow diagram. Despite being somewhat different in the outline of the methodology, the diagram is basically adapted from the methodological guide.

IV. METHODOLOGY FOR INVENTORY DEVELOPMENT

IV.1. Inventory Program Establishment and Management System

IV.1.1. Policy

A definite program on inventory of e-waste or hazardous waste covering the e-waste stream should be established in order to facilitate an effective hazardous waste management. A national policy on hazardous waste management covering e-waste stream will be a strong drive to the establishment and implementation of an inventory. In return, the results of an e-waste inventory may be used as an input in reviewing a policy or even establishing it when none is in place. The policy should be supported with a sound inventory management system which elements are indicated in Figure 8 below.

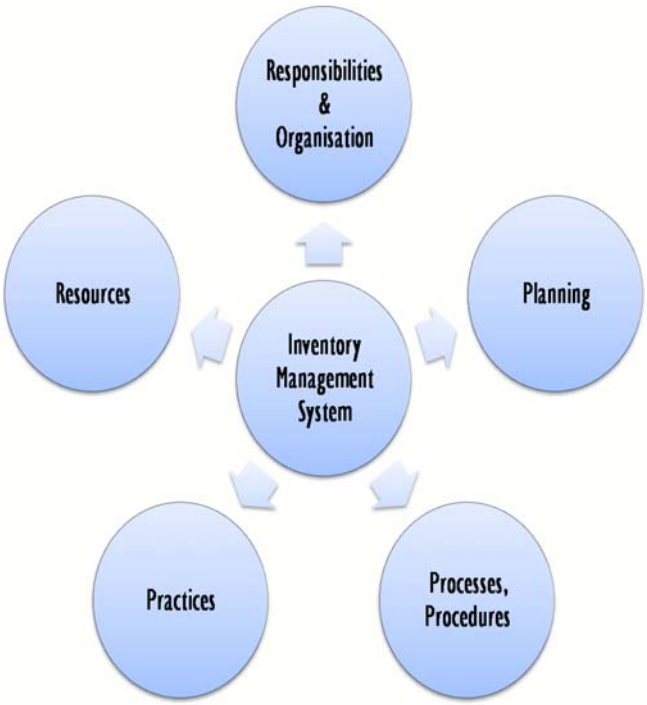


Figure 8 – Inventory Program Management System

IV.1.2. Responsibility

Responsibilities for e-waste Inventory Program must be clearly defined. Leading institution and personnel should be defined first. It is logical that the national

focal point to the Basel Convention bears the main responsibility for the inventory despite involving other relevant institutions or stakeholders.
Once the main responsible personnel is appointed, the program should be well organised for implementation. The main responsible personnel can set up a team making up the expertise and skill that may be required in order to achieve the goal of the e-waste inventory program.

IV.1.3. Planning

An effective and efficient inventory program stems primarily from a good plan. A good plan serves as a road map that provides the right direction for the implementation of an inventory as well as the optimal utilization of resources in order to achieve the objectives the inventory.

An initial assessment may provide essential information on various aspects of e-waste inventory that can be used to develop a good inventory plan (please refer to Section 4.2.1. of this document). The plan may be reviewed and revised as necessary based on the results of evaluation of the initial inventory program implementation.

IV.1.4. Processes, Procedures, Practices

Various processes, procedures and best management practices are required to ensure that the inventory is undertaken as planned. Some adjustments may be required in order to meet the objectives of an inventory.

IV.1.5. Resources

Various resources including human, financial, equipment will be needed to develop and maintain an inventory program. The national focal points of the Basel Convention should ensure that the necessary resources are adequately available to the inventory program.
Strong commitment of competent authorities and their responsible persons on resources allocation in inventory has been proved to be critical for effective implementation and results.

IV.2. Preparatory Works

This section provides guidelines for preparatory works aimed primarily at setting up an initial inventory program. Some elements of the preparatory works may be needed to be repeated to some extent for further development of the inventory program.

IV.2.1. Initial assessment

Initial assessment on e-waste management in a specific area may be needed in advance of an e-waste inventory planning. It will provide an overview or snapshot of:

- The current e-waste management actors,
- The current e-waste management practices,
- E-waste flow pattern in a specific area,
- Available relevant information and data sources.

An initial assessment may also provide other important information for developing an effective e-waste inventory plan, e.g.:

- Setting out priorities in an inventory program scoping with regards to
  - Specific e-waste streams or e-product types,
  - Appropriate assumptions to be taken,
  - Specific administrative areas,
  - Specific e-waste management actors/facilities,etc.
- Estimate of inventory team size,
- Estimate of initial inventory project time span,
- Estimate of costs.

It may be performed as a desk study, using some documented references for e-waste inventory, or quick observations in some selected areas.

IV.2.2. Initial inventory program design

A national e-waste inventory program should be started with an initial inventory. The initial inventory will serve as a model for further inventory program. An effective and efficient initial e-waste inventory program should result in useful output. In order to achieve it, the program has to be properly planned and designed, e.g. by clearly defining:

- Specific objectives,
- Scope,
- Required information types and sources,

- Operational procedures,
- Approaches,
- Appropriate methods and tools, and
- Resources,etc.

IV.2.3. Team formation and assignments

An inventory program is usually undertaken by a team. The national focal points of the Basel Convention should appoint a team leader first. The team leader may select other team members in accordance with the identified needs for necessary expertise and skills to achieve the objective(s) of the program.

An e-waste inventory program team may consist of:

- Project Director
- Project Officer
- Team Leader
- e-Waste Management Expert
- Surveyors
- Database Development Specialist
- Administrative Assistant(s)

There is no requirement or standard for team composition. The team composition may be determined by professional judgment by taking some objective considerations into account. However, regardless the team composition, each team member's roles, responsibilities and tasks should be clearly defined, communicated to, and understood by the team members.

IV.2.4.Training on inventory program and implementation

Apart from the expertise and or skill already possessed by the members of an e-waste inventory team, a training or briefing should be provided to all team members. At minimum, the training or briefing is necessary to ensure that each team member understands:

- The objectives, targets and scope of the inventory program;
- His/her roles, functions, responsibilities, and tasks;
- The importance of output of a member's job to the others and the achievement of the program;
- The procedures to be followed;
- The use of survey instruments;
- Specific situation in the survey area,etc.

When non-experienced human resources are to be assigned to an e-waste inventory

team member, they should be trained first with appropriate topics as well. Training methods may vary and be selected to suit the need and characteristics of a team, its members, and the circumstances.

IV.3. Initial Inventory Database Development

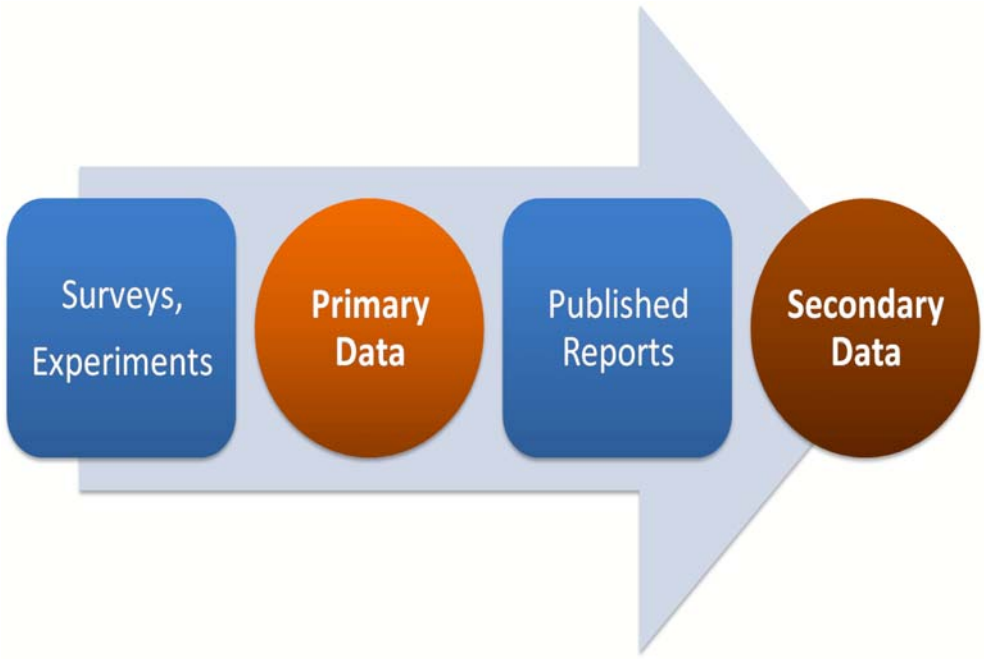
An initial inventory database should be developed to store all results of the initial inventory program in selected areas. In addition as baseline data source, it also serves as a model and a baseline for further inventory development and maintenance. The initial inventory database development starts with entry of the results of an initial or pilot inventory program.

IV.3.1. Information & Data Collection

Upon determination the types of information and data to be collected, potential information and data sources have to be identified. Some data can be obtained from relevant publication (secondary sources) such as technical journal, published reports on e-waste studies, inventories, market researches, business intelligence, etc. Some information and data may not readily be available. So, they have to be acquired through some approaches and procedures, e.g. collection and processing of other related data first.

In many cases, some types of basic data have to be acquired through primary sources, e.g.with experiments (e.g. actual end-of-life determination tests) or surveys. Surveys are usually conducted with various instruments such as interviews or questionnaires. Figure 9 below illustrates how secondary data may evolve.

Figure 9 - Secondary data evolved from primary data through published reports on experiments and or surveys.



There are various methods available for e-waste inventory with regards to e-waste generation quantities. Under this guideline the methods are selected with the consideration of the availability of the secondary data. However, in certain circumstances, the use of a method may require one or more type of data source:

- Primary data;
- Secondary data;
- Combination of primary and secondary data.

Figure 10 below depicts the relations of an e-waste generation estimation method and its possible input from the two main types of data source.

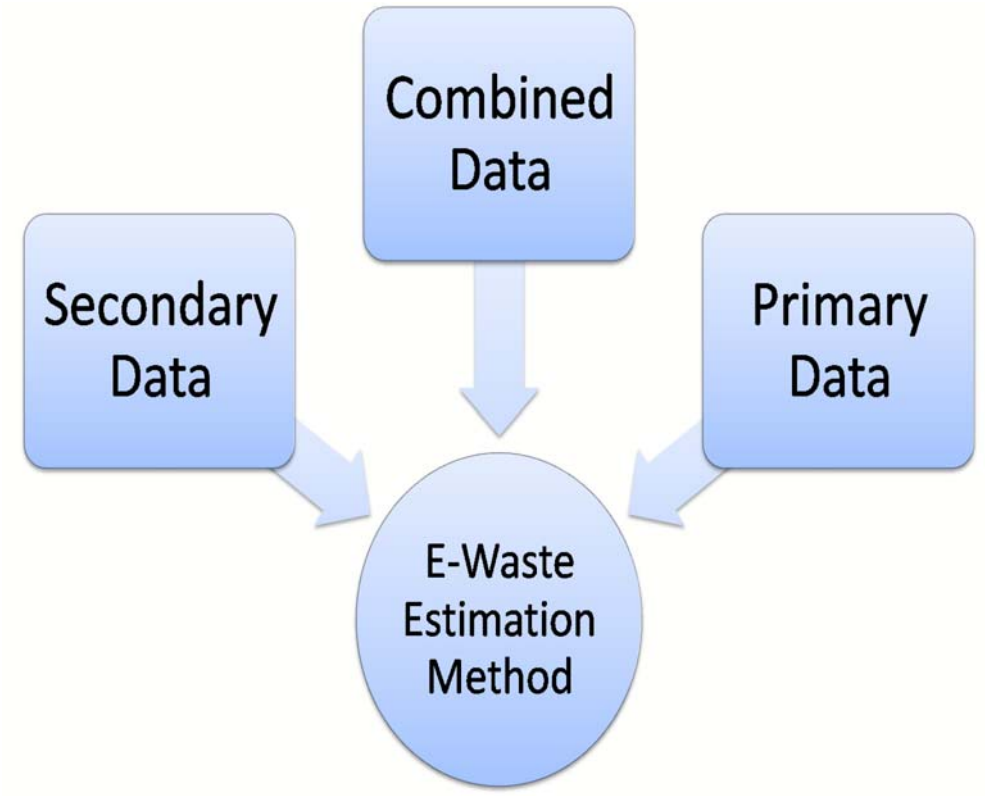


Figure 10 - E-Waste estimation methods and possible data sources

It is recommended that any available secondary data be optimally used first. Primary data may be acquired as necessary in order to make up or validate the inventory database. Table 1 below lists some potential e-waste management actors which also serve as information and data sources, both of secondary and primary types, for e-waste inventory. Appendix A to these Guidelines provides also provides list of commonly required information or data pertaining to e-waste inventory with their potential information and data sources.

Table 1 - Potential Information Sources for e-waste Inventory

Source	Type of Information/Data	Remark
Customs	■ Types and quantities of brand new eProducts imported ■ Types and quantities of used eProducts imported	
Trade Affairs Authorities	■ eProducts trading data and related information	
Electronics and Electrical Equipment Industrial Associations	■ List of eProduct manufacturers	
eProduct Manufacturers	■ Types and quantities of eProducts manufactured ■ Domestic sales ■ Export sales ■ List of distributors ■ Designed lifetime of specific eProducts ■ eProduct material data	
Exporters/Importers	■ Types and quantities of eProducts imported ■ Origin countries and companies ■ Types and quantities of eProducts exported ■ Destination countries and companies	
eProduct Distributors	■ Sales of specific eProducts ■ Destination areas of sales ■ eProducts return policies ■ List of authorized service centres	
eProduct Retailers	■ Types and quantities of eProducts sold	
eProduct Repair Workshops	■ Types and quantities of eProducts being repaired ■ Commonly replace parts/components ■ Ratio of non-repairable over repairable eProducts of each type ■ Types and quantities of e- waste resulted from repair process ■ e-waste management practiced	

Source	Type of Information/Data	Remark
e-waste recycling facilities	■ Types and quantities of e-waste received ■ Recycling methods ■ Recycling products ■ Residual materials management practiced	There are also some illegal recycling facilities usually refuse to cooperate.
Waste Disposal Facilities	■ Quantities of e-waste received ■ Disposal methods ■ Residual materials management practiced	
Consumers Protection Organisation	■ Various possible information as initial tracking point for data collection.	
eProduct Users	■ eProduct consumption pattern ■ eProduct possesion period ■ eProduct lifetime estimation ■ Action taken on eProduct when damaged, no longer used or unwanted	■Used as primary data source. ■ Residential eProduct users can be classified by: ■ income range ■ family size ■ Consider: ■ number of users per household ■ number of similar e-product per user ■ Institutional eProduct ■ Users can be classified by: ■ type of activity; ■ number of employee.

A procedure for information and data collection should be established. It may be supplemented with work instructions, e.g. to select and use appropriate methods and tools, recording and reporting the collected information and data.

In order to get data on the quantities of e-waste generated over a certain period and/or in a certain geographic area or from certain economic activity sectors, one or more appropriate methods should be used. The use of a method may also require some tool(s) such as questionnaires.

Information on selected methods currently available for use in an e-waste inventory is provided on Chapter 5 of this document.

4.3.2. Information & Data Analysis

This stage may be started with collected information/data sorting, compilation, and analysis. The results of data analysis may be used to synthesize the desired information and data with certain units for presentation or use in e-waste generation estimation or projection for other areas as well as data entry into a database system.

4.3.3. National Inventory Database Development

A national inventory database can be developed with the results of the initial inventory program/project. The national database can be developed through compilation of lower level database (local, provincial) as illustrated in Figure 11 below.

Figure 11 - The Structure of a National Inventory Database of E-Waste

A mechanism for compilation and validation should be developed first. Responsible persons for database management at each administrative level should also be appointed. The illustration of a national database structure also shows the importance position of the local level of administration, including those of the provincial or state levels, in building the national inventory database. The accuracy or reliability of the higher levels of database may depend on the accuracy or reliability of it. In return, the best leadership must be kept at the national level.

IV.4. Inventory Database Use and Maintenance

IV.4.1. Database Use

An e-waste inventory database may be used for:

- Identification of all e-waste management actors;
- Identification of significant sources of e-waste;
- Identification of significant e-waste type in terms of both quantity and hazards;
- Identification of trends in flow patterns;
- Identification of lacking information on certain aspect of e-waste management;
- Identification of policy and program gaps to promote environmentally sound and sustainable e-waste management; and
- Analysis of the magnitude of the e-waste problems.

IV.4.2. Database Maintenance

As more data available, the initially developed database can be updated regularly. It is also important to develop a plan for regular updating of the e-waste inventory database to ensure the availability of adequate tool for decision making in environmentally sound management of e-waste.

IV.5. Inventory Program Evaluation and Improvement

IV.5.1. Inventory Program Evaluation

At least, once a year an e-waste inventory program is recommended to be comprehensively evaluated. Evaluation should essentially be aimed at:

- Assessing the accomplishment of the inventory against the specified objectives;
- Identifying any deficiencies in the current inventory program;
- Identifying any needs for corrective actions;
- Identifying any opportunities for improvement.

It is recommended that the most responsible person with the national focal points initiates or lead the evaluation activities so that when an important or strategic decision is needed to be made for corrective actions and or improvement, it can be made quickly. Another person is also recommended to prepare all reports required for a comprehensive evaluation of an inventory program.

4.5.2. Corrective and Improvement Actions

When a deficiency in developing an inventory program is identified, assessment should be made in order to further identify the root cause(s) so that a strategic and effective corrective action can also be performed. Similarly, when an opportunity for improvement is identified, some strategic improvement actions should also be assessed.

V. E-WASTE GENERATION ESTIMATION METHODS

V.1. The Role of Estimation Methods in E-Waste Inventory

According to Hasanuddin-Suraadiningrat (2005b), a hazardous waste inventory may start at the individual generators level up to the national level. However, a proper inventory can not be completed without complete individual hazardous waste generation data input. Unfortunately, in many cases, individual hazardous waste generation data are not always available due to some causes. On the other side, fortunately, some hazardous waste generators have similarities in main activities and their hazardous waste generated. Therefore, those similarities can be assessed and used as a basis for the formulation or establishment of hazardous waste estimate factor(s).

The abovementioned statement also applies to e-waste inventory. However, since the nature of e-waste generation is different from that of hazardous waste from industrial processes, the approriate methods for e-waste are somewhat different from those for the common industrial hazardous waste. "Similarities" in the case of e-waste generation should be translated into e-product similarities. There are some e-products with similar characteristics in terms of reusability or recyclability or refurbishability so that the appropriate methods for e-waste generation estimation for them may also be corresponding to their groups.

To become an ultimate e-waste, an e-product may have to undergo a long chain of ownerships, processes and time. It is difficult to determine the actual end of life of each e-product item, as one of determinants in estimation of e-waste generation, in order to develop an accurate e-waste inventory with regards to the actual quantities of e-waste being disposed. In addition, e-waste inventory is only a tool for decision making in formulating and or improving e-waste management policies, regulations and practices. The ultimate goal is environmentally sound management of e-waste, protecting human health and the environment. Therefore, a set of criteria and assumptions to be taken in e-waste generation will help simplify an inventory method while achieving the ultimate goal.

Some e-product types have fewer or no reusable/repairable part at all so that when

their lifetime is reached or they are damaged, they turn directly into less reusable or less recyclable or less refurbishable e-waste. The process of generation of such an e-waste group is relatively simple since it has short flow path and fewer flow chains. Therefore, taking assumptions of the appropriate lifetime of the e-product types in e-waste generation estimation is easier and the estimation results are usually more reliable.

The other e-product types have more reusable/repairable parts so that when they do not function properly or are partially damaged, they lifetime can be extended by replacing the damaged or defective parts only. Sometimes, they may also undergo refurbishment. Based on field observations, even damaged or not functioning properly, a replaced part or component of an e-product still has economic value. It is commonly sold in electronics markets instead of directly disposed of. As a result, establishing reliable assumptions of the appropriate lifetime of those types of e-product in estimating e-waste generation is more complicated. The results of estimation of e-waste quantities generated from such e-products will significantly be affected by the assumptions taken. Therefore, determining the actual generation of e-waste originating from such an e-product group is more difficult.

Prior to selection of an appropriate method for estimation, it is important to establish e-waste generation criteria and assumptions to be taken first. E-waste generation criteria will help determine the extend to which a form of e-waste is to be assessed. Assumptions of some values, e.g. specific e-product lifetime, percentage of unrepairable parts of an e-product, e-product users growth, etc., are required in e-waste generation quantity estimation. Such assumptions can be taken from either secondary data or primary data sources. Sometimes a combination of secondary data and primary data has to be taken in order to perform an efficient, yet quite reliable, estimation method.

The solution to the problem of inavailability of e-waste generation data can be approached with estimation using some estimate factor(s) or coefficient. On the other hand, selecting a method for e-waste generation estimation correlates to the desired e-waste generation units. In return, the desired unit also affects the determination of e-waste estimate factor/coefficient to be used in calculation for estimation.

There are some e-waste generation units that can be used in estimation in inventory, e.g. ratios of e-waste generation quantity (in tonnes or other weight units) over:

- The number of residents;
- The number of households;
- The number of offices or business facilities;
- Number of sales of certain e-products;
- Quantities of second-hand e-products imported.

All of the abovementioned units should also be limited by certain area and period, e.g. annual waste batteries generation from households in Legok Hangseur, West Java, Indonesia. There may be some more units that can be used in estimation. These guidelines do not restrict the use of any other units as long as appropriate.

In the context of e-waste hazard assessments, e-waste may be further analysed for hazardous materials/substances content or composition. In that case, the estimate factors to be used will be more specific, e.g. gram mercury per tonne waste lamp. It can be further extended to either other specific substances or specific type of e-waste.

Estimate factor(s) can be derived from various sources, especially e-waste inventories or studies in the other jurisdictions with similar characteristics, e.g. developing countries in Southeast Asia or those within the Asian region. Otherwise, the estimate factor(s) should be obtained through initial or pilot inventory program. Some essential secondary data that can be used as estimate factors resulting from literature review and field observations under this project are provided in Appendix B.

Once the e-waste estimate factors are established, they can be used in calculation for estimation of e-waste generation in the other areas with similar characteristics that do not actual data on their e-waste generation at local level, national level or even regional level. But, some essential data as independent factor for e-waste generation estimation such as the e-product type and annual quantities, the number of households, sales and the other data related to the estimate factor must exist.

E-waste generation estimation, in general, can be accomplished through some general steps as follow:

- Specific e-waste quantity estimation;
- Specific e-waste components analysis/breakdown;
- Annual growth rate calculation or assumption;
- Synthesis of e-waste generation by combining the previous steps
- Projection of annual quantities of e-waste generation in certain period.

Figure 13 below illustrates a general procedure in using various methods for estimating and projecting annual quantities of an e-waste stream generation.

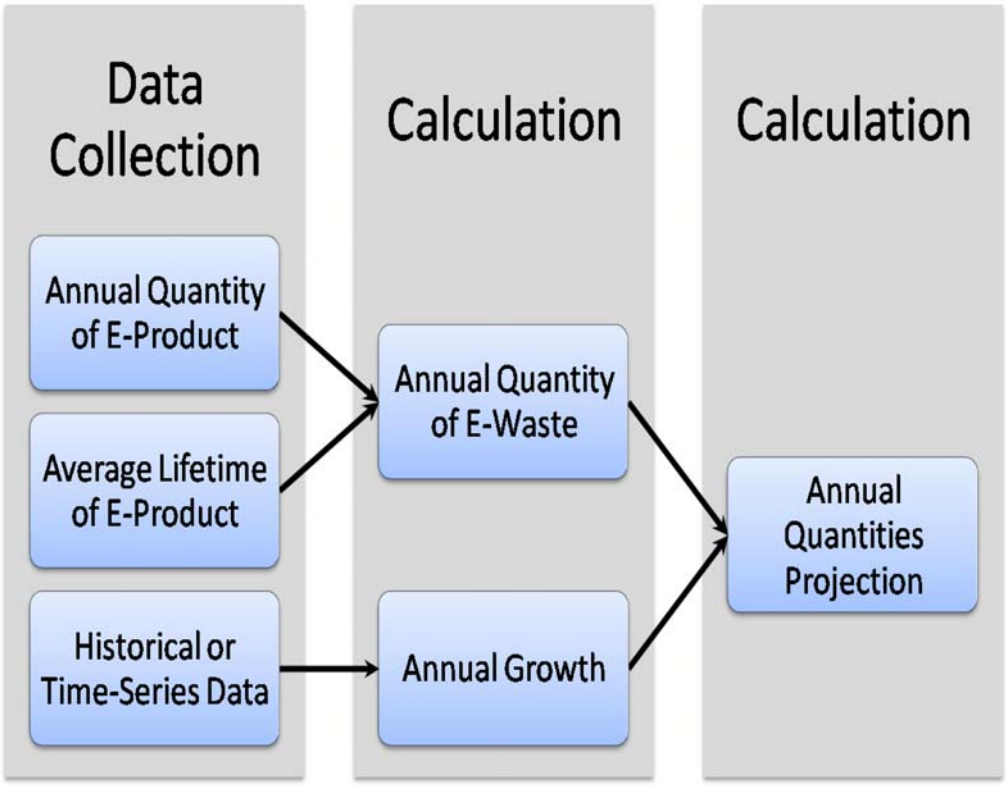


Figure 13 - General procedure in using methods for estimating and projecting annual quantities of e-waste generation starts on the right-side. The procedure may be modified in using specific methods.

Under these guidelines, three methods commonly used for estimating e-waste generation quantities are selected and recommended for developing an initial inventory of e-waste. They consist of:

- End-Points Catch Method,
- Market Supply Method, and
- Consumption and Use Method.

The abovementioned methods are explained in details in the following sections.

V.2. End-Points Catch Method

V.2.1. Description/Idea.

The method is developed based on the assumption that almost all of the e-waste generated in a given area eventually flows through e-waste recyclers and into waste disposal facilities. Therefore, information on the quantities of the e-waste received at the recycling and disposal facilities over certain period can be cought there.

V.2.2. Specific Applications.

The method is applicable to estimation of ultimate e-waste generation quantities that may be generated in a specific administrative area. The result is best performed intensively at local level first, e.g. at municipality level. The collected data on annual quantity of e-waste generated at local levels should be compiled by the higher level of administrations in order to make up the national inventory.

V.2.3. Comments on strength and weakness.

- Strength. More accurate data on the minimum quantities of e-waste generated in a given geographic or administrative area may be obtained. E-waste delivery is in bulk quantities so that the quantity is usually expressed in weight units. So, no quantity unit conversion is required. The recycling facilities should also have information or data on the source of e-waste deliveries, the types and quantities of the recycling products, recycling products sales and or disposal destinations.

- Weakness. The method relies on the available records on incoming or received e-waste at the recycling and disposal facilities. The records should be kept by - or also be available as part of regular reports from - every e-waste recycling and disposal facilities to the environmental authority of an administrative area. But, such reports may not be available if the recycling and or disposal facilities are illegal or of informal sector. In that case, a survey may be needed to be conducted in order to get the required information and data (primary data).

V.2.4. Estimation Procedure

The procedure for estimating the annual quantity of specific or selected e-waste stream with the "End Points Catch" method is outlined as presented in Figure 13 below.

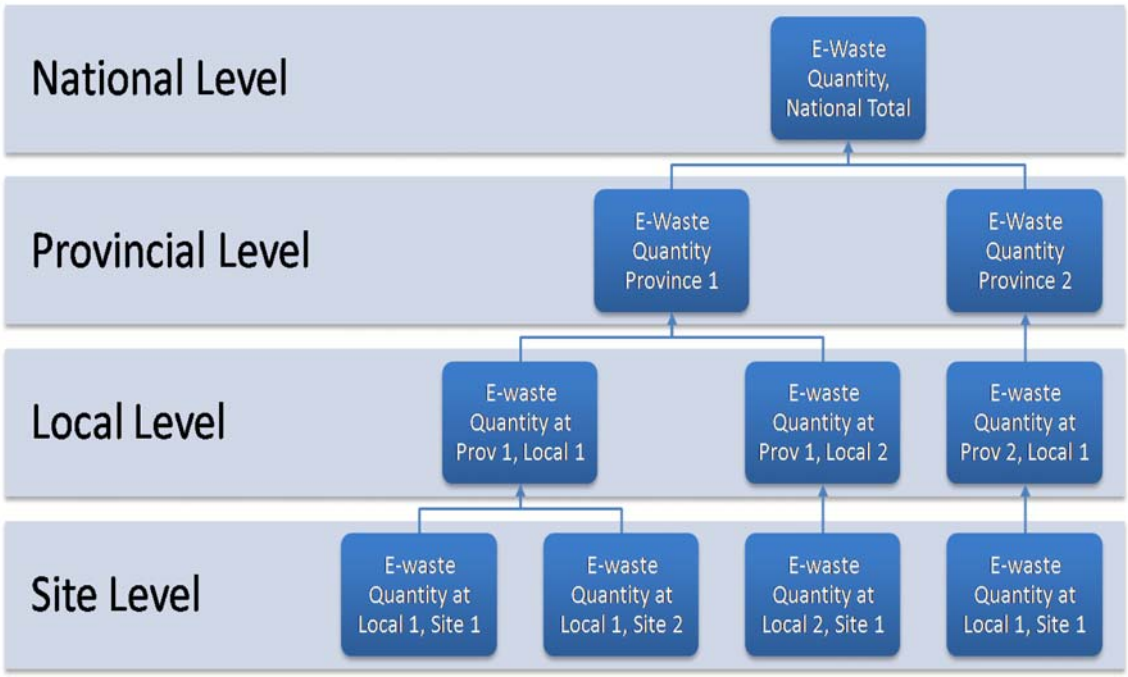


Figure 14 - Simplified procedure for estimating e-waste generation quantity using the End Points Catch method.

- Expected Output
  - Annual quantities of ultimate e-waste generated in a given administrative area at local, provincial and national levels.
  - Annual quantities of ultimate e-waste recycling residues generated in a given administrative area at local, provincial and national levels.
  - Annual quantities of recycled products generation in a given administrative area at local, provincial and national levels.

- Assumptions
  - All or the major portion of e-waste generated in a given area eventually goes to the nearby recyclers and or disposal facilities.
  - Recyclers and disposal facilities receives e-waste which is generated only in its administrative area or the portion received from the other areas is not significant.

- Required Input, Data

  - Identity and geographic location of e-waste recyclers
  - Identity and geographic location of e-waste disposal facilities
  - E-waste quantity received at a recycling facility in certain period of time
  - E-waste quantity received at a disposal facility in certain period of time

- Procedural Steps

  At the local level.

  - Identify all e-waste recycling facilities operating in the selected local administrative area. Information and/or data on waste recycling facilities are usually available from the local environmental, industry and trade authorities. In some countries, all hazardous waste recycling, treatment and disposal facilities are obliged to register and submit regular environmental management and monitoring reports to the competent authorities. Such reports usually include information and data on the types and quantities of waste received, recycled or treated, and disposed of.
  - Collect data on the quantities of e-waste received at each identified facility during the last one year or as specified. If the data are not available at the local competent authorities, an initial survey is needed. The survey should cover both formal and informal e-waste recycling facilities. Identify and collect the other relevant information pertaining to e-waste inventory as well.
  - Compile all collected data and enter into the local computerised database system.
  - Analyse for trend and annual growth at the local level.
  - Submit the local e-waste inventory report to the provincial authority on a regular basis, e.g. monthly, quarterly or at least annually.

  At the provincial level.

  - Collect the annual e-waste management reports or data from the local authorities.
  - Compile all collected data and enter into the provincial computerised database system.

- Analyse for trend and average annual growth at the provincial level.
- Submit the provincial e-waste inventory report to the national focal point and the other relevant authorities on a regular basis, at least annually.

At the national level.

- Collect the annual e-waste management reports or data from the provincial authorities.
- Compile all collected data and enter into the national computerised database system.
- Analyse for trend and average annual growth at the national level.
- Project the annual e-waste generation quantity for each year in the specified time period.
- Incorporate the e-waste stream report into the annual country report for submission to the Secretariat of Basel Convention with a copy to the Secretariat of Basel Convention Regional Centre for South-East Asia.

V.3. Market Supply Method

V.3.1. Description/Idea

The method is used with an approach to the utilisation of records on the quantities of the e-products distributed or supplied to the market. It includes both brand-new and used e-products. The e-waste quantities generated in a selected area can be estimated or projected based on the available data on domestic sales of an e-product and taking assumption about the average lifetime of the product.

The method relies on the availability of secondary data, e.g. statistical or historical data, and references from various sources such as government institutions, industrial associations, manufacturers, importers, distributors and retailers.

However, the use of the method may need some specific primary data obtained through survey with questionnaires distribution and interviews with a limited number of e-waste management stakeholders.

The specific primary data collection is necessary when the collected secondary data need to be verified or when there is no secondary data available.

V.3.2. Specific Applications

In principle, the 'market and supply' method can be applied to virtually all sorts of e-product as long as the required data are available or accessible. However, the method is more suitable for estimating the less reusable/recyclable e-waste, e.g. non-rechargeable dry power batteries and fluorescent lamps. The application of the method to the more reusable/recyclable e-waste may need an intensive collection of primary data.

Depending on the availability or accessibilty of the required statistical or historical data, the method can be applied to an e-waste inventory at the local level first. The results can then be compiled and further developed towards the national level.

V.3.3. Comments on Strength/Weakness

The 'market and supply' method is considered to be quite simple in use, resulting in relatively quick and less expensive estimation of e-waste generation quantities. As the method relies on the available statistical or historical data, validation is needed in order to finetune or to develop a more accurate inventory.

Based on experience, not all administrative areas have adequate statistical or historical data on e-products which are required for estimation. In many cases, the data availability or accessibility constraints have to be solved with simplification of data analysis and projection. Sometimes the available data on e-products encompasses all types of the products as a whole without specific details on the types or categories of the e-product. In this case, data verification and validation with the relevant sources of the information should be performed.

V.3.4. Estimation Procedures

The estimation procedure using the 'Market Supply' Method is illustrated as a flow chart in Figure 15.

- Expected Output

  - Specific e-waste generation quantity rate in units per annum at a specific administrative level or at the national level.
  - Specific e-waste generation quantity rate in weight units per annum at a specific administrative level or at the national level.

- Assumptions

  - The e-products of concern are used and maintained in accordance with the operating guidance manual
  - The e-product usage category and the users profile are comparable
  - No urban and rural characteristic differences taken into consideration

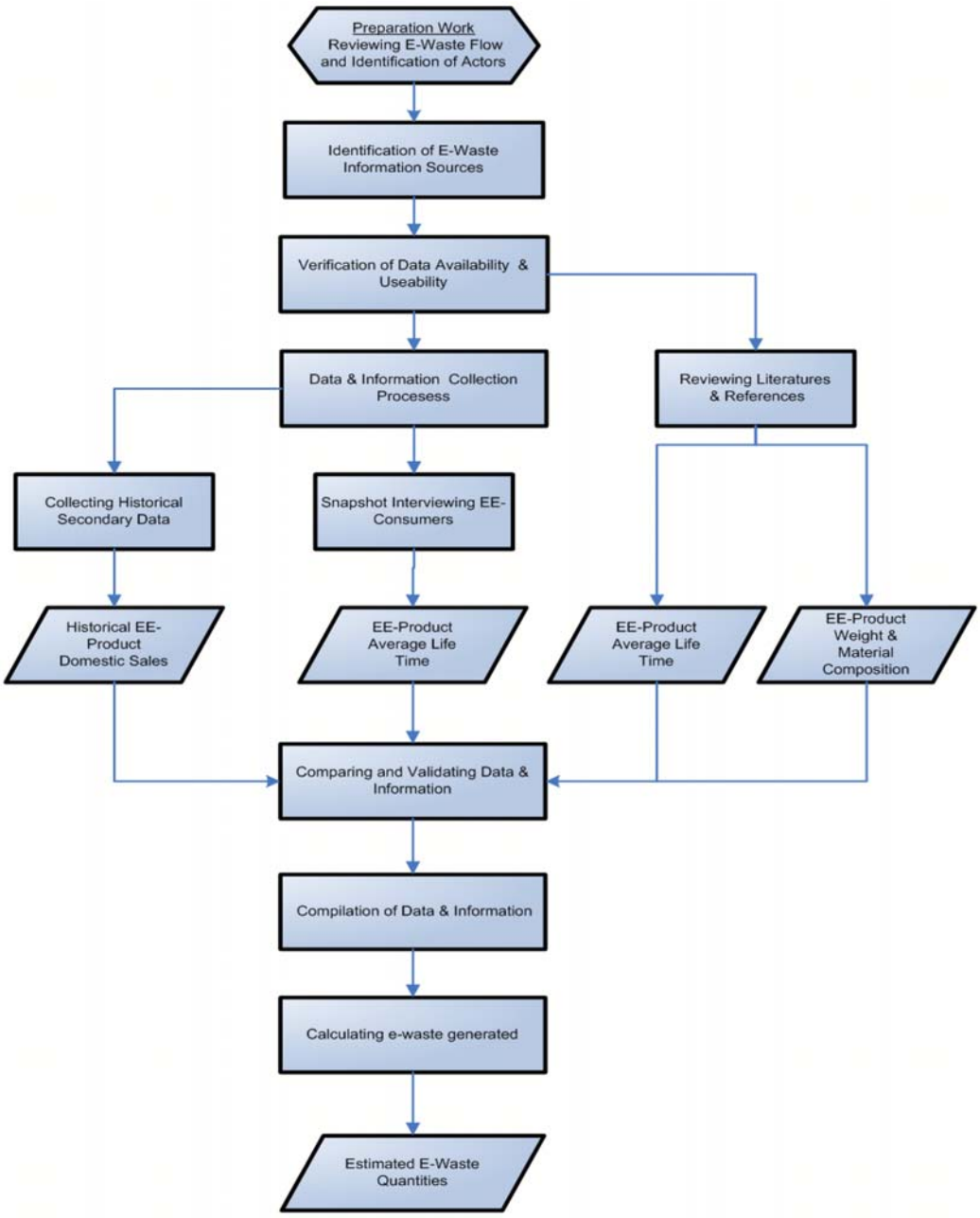


Figure 15- Estimation procedure using the "Market Supply" Method

- Required Input or Data

  - Brand-new E-Product
    - Domestic Production of Brand-New E-Product
    - Import of Brand-New E-Product
    - Export of Brand-New E-Product
    - Domestic Sales of Brand New E-Product

  - Used E-Product Product
    - Import of Used E-Product
    - Export of Used E-Product
    - Domestic Sales of Used E-Product
  - Average Life Time E-Product Product
    - Average Life Time of Brand-New E-Product
    - Average Life Time of Used E-Product
  - Others
    - Weight of E-Product
    - Material Composition in E-Product
    - % Weight of Material

- Procedural Steps

  - Start with reviewing e-waste flow, identification of involved actors and or stakeholders on the selected e-product.

  - Identify the relevant information sources for the required data.

  - Before starting data collection, verify the identified information sources in order ensure the worthiness and the availability of the data for estimation purpose.

  - Establish a baseline year for estimation. The earliest purchasing year for the selected e-product, based on a snapshot interview with users/consumers, can be used as the baseline year.

- Collect statistical data on the selected e-product sales, estimated lifetime and the material composition of the e-products.
- The collection of historical or statistical data from the identified sources can be performed simultaneously with interviews. Information on the average lifetime of the selected e-products can be performed also with interviews with user groups (about 20 samples per specific area).

- Refer to relevant literature or references in order to seek the average lifetime and material composition of the selected products as well. As an example, some data on the average lifetime of selected e-products compiled from literature review are presented on Table 2 below.

- Compare all similar data and information collected from different sources and validate them as well. If necessary, validate the data by reinterviewing the relevant sources.

Table-2. Average lifetime of selected e-products.

No.	E-Product	Average Life Time (Year)				
		Cambodia	India	Malaysia	Thailand	China
1	Personal Computer	5	5 - 7	5	5	4
2	CRT TV Sets	4			10	
3	CRT PC				6	10
4	Mobile Phone	2.5			2	
5	MP Power Battery				1	
6	Fixed Telephone	5				
7	Refrigerator					13
8	Washing Machine					12
9	Air Condition					11
10	Dry Cell Battery				0.17	
11	Fluorescent Lamp				1	

- Compile and sort the validated information and data based on the specified categories of the selected e-products.

- Estimate the domestic annual sales of each of the selected e-products starting from the baseline year, including both the new and used ones.

Domestic sales = (domestic production) + (import) - (export)

- Estimate the annual e-waste generation from both the new and used e-products and develop annual projection starting from the baseline year.

$$\sum_{i}^{n} DomesticSales$$

E-Waste generated at year 'x' [unit] =

i = baseline year
n = x - y
x = year at which the specified e-waste generated
y = average lifetime

E-Waste generated/year [weight] =
(Amount of e-waste generated/year [unit]) x (average weight/unit)

Specific E-Waste Material generated/year [weight] =
(Amount of e-waste generated/year [unit]) x (average weight/unit) x (% weight of specific material)

V.4. Consumption and Use Method

V.4.1. Description/Idea

According to Widmer (2005), the ”consumption and use method” takes the average equipment of a typical household with electrical and electronic appliances as the basis for a prediction of the potential amount of WEEE (used in the Netherlands to estimate the potential amount of WEEE).

V.4.2. Specific Applications

The method is used in estimating potential e-waste generation quantities based on specific e-product consumption/use rate and population in a given administrative area and the estimated lifetime of the e-product. The population as the source of the used e-products or potential e-waste generation may be further grouped into residential source and institutional source. For example, waste personal computers generation from institutional source in a selected area may be estimated separately from that of the residential source.

Taking assumption about the lifetime or ownership time of PCs may be quite simple since many institutions completely replace their computers with the new ones regularly, e.g. every three or four years. However, the ratio the number of personal computer units used over the number of employees varies with the specific type of business, even in the same sector. For instance, a computer training institution has a much higher ratio of computer units over number of employee than that of an elementary school.

Therefore, further criteria and classifications should be made first. The establishment of criteria and classifications may also apply to the residential source due to the relationship between e-product ownerships and family income levels. However, source classification may not be needed for some popular e-products such as mobile phones and television sets.

V.4.3. Comments on Strength/Weakness.

- Strength. The method uses data on the quantities of e-products used in a specific administrative area so that it is expected that the resulting e-waste streams and quantities will also be specific to the target area.

- Weakness. Some area-specific data may not readily available so that detailed surveys have to be conducted. Consideration for lifetime span for PCs due to possible ownership changes should also be taken.

V.4.4. Estimation Procedure

The procedure for estimating the annual quantity of specific or selected e-waste stream with the "consumption and use" method is outlined as presented in Figure 15 below.

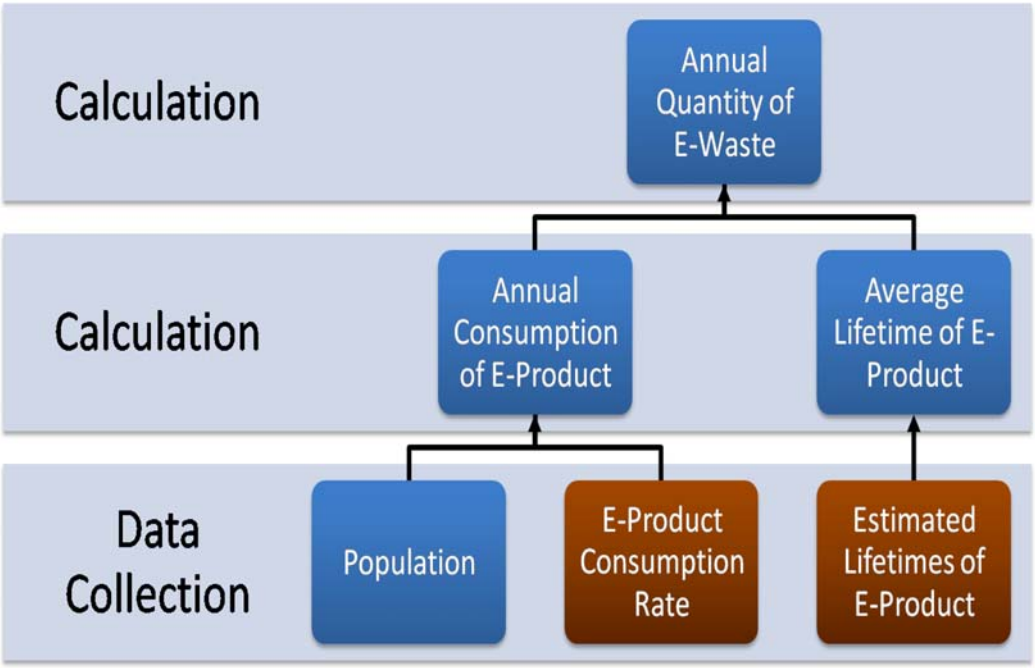


Figure 16 - Simplified procedure for estimating annual e-waste generation quantity using the "consumption and use" method. The data in red boxes may require primary data obtained through survey or taken by assumption

- Expected Output

  - Annual quantity of specific/selected e-products generated from the residential source in an administrative area
  - Annual quantity of specific/selected e-products generated from selected institutional source in an administrative area
  - Annual total quantity of a specific e-waste stream potentially generated in a specific administrative area

- Projected annual total quantities of a specific e-waste stream potentially generated in a specific administrative area for a certain period of time

■ Assumptions

- An e-product is considered to be a potential e-waste when it is no longer desired or discarded by the first user/owner.
- Any possible extension of e-product lifetime through reuse by another owner, reparation or refurbishment is not taken into account.
- Any possible long term storage or stockpiling by the first owners, when the selected e-product(s) has reached its end-of-life or is no longer used, is not taken into account.
- An assumption about the average consumption rate of each of the selected e-products has to be taken.
- An assumption about the average usage period or lifetime of each of the selected e-products has to be taken.
- An assumption about the portion of the new e-product used or purchased in each year within the selected time period.

■ Required Input or Data

- Population in a specific area
- Selected/specific e-products of concern
- Average consumption rate of the products of concern
- Average lifetime of the e-products of concern
- Average weight of the e-products of concern
- Population growth rate

■ Procedural Steps

- Collect data on population in the selected area for the last five to ten years.
- Calculate the annual average growth of the population based on the population data.
- Project the population for a certain period of time, e.g. within the next 5 or 10 years.

- Collect data on the use of each of the selected e-products from secondary sources. Usually the Census Bureau or the National Bureau for Statistics can provide data on the ownerships of certain e-products for certain census time period. The available data may enable determination of e-product consumption/use per capita or per household.
- Estimate the number of each of the selected e-product in each year within the specified time period.
- Take assumptions about the average lifetime of each of the selected e-products. Refer to the exisiting data on the range of estimated lifetime of each of the selected e-products from the other e-waste studies or Appendix of these guidelines.
- Calculate the quantities of potential e-waste generation for each year in the specified time period.
- Collect data on the range of the unit weight of each e-product and take assumption on the average unit weight of each of the selected e-product.
- Convert the annual e-waste generation quantity unit to weight unit by multiplying the annual e-waste quantity unit by the average unit weight of the e-product.

REFERENCE

- Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal

- BCRC China (2005). Report on the Survey of the Import and the Environmentally Sound Management of Electronic Wastes in the Asia-Pacific Region. Beijing, 2005.

- BCRC-SEA (2005). National Inventories of Hazardous Waste Demonstration Project, Final Report. Prepared by PT Amar Binaya Karsa for the Basel Convention Regional Centre for Southeast Asia. Jakarta, 2005.

- E-Waste Guide. Electronic Waste Guide, a knowledge base for the sustainable recycling of e-waste. www.ewaste.ch. Last accessed in September 2006.

- European Union (2003a). 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.

- European Union (2003b). Directive 2002/96/EC of the European Parliament and of the Council of 27 January 2003 on waste electrical and electronic equipment (WEEE).

- European Union (2003c). Directive 2003/108/EC of the European Parliament and of the Council of 8 December 2003 amending Directive 2002/96/EC on waste electrical and electronic equipment (WEEE).

- Hasanuddin-Suraadiningrat, D. Wardhana (2005a). Review on Methodological Guide for the Undertaking of National Inventories under Basel Convention Framework Based on Existing Conditions and Case Study. A report prepared for and presented to the Basel Convention Regional Centre for Southeast Asia. Jakarta, 2005.

- Hasanuddin-Suraadiningrat, D. Wardhana (2005b). A Generic Guideline for Hazardous Waste Streams Generation Estimation Methods in the Context of Hazardous Waste Inventory. Paper, previously presented at the Regional Training Workshop on Inventory of Hazardous Waste Generation conducted by the Basel Convention Regional Centre for Southeast Asia. Jakarta, Indonesia, 22.06.2005

- Microsoft Encarta 2007. Microsoft Corporation. 1993-2006.

- National Statistics Bureau of Indonesia. Statistics of SMEs of 2004.

- Secretariat of Basel Convention (2000). Methodological Guide for the Undertaking of National Inventories within the Framework of the Basel Convention, First Version. Geneve, 2000.

- Secretariat of Basel Convention. Guidance Document on the Preparation of Technical Guidelines for the Environmentally Sound Management of Wastes Subject to the Basel Convention.

- Swiss State for Economic Affairs (2004). Final Draft report on E-Waste Recycling in the Delhi Region.

- Thailand Electrical and Electronics Institute (2005). Survey of the Import and the Environmentally Sound Management of Electronic Wastes in Thailand, Final Report. Thailand, 6 June 2005.

- Widmer, R. et al (2005). "Global perspectives on e-waste" in Environmental Impact Assessment Review. Elsevier. www.elsevier.com, 2005.

APPENDIXES

A. E-Waste Data & Potential Sources

B. Compiled Estimate Factors

B.1. E-Products Lifetime
B.2. E-Products Material Weight and Composition
B.3. E-Product Hazardous Materials Content

C. Examples of Estimation Methods Use

C.1. Market Supply Method, Less Recyclable E-Waste: Dry Power Batteries
C.2. Consumption and Use Method, More Recyclable E-Waste: Personal Computers
C.2.1. Residential Source
C.2.2. Institutional Source

D. Examples of E-Waste Categories & Types (Annexes from EU Directive for WEEE)

E. Example of Essential Items to be Included in Questionnaires

F. Terms and Definitions