RONGO UNIVERSITY SCHOOL OF INFOCOM; Bsc. Informatics Year 3.1

UNIT: Green Computing

Presented By: Ms. Tabitha N.

Extended producer responsibility, sustainable e-production and use.

- ✓ Producer Responsibility Organisations are committees that take the responsibility for the end-of life disposal of products being manufactured or assembled.
- ✓ They can be established with the support of all manufacturers largely responsible for the management of e-waste in an environmentally sound manner. Manufacturers should implement take-back policies for used devices to ensure that they do not turn into e-waste.

About the PRO Structure

- ❖ The PRO will be expected to operate as a non-profit committee built on the ethos of Corporate Social Responsibility (CSR) and be an active participant in this sector.
- ❖ The cost of establishing these structures shall be supported by the manufacturers. The details on the contribution made by individual companies can be worked out through detailed deliberation. A part of revenue can also be generated through the sale of the e-waste by the recycler.
- ❖ The PRO should operate with all stakeholder participation (including representatives of the informal sector) and with full operational transparency to ensure efficacy in its implementation.

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Roles of Producer Responsibility Organisation

- The Producer Responsibility Organization will have overall responsibility for the complete recycling process of e-waste with different levels of engagement in various processes.
- The PRO will take on direct responsibility of collection and storage of all waste resulting from electrical and electronic equipment generated across the country and then passes this on to the dismantler/recycler for a price.
- The nature of goods being classified as e-waste, have an intrinsic material value and this value is key to the complete financial plan of this structure. It is a globally accepted fact that e-waste has a material value assigned and all recyclers, big or small, procure electronic wastes at a price and then make profits by selling the recovered materials.

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- This structure suggests provision of incentives to the manufacturers to be active participants and streamline the storage and collection system to an authorized agency that will handle the e-waste.
- The PRO will pay the manufacturers for the material collected and provide free collection system. The dynamic fee system for different end-of-life products will be fixed by the PRO and will be open to review at periodic intervals. This will give an option to vary the monetary value attached to it according to the prevailing market values of the materials extracted.
- The revenue generated by PRO through sales of this e-waste to the recyclers will be utilized for financing the take back process from the consumers (cost paid for the e-waste) as well as the collection and storage of the waste.
- Dealers selling such household products will have to take back the old products and the household manufacturers will get a discount on new purchase of electrical and electronic goods (the end-of-life cost can be fixed according to product type). These products will be then transferred back to the PRO with proper reporting.

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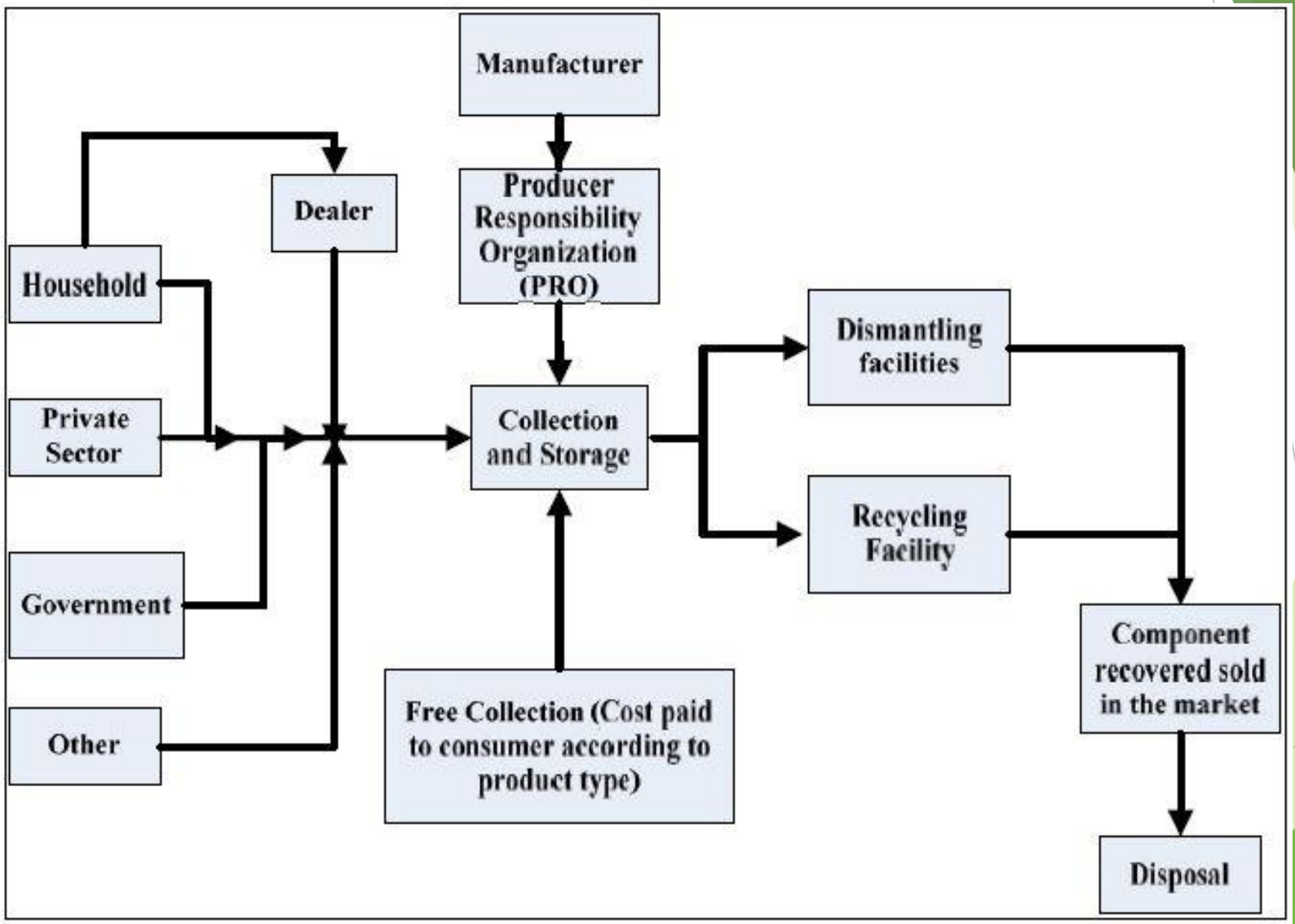
- The flow chart below shows a systematic flow of managing e-waste that result when most of the products reach their end of life.



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TREATMENT TECHNOLOGY FOR E-WASTE

- The presence of hazardous elements and compounds in e-waste offers potential for increasing the intensity of their discharge in the environment due to land-filling and incineration.
- Therefore, a recommended approach to treating e-waste is to first reduce the concentration of these hazardous chemicals and elements and finally dispose e-waste fractions through either incineration or landfilling or a combination of both.
- The e-waste treatment options should include the following unit operations:

a. *Decontamination or Dismantling:* This is done manually and will includes;

i. Removal of parts containing hazardous/ dangerous substances (CFCs, Mercury (Hg), switches, PCBs).

ii. Removal of easily accessible parts containing valuable substances (cables containing copper, steel, iron, and precious metals, e.g. contacts)

iii. Segregation of hazardous/ dangerous substance and removal of easily accessible parts.

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TREATMENT TECHNOLOGY FOR E-WASTE

b. *Segregation of ferrous metals, non-ferrous metals and plastics:* This separation is generally carried out after shredding and is followed by a mechanical and magnetic separation process.

c. *Recycling or recovery of valuable materials:* E-waste fractions after segregation consisting of ferrous and non-ferrous metals are further treated. Ferrous metals are smelted in electrical arc furnaces whereas non-ferrous metals and precious metals are smelted in smelting plants.

d. *Treatment or disposal of dangerous materials and waste:* Shredded light fractions are disposed of in landfill sites or sometimes incinerated, CFCs are treated thermally, Poly Chlorinated Biphenyls (PCBs) are incinerated or disposed of in underground storages, Mercury (Hg) is often recycled or disposed of in underground landfill sites

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TREATMENT TECHNOLOGY FOR E-WASTE

Guidelines for development of e-waste treatment technology

An e-waste treatment process should include the following components;

- Testing of e-waste product in order to sort reusable and non-reusable e-waste separately.
- Disassembling non-reusable e-waste and sorting e-waste fractions into reusable and non reusable parts.
- Size reduction, separation and recovery of different materials from non-reusable e-waste.
- Disposal of the remaining e-waste fractions.

A detailed e-waste treatment system falls in a hierarchy of three levels:

- First level treatment
- Second level treatment and
- Third level treatment.

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TREATMENT TECHNOLOGY FOR E-WASTE

- All the three levels of e-waste treatment systems are based on material flow from first level to third level treatment. Each level treatment consists of unit operations where e-waste is treated and the output of first level treatment serves as input to second level treatment.
- After the third level treatment the residues are disposed off either in hazardous waste landfill or incinerated. The simplified flow diagram for e-waste treatment is given below

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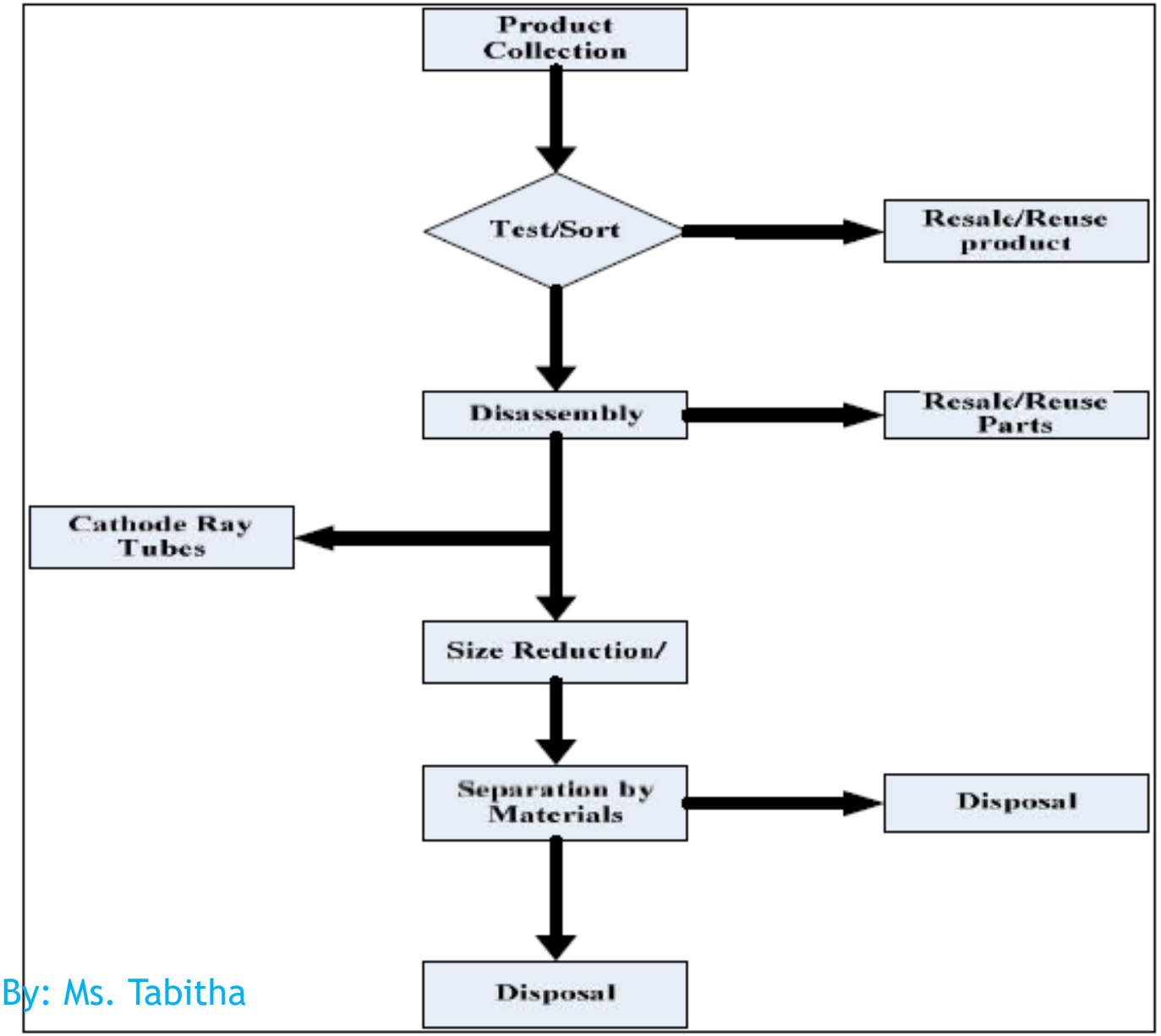

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TREATMENT TECHNOLOGY FOR E-WASTE

First level e-waste treatment

- Inputs: They include e-waste items like TVs, refrigerators and Personal Computers (PCs).
- Unit Operations: There are three unit operations at first level of e-waste treatment.

These are:

1. *Removal of all liquids and gases*: The first treatment step is to decontaminate e-waste and render it non hazardous. This involves removal of all types of liquids and gases under negative pressure, their recovery and storage.

2. *Dismantling (manual or mechanised breaking):* The decontaminated e-waste or the ewaste requiring no decontamination are dismantled to remove the components from the used equipments. The dismantling process could be manual or mechanised requiring adequate safety measures to be followed in the operations.

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3. *Segregation:* After dismantling the components are segregated into hazardous and non hazardous components of e-waste fractions to be sent for third level treatment.

All the three unit operations are dry processes, which do not require usage of water.

- Outputs from First level e-waste treatment are:

- Segregated hazardous wastes like CFCs, Hg, Switches, batteries and capacitors.
- Decontaminated e-waste consisting of segregated non-hazardous e-waste like plastics, CRTs, circuit boards and cables.
- Emissions that include air, water, noise.

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Second level e-waste treatment

These are:

- Inputs: Decontaminated e-waste consisting segregated non hazardous e-waste like plastic, circuit board and cables.
- Unit Operations: There are three unit operations at second level of e-waste treatment;

1. Hammering: Size reduction
2. Shredding : Size reduction
3. Special treatment processes comprising of;

- CRT treatment consisting of separation of funnels and screen glass (Appendix 4).
- Electromagnetic separation
- Eddy current separation
- Density separation using water

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Outputs: Materials from the second level treatment technology include.

- Ferrous metal scrap (secondary raw material)
- Non ferrous metal scrap mainly copper and aluminium
- Precious metal scrap mainly silver, gold and palladium
- Plastic consisting of sorted plastic, plastic with flame retardants and plastic mixture.

Third level e-waste treatment

- This is carried out mainly to recover ferrous and non-ferrous metals, plastics and other items of economic value. The major recovery operations focus on ferrous and non ferrous metal recovery, which is either geographically carried out at different places or in an integrated facility.

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TREATMENT TECHNOLOGY FOR E-WASTE

Plastic recycling

- There are three different types of plastic recycling options i.e. mechanical recycling chemical recycling, and thermal recycling.

• In chemical recycling process, waste plastics are used as raw materials for petrochemical processes or as reductant in a metal smelter.

• In mechanical recycling process, shredding and identification process is used to make new plastic products.

• In thermal recycling process, plastics are used as alternative fuel.

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TREATMENT TECHNOLOGY FOR E-WASTE

Mechanical recycling process

- The first step is the sorting process, where contaminated plastics such as laminated or painted plastics are removed.
- Shear-shredder and hammer mills are generally used for size reduction and liberation of metals (coarse fraction) followed by granulation and milling for further size reduction.
- Magnetic separators are used for ferrous metals separation, while eddy current separators are used for non ferrous metals separation.
- Air separation system can be used to separate light fractions such as paper, labels and films.
- Resin identification can be carried out by using a number of techniques like turboelectric separator, high speed accelerator and X-ray fluorescence spectroscopy.
- X-ray fluorescence spectroscopy is effective in identifying heavy metals as well as flame retardants.
- After identification and sorting of different resins, they are extruded and palletized.

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TREATMENT TECHNOLOGY FOR E-WASTE

Chemical recycling process

- Mixed plastic waste is de-polymerized, dehalogenated, metals removed and hydrogenated to produce high quality products like off gas and syncrude obtained by hydrotreatment, which are sent to the petrochemical process.

Thermal recycling process

- Plastics recovered in the second level treatment are used as fuel to provide energy. Since plastics have high calorific value, which is equivalent to or is greater than coal, they can be combusted to produce heat energy in cement kilns.

Metals recycling

- Metal recycling includes lead recycling, copper recycling and precious metals recycling. After sorting of metal fractions at second level e-waste treatment, they are sent to metal recovery facilities.

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