

## **RANGE & SCOPE OF THE PROCESS for WEEE re-utilization (Patent pending) or WEEE CONTENTS THAT CAN BE INCLUDED.**

WEEE/E-waste is a complex mixture of hazardous and non-hazardous waste, which consists of items of economic value. Therefore, it requires specialized segregation, collection, transportation, treatment and disposal. It contains more than a 1000 different substances, which fall under “hazardous” and “non-hazardous” categories. Broadly, it consists of ferrous and non-ferrous metals, plastics, glass, wood and plywood, printed circuit boards, concrete and ceramics, rubber and other items. Iron and steel constitutes about 50% of the WEEE followed by plastics (21%), non ferrous metals (13%) and other constituents. Non-ferrous metals consist of metals like copper, aluminium and precious metals like silver, gold, platinum, palladium etc. Since the recyclable potential of WEEE/ E-waste is specific for each appliance, the parts/materials found in WEEE/ E-waste have been divided broadly into following six categories.

- Iron and steel, used for casings and frames
- Non-ferrous metals, especially copper used in cables, aluminum and gold.
- Glass
- Plastic
- Electronic components
- Others (rubber, wood, ceramic etc.).

The presence of elements like lead, mercury, arsenic, cadmium, selenium, and hexavalent chromium and flame retardants beyond threshold quantities in WEEE / Ewaste classifies them as hazardous waste.

### **1a. Categories**

“Electrical or electronic equipment which is waste including all components, subassemblies and consumables, which are part of the product at the time of discarding.”

Source: Categories of electrical and electronic equipment (*covered by WEEE Directive, EU, 2002*)

1. Large household appliances
2. Small household appliances
3. IT and telecommunications equipment
4. Consumer & entertainment equipment
5. Lighting equipment
6. Electrical and electronic tools (with the exception of large-scale stationary industrial tools)
7. Toys, leisure and sports equipment
8. Medical devices (*with the exception of all implanted and infected products*)
9. Monitoring and control instruments
10. Automatic dispensers
11. Wet Batteries & Accumulators viz. Lead Acid cells, Nickel Hydroxyl cells etc. (*Dry Batteries, Bio Medical equipment, Radioactive substances, Fluids/Liquids/gells, Color or Black & White ink cartridges are excluded in all of the below listed WEEE*)

**1b. List of products, which fall under the categories of Annex IA are given below.**

1. Large household appliances

- Large cooling appliances
- Refrigerators
- Freezers
- Other large appliances used for refrigeration, conservation and storage of food
- Washing machines
- Clothes dryers
- Dish washing machines
- Cooking
- Electric hot plates
- Microwaves
- Other large appliances used for cooking and other processing of food
- Electric heating appliances
- Electric radiators
- Other fanning, exhaust ventilation and conditioning equipment

2. Small household appliances

- Vacuum cleaners
- Carpet sweepers
- Other appliances for cleaning
- Appliances used for sewing, knitting, weaving and other processing for textiles
- Iron and other appliances for ironing, mangling and other care of clothing
- Toasters
- Fryers
- Grinders, coffee machines and equipment for opening or sealing containers or packages
- Electric knives
- Appliances for hair-cutting, hair drying, tooth brushing, shaving, massage and other body care appliances
- Clocks, watches and equipment for the purpose of measuring indicating or registering time Scales.

3. IT and telecommunications equipment

- Centralized data processing
- Mainframes
- Minicomputers
- Printer units
- Personal computing:
- Personal computers (CPU, mouse, screen and keyboard included)
- Laptop computer (CPU, mouse, screen and keyboard included)
- Notebook computers
- Notepad computers
- Printers (Color or Black & White casrtridge excluded)
- Copying equipment (Color or Black & White casrtridge excluded)
- Electrical and electronic typewriters (Color or Black & White casrtridge excluded)
- Pocket and desk calculators (*Batteries excluded*)
- And other products and equipment for the collection, storage,processing,presentation or communication of information by electronic means

- User terminals and systems
- Facsimile
- Telex
- Telephones
- Pay telephones
- Cordless telephones
- Cellular telephones
- Answering systems
- And other products or equipment of transmitting sound, images or other information

by telecommunications

#### 4. Consumer equipment

- Radio sets
  - Television sets
  - Video cameras
  - Video recorders
  - Hi-fi recorders
  - Audio amplifiers
  - Musical instruments
  - Other products or equipment for the purpose of recording or reproducing sound or image, including signals or other technologies for the distribution of sound and image
- than by telecommunications

#### 5. Lighting equipment

- Luminaries for fluorescent lamps with the exception of luminaries in households
- Straight fluorescent lamps
- Compact fluorescent lamps
- High intensity discharge lamps, including pressure sodium lamps and metal lamps
- Low pressure sodium lamps
- Other lighting or equipment for the purpose of spreading or controlling light with the exception of filament bulbs

#### 6. Electrical and electronic tools (with the exception large-scale stationary industrial tools)

- Drills
- Saws
- Sewing machines
- Equipment for turning, milling, sanding, grinding, sawing, cutting, shearing, drilling, making, holes, punching, folding, bending or similar processing of wood, metal and other materials
- Tools for riveting, nailing or screwing or removing rivets, nails, screws or similar uses
- Tools for welding, soldering or similar use
- Equipment for spraying, spreading, dispersing or other treatment of liquid or gaseous substances by other means
- Tools for mowing or other gardening activities

#### 7. Toys, leisure and sports equipment

- Electric trains or car racing sets
- Hand-held video game consoles

- Video games
- Computers for biking, diving, running, rowing, etc.
- Sports equipment with electric or electronic components
- Coin slot machines

8. Medical devices (*with the exception of all Bio medical implanted and infected products*)

- Radiotherapy equipment
- Cardiology
- Dialysis
- Pulmonary ventilators
- Nuclear medicine
- Laboratory equipment for *in-vitro* diagnosis
- Analysers
- Freezers
- Fertilization tests
- Other appliances for detecting, preventing, monitoring, treating, alleviating illness, injury or disability.

9. Monitoring and control instruments

- Smoke detector
- Heating regulators
- Thermostats
- Measuring, weighing or adjusting appliances for household or as laboratory equipment
- Other monitoring and control instruments used in industrial installations (e.g. in control panels)

10. Automatic dispensers (excluding any fluids/liquids)

- Automatic dispensers for hot drinks
- Automatic dispensers for hot or cold bottles or cans
- Automatic dispensers for solid products
- Automatic dispensers for money
- All appliances which deliver automatically all kind of product

All of above WEEE which is/are damaged, discarded, old, obsolete & outdated in design, scraps/ rejects from manufacturing process, historical wastes, orphaned products, 'end of life'. Excluded are Dry Batteries, Bio Medical waste & Radio active material/parts.

Included in above are: Motor/ compressor, cooling, plastic, insulation, glass, LCD, rubber, wiring/ electrical, concrete, transformer, magnetron, textile, circuit board, fluorescent lamp, incandescent lamp, heating element, thermostat, FR/ BFR containing plastic, external electric cables, refractory ceramic fibers and electrolyte capacitors (over L/D 25 mm).

Specific component, which are found in refrigerator, washing machine, personal computers, cellular telephones and TVs, are:

1. Radioactive substances, refractory ceramic fibers, Fluids/liquids/acids, electrolyte capacitors (over L/D 25mm), textile and magnetron are not present in any item.
2. Plastic, circuit board and external electric cables are present in a majority of items. BFR/FR containing plastic is present in refrigerator, laptop, television and cellular telephone.

3. Refrigerators are unique items because of presence of CFC/HCEC/HEC/HC (gases

4. Heating element is found in washing machine, while thermostat is found in both refrigerator and washing machine.
5. Fluorescent lamp is found only in laptop and cellular telephone.
6. Metal and motor are found in majority of items except refrigerator.
7. Transformer is not found in washing machine, refrigerator and cellular telephone.
8. CRT is found in personal computer and TV, while LCD is found in PC, TV and cellular telephone.
9. Concrete is found in washing machine.
10. Rubber is found in refrigerator and washing machine.
11. Wiring/ Electrical is found in all the items.

#### **2a. Following can be included (ref. Basel Convention)**

Ashes from the incineration of insulated copper wire

Precious metal ash from incineration of printed circuit boards not included on list B

Waste electrical and electronic assemblies or scrap containing components such as accumulators and 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. Annex IX, contains the mirror entry, Electrical and Electronic assemblies given below.

- Electronic assemblies consisting only of metals or alloys
- Waste electrical and electronic assemblies or scrap (including printed circuit boards) not 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 not contaminated with Annex 1.

Waste metal cables coated or insulated with plastics containing or contaminated with coal tar, PCB1, lead, cadmium, other organo halogen compounds or other Annex I constituents to an extent that they exhibit Annex III characteristics.

Glass waste from cathode-ray tubes and other activated glasses

#### **2b. Components in PROCESS for WEEE re-utilization (Patent pending)**

Metal

Motor

Cooling

Plastic

Insulation

Glass

CRT

LCD

Rubber

Wiring / Electrical

Concrete

Transformer

Magnetron

Textile

Circuit Board

Fluorescent lamp (ineballast)

Incandescent lamp

Heating element

Thermostat

generators and freezers 48

ing Machine 40 to 47

nal computer 29.6

ets 36.2

lar Telephones 0.080 to 0.100

ce: (1) *Data compiled from Waste from electrical and electronic equipment*

(EE) – quantities, dangerous substances and treatment methods, EEA

nhagen, 2003;

WERTY and *Eco-Efficiency analysis on cellular phone treatment in Sweden.*

elft, the Netherlands, 2004).

### **Recoverable quantity of elements in a PC**

cs,Lead, Aluminum, Germanium, Gallium, Iron, Tin, Copper, Barium, Nickel, Zinc, Iridium, Indium, Vanadium, Terbium, Beryllium, Gold, Europium, Tritium, Ruthenium, Cobalt, Palladium, Manganese, Silver, Antimony, Bismuth, Silica, Chromium, Cadmium, Selenium, Niobium, Yttrium, Rhodium, Mercury, Arsenic.

ce: *Compiled from data presented in (1) Exporting Harm – High-Tech*

*Management of Asia. Basel Action Network and Silicon Valley Toxics Coalition, US, 2005; (2)*

*Management of Waste Electrical & Electronic Equipment, ACRR 2003).*

**PROCESS for WEEE re-utilization (Patent pending), it is possible to extract precious metals viz. Gold, Silver etc prior to the process initiation.**

### **Possible hazardous substances in WEEE/E-waste Components**

ic Phthalate plasticizer, BFR, Insulation, ODS in foam, asbestos, refractory ceramic  
Glass, CRT Lead, Antimony, Mercury, Phosphors, LCD Mercury, Rubber  
late plasticizer, BFR, Wiring / Electrical Phthalate plasticizer, Lead,  
Concrete, Transformer, Circuit Board Lead, Beryllium, Antimony,  
Fluorescent Lamp Mercury, Phosphorus, Flame Retardants, Incandescent  
, Heating Element, Thermostat Mercury, BFR – containing plastic BFRs, CFC,  
C, HFC, HC Ozone depleting substances.

nal electric cables: BFRs, plasticizers Electrolyte Capacitors (over L/D 25mm)  
bl, other unknown substances.

ce: *Compiled from WEEE & Hazardous Waste, A report produced for DEFRA,  
h 2004, AEA Technology)*

substances within the above mentioned components, which cause most concern  
e heavy metals such as lead, mercury, cadmium and chromium (VI),  
enated

ances (e.g. CFCs), polychlorinated biphenyls, plastics and circuit boards that  
in brominated flame retardants (BFRs). BFR can give rise to dioxins and furans

Discarded metals again undergo oxidation, corrosion, dissolution and get distributed on the surface of the soil and in waterways thereby contaminating the soil and the food grown on it. Unfortunately these metals are not bio assimilated by the various life forms including animals and humans. Subsequently these ingested toxic metals prove to be toxic, teratogenic, mutagenic, and carcinogenic

## **2f. E-waste stream/ WEEE/E-waste trade Value Chain**

1. Used E-product from other countries;
2. Used E-products;
3. Recyclable wastes (print circuit boards, plastic frame, etc.);
4. Non recyclable wastes (broken CRTs, etc.);
5. Obsolete or broken E-product;
6. Repaired E-product as second-hand products;
7. Broken E-product & Non recyclable E-product. **13/16**
8. Non recyclable wastes (broken CRTs);
9. Recyclable waste (print circuit boards, plastic frame, etc.);
10. Print circuit boards and plastic frames;
11. Non recyclable wastes.

## **3. Exclusions**

**The PROCESS for WEEE re-utilization (Patent pending) excludes all of the following:**

- (a) Waste water and exhaust gases as covered under the provisions of the Water (Prevention and Control of Pollution) Act, 1974 (6 of 1974) and the Air (Prevention and Control of Pollution) Act, 1981 (14 of 1981) respectively and rules made there under;
- (b) waste arising out of the normal operations from ships beyond five kilometers of the relevant baseline as covered under the provisions of the Merchant Shipping Act, 1958 (44 of 1958) and the rules made there under;
- (c) radio-active wastes as covered under the provisions of the Atomic Energy Act, 1962 (33 of 1962) and rules made there under,
- (d) ozone depleting substances (ODS) as covered under the Ozone Depleting Substances (Regulation and Control) Rules 2000 made under the Act; and
- (e) Batteries (Dry) as covered under the Batteries (Management and Handling) Rules, 2001 made under the Act.
- (f) Bio Medical waste (but including the Medical devices).
- (g) Used Oil needs to be disposed out as per Hazardous Waste Management Rules,2003.

Capacitors containing PCB's can be included in this process,instead of being incinerated in common hazardous waste incineration facilities.

This is applicable to the area/jurisdiction falling under the Central or State Pollution Control Board/ Committee of Union Territories and applicable to all authorized collection centers (in India).

**PROCESS for WEEE re-utilization (Patent pending) is a expeditious process,has no time/effort/man power or electric power wasted in following:**

Cutting, crusehing and sorting into discreet product streams consisting of scrap iron, non-ferrous metal fractions, PC and TV casing components

(consisting of wood and plastics), granulates of mixed plastics, cathode ray tubes, printed circuit boards, copper cables and fine particulate (dust) or separated according to density granulate size and magnetic properties, and multiple pulverization by

#### 4. SALIENT FEATURES

Some other advantages of this Process (Patent pending) are:

1. ONLY REQUIRE CARRY OUT THE INITIAL UNITS OPERATION PART OF THE 1ST LEVEL TREATMENT VIZ. DECONTAMINATION (REMOVAL OF ALL LIQUIDS AND GASES)

2. NO FURTHER POLLUTION OF Air v (fugitive), Water, Land/ Soil Contamination due to spillage, Generation of hazardous waste.

3. NO 2ND LEVEL TREATMENT- Shredding OR Special treatment Processes comprising of

(i) CRT treatment consisting of separation of funnels and screen glass.

(ii) Electromagnetic separation

(iii) Eddy current separation

(iv) Density separation using water

4. NOT REQUIRED in **PROCESS for WEEE re-utilization (Patent pending)**: Any Equipment like hammer mill and shear shredder will be used at comminuting stage to cut and pulverize E-waste and prepare it as a feedstock to magnetic and eddy current separation. NOR ANY heavy-duty hammer mill TO grind the material to achieve separation of inert materials and metals.

5. THE **PROCESS for WEEE re-utilization (Patent pending)**. MODEL IS APPLICABLE TO AND CAN INCLUDE ALL THE HAZARDOUS SUBSTANCES THAT CAN OCCUR IN E-WASTE & Mixed plastic waste CAN BE INCLUDED INTO THE TREATMENT.

6. **PROCESS for WEEE re-utilization (Patent pending)** SAVES THE ENVIRONMENT BY TWO METHODS / ROUTES:

I) ENSURES THAT WEEE & E-WASTE IS USED EFFECTIVELY IN AN ENVIRONMENT FRIENDLY MANNER. THUS, EVEN AFTER THE WEEE PRODUCT REACHES ITS END OF LIFE PHASE & ALL THE PRECIOUS METALS HAVE BEEN EXTRACTED, THE REMAINING MATERIAL eg. GLASS, PLASTICS, METALLIC SHEETING, POLISH & PLATING (of IRON, STEEL etc) CAN STILL BE UTILIZED AS A USEFUL MATERIAL / MATTER. WEEE BEING GENERATED/ PRODUCED, USED, DISCARDED (due to being damaged / obsolete/ old) AND ACCUMULATION DOES NOT OCCUR.

II) THE SCOPE & RANGE OF USES FOR **PROCESS for WEEE re-utilization (Patent pending)** ENSURES THAT NIL OR REDUCED NATURAL PRODUCTS / RESOURCES ARE USED eg. WOOD, SAND, ORE, SOIL, WATER, ENERGY (through mining / excavation, transportation, processing & finalizing). THEREFORE, THE FAST DEPLETING RESERVES OF EARTH'S NATURAL PRODUCTS/RESOURCES ARE SAVED & CONSERVED FOR REGENERATION AND FOR MAINTAINING THE ENVIRONMENTAL BALANCE.

7. NO DISPOSAL or RE-CYCLING , NEGLIGIBLE CARBON FOOTPRINT, NOMINAL COST & NIL EMISSIONS

8. NO RISK of Acidification, climate change, eutrophication, photochemical oxidation, ozone and resources depletion.

9. NO REQUIREMENT for e-waste treatment involves complex treatment rationale driven by "Material Flow" or for Landfilling & Incineration

10. TO ACHIEVE A FASTER **PROCESS for WEEE re-utilization (Patent pending)** & RATE CAN BY-PASS the best available technologies: Process that use a



Also, Precious metal operations (PMO) involving recovery of gold, silver, platinum, palladium, rhodium, iridium and ruthenium and base metal operations (BMO) involving recovery of Pb, Cu, Ni, Sb, Sn, Bi, Se, In, Te, As. CAN CONTINUE.

11. VERY MODERATE RISK as per Indian Regulation & also as per threshold followed in Europe. AS NO Danger exists of serious damage to health by prolonged exposure.

12. This process IS NOT APPLICABLE TO RADIO-ACTIVE SUBSTANCES ,BIOMEDICAL WASTE (R3EQUIRE TO BE SEGGREGATED AND UNDERGO SPECIAL TREATMENT) & DRY BATTERY.

13. ALSO CAN CARRY OUT PRIOR Recycling/recovery of valuable materials (NOT A CDM - EB Approved methodologies YET).

14. **PROCESS for WEEE re-utilization (Patent pending)** is an innovative technology LEADING TO 100% RE-USE IN VARIOUS SECTORS OF ECONOMY LIKE DEFENSE, ROADS & RAILWAYS, TOURISM, REAL ESTATE DEVELOPEMENT, HOSPITALITY INDUSTRY ETC.

15. EMISSIONS ELIMINATED: THERE IS NO Generation of mixed e-waste along with hazardous waste after dismantling & PRACTICALLY NO FORM OF ANY HEAT TREATMENT IS REQUIRED (Except in the last stage of some versions). So, exemption under Scope 3 of GHG emissions can be claimed.

#### CONCLUSION

With the systematic application of this Process (Patent pending), Earth's environment will benefit greatly as its sustainability will be reinforced and much of damage or destruction of precious natural resources that is occurring world wide will cease.

The process of the present invention utilizes E-waste as raw material in manufacturing & construction activity, for example, preparation of bricks, building material, doors, furniture, walls, road, Parking and highway blocks etc.

The Sustainability will be reinforced as Deforestation will be reduced (for Wood from Trees) along with reduction in Digging/ Excavation of Earth (for Wood, Rock, Marble, Granite & Soil etc).

**WEEE as raw material will be a far more cheaper, tougher, durable, non-biodegradable as well as weather, wear, insect, rodent, water/moisture & fire resistant.**

- **Rahul Nagpaul**

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*(Excepts from various sources viz. MoEF, DIT, EU, BAN, UNEP etc, with comments in CAPITALS)*

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*Re-inforcing Environmental Sustainability with Constructive Utilization of Waste*

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