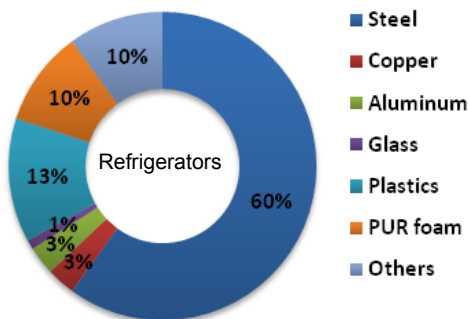
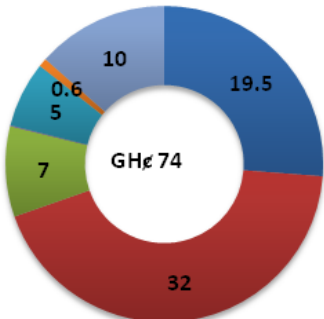


## Material Composition



## Scrap Value In Agbogbloshie



## Urban Mining

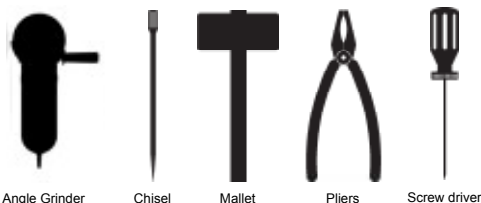
Several materials can be sourced from a refrigerator. One of the most common materials is plastic which can be shredded and recycled as is done in parts of Agbogbloshie. Other valuable metals like steel, aluminium and copper can be mined, recycled, remelted and reused. The body is typically made of steel coated with ceramic enamel/resins (to avoid corrosion), and the interior is made of aluminium (Al) and plastics. The advantage offered by refrigerators is that, its entire composite skin can be mined as an insulated panel and reused in various applications such as buildings.

In Agbogbloshie, refrigerators constitute one of the largest streams of e-waste and supplies large volumes of sheet metal for re-use.



## Tools For Disassembly

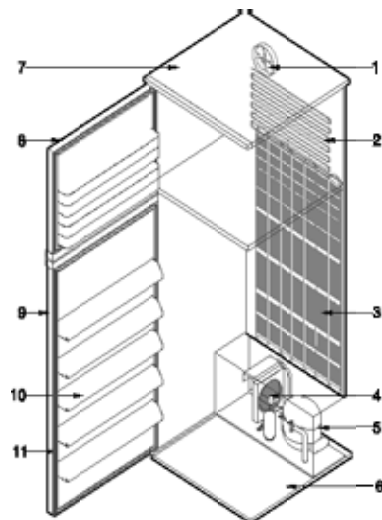
The tools required for processing are: angle grinder, chisel, mallet, pliers, screw drivers, wire cutters.



Tools are essential to the process of disassembly and are the primary means by which industrial activities are carried out. Not all the tools listed above are used in the process of disassembling refrigerators. The most commonly used ones are the mallet, the chisel and the screw driver. Out of these, the mallet and the chisels are made in Agbogbloshie by local blacksmiths.

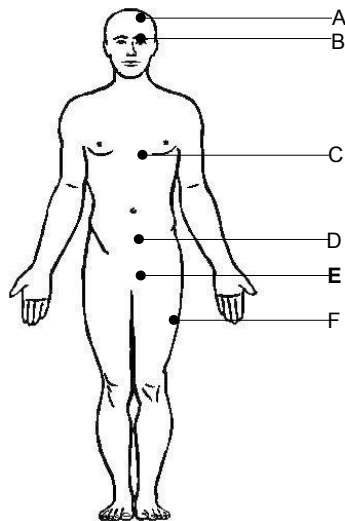
**Tools are a potential source of injury. The risk can drastically be minimised by using the right tool for the right job. In the process of disassembling refrigerators, the highest risk to workers especially in Agbogbloshie is the risk of injury from handling a mallet and chisel.**

## Refrigerators



1. Evaporator Fan
2. Freezer Evaporator Coil
3. Fridge Evaporator Coil
4. Fan
5. Compressor
6. Refrigerator Base
7. Stainless Steel Body
8. Freezer Door
9. Fridge Door
10. Crisper
11. Gasket

## Health



- |                       |                   |
|-----------------------|-------------------|
| A. Nervous System     | D. Urinary system |
| B. Eye                | E. Reproductive   |
| C. Respiratory system | F. Skin           |

## Step by Step Disassembly

1. Remove the interior components and separate them carefully.
2. Disconnect the capacitor and discharge it of excess charges by using a power resistor, insulated body with heat shrink tubes.
3. Cut off the copper (Cu) wires at the bottom and pull off the compressor
4. Open the motor by using an angle grinder to extract the copper or sell the compressor if it is in good condition
5. Unscrew all the joints and pull off the condenser,
6. Remove the polyurethane foam from the casing used for insulation and carefully package it for proper disposal
7. The steel body can be removed by using a chisel and a mallet.
8. All the wires (mostly copper) can be removed using wire cutter.

## Refrigerator Overview

### Common Brands:

Frigidaire, General Electric (GE), Haier, LG, Maytag Samsung, Whirlpool \*\*

### Hazardous Materials:

Chlorofluorocarbon (CFC), mercury (Hg), polyvinyl chloride (PVC), polyurethane (PUR) foam

### Key components/parts:

Compressor, condenser, copper tubing, & evaporator

### Primary materials:

Aluminium (Al), copper (Cu), glass, plastic, polyurethane (PUR), steel

### Types:

Bottom freezer, chest freezer, compact, counter-depth, double-door, freezer-less, French door, side-by-side, single-door, top freezers \*\*

### Weight composition (%):

3% Al, 3% Cu, 1% glass, 13% plastic, 10% PUR, 60% steel [1]



A refrigerator contains several hazardous chemicals such as CFCs, PVC, and PUR foams as well as mercury in the light bulbs. These should be handled with care.

## Hazardous Material

**Mercury (Hg)** - Brain and DNA damage, disruption of nervous system, sperm damage, birth defects, skin rashes and headaches.

**Polyvinylchloride (PVC)** - Headaches, dizziness, eye and throat irritation, lung and kidney irritation, liver damage and increased cancer risk.

**Polyurethane (PU/PUR)** - Eyes, nose, throat and skin irritation and work-related asthma.

## Safety Gear

The disassembly process exposes the worker to various levels of potential harm. There is a need for protective gear to reduce impact of these practises. Safety gear include gas masks to protect e-waste workers from dust and toxic gases, safety boots, hand gloves and mostly HazMat suits, which are full garments with footwear and masks, worn to protect workers from exposure to dangerous chemicals.

9. After disassembly, components should be documented. See example of this done during AMP disassembly workshop.



Condenser



Fan



Evaporator



Switch

Screws

## Re-make

The steel body waste can be sold to steelwork industries for reuse; some are used by local manufacturers to make coal pots. Other materials can be sold such as: Aluminium (Al), Copper (Cu) from the cables and electric motor, brass and some plastics. Undamaged parts such as the electric motor, if in good condition, can be reused. The condenser can likewise be sold to local makers, who use it to make grills for barbeque/ kebab stands.



Silent air compressor, made from old refrigerator compressor. Source: homeshopmachinist.blogspot.com/2010/12/silent-air-compressor.



Old refrigerator shells are used all over Agbogbloshie as storage areas for tools



Cooking pots made from refrigerator steel bodies in Agbogbloshie.



Made in Agbogbloshie  
Barbecue grill made out of refrigerator condenser at Agbogbloshie.

## References & Notes

1. <http://eco3e.eu/products/refrigerator>
2. <http://en.wikipedia.org/wiki/Refrigerator>
3. <http://www.lennotech.com/periodic/periodic-chart.htm>
4. <http://www.epa.gov/ttn/atw/hlthef/vinylchl.html>
5. [http://www.epa.gov/dfe/pubs/projects/spf/health/\\_concerns\\_associated\\_with\\_chemicals\\_in\\_spray\\_polyurethane\\_foam\\_products.html](http://www.epa.gov/dfe/pubs/projects/spf/health/_concerns_associated_with_chemicals_in_spray_polyurethane_foam_products.html)

### \*Calculation on estimated value:

Prices of materials vary in Agbogbloshie depending on the local market. Also the state of the materials also influences the price, that's the price of burnt copper differs from that of the unburned by 1 Ghana cedis per pound. In Agbogbloshie, copper and aluminium are weighed in pounds (lbs) and iron/steel is weighed in kilograms (kg). The prices we used in this calculation are that charged as at July, 2014.

### Calculation inputs:

Total weight of equipment (W): 35 kg  
Weight percent of material (W%): %  
Weight of material (Wm): W% \* W  
Price per material = Wm \* amount in GHC per kg  
(1 kg = 2.204 pounds)

\*\* These types of EEE are mostly found and dismantled in Agbogbloshie.



For more information, visit:  
<http://qamp.net/Refrigerators>

## What is a Refrigerator

A refrigerator is an equipment which keeps items cool and helps preserve them. It functions within a temperature range lower than room temperature. The temperature ranges within which it functions are as follows [2]:

Freezer: -18 °C (0 °F)

Meat products: 0 °C (32 °F)

Standard fridge: 5 °C (41 °F)

## How it works

Refrigerator cooling is a cyclical process, in which a fluid (refrigerant) circulates continuously throughout the interior of a refrigerator and takes away the heat from the items to be cooled. The evaporator tubes which hold the refrigerant, are made up of copper or Aluminium. The compressor is powered by an electric motor and transfers all heat generated to the condenser. The condenser removes this heat and releases it into the atmosphere.



## Refrigerators