



## RESEARCH ARTICLE

### LIFE CYCLE ASSESSMENT (LCA) OF MOBILE PHONES

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#### ABSTRACT

The increase in advancement in technology for the purpose of improving communication leads to availability of mobile phones at low prices. Availability of mobile phones at economical price enabled the low income group people to use personal means of communication. The multitude of mobile phone besides doing well for humanity also has adverse impact on environment. The adverse impacts ranges from the radiation effect to the degrading effect due to energy utilized for all the phases of life cycle as well as effect of disposing of materials. In this research paper the negative effect of mobile phone from start of life cycle to end of life cycle is critically analyzed. This paper concludes that the cell-phones contain hazardous material, harmful to environment according to EPA. The viability of mobile phone manufacturer is taken into consideration while making recommendation.

## INTRODUCTION

In this Assessment of life cycle, we examine the effects it has during its life and at each stages of its processing, use and destroying or recycling. The main objective of a full LCA is to look at the effect of a mobile phone on environment during the various stages starting from mining, manufacturing , Operation Charging , Usage , Life time and even destroying. After analyzing the environmental impact of mobile phone, we try to reduce impact during its LCA on each stage and level and ultimately Recycling with will automatically reduce carbon footprints. The process is defined by code ISO 14000 and environmental standards by ISO 14040:2006 and ISO 14044:2006.

### Life cycle of a mobile phone

Generally it consists of 4 main parts i.e. Manufacture, Transportation, Product Usage and Recycling.

### Objective

By LCA, We have an objective of reducing the impacts by applying systematic market approach by the analysis of its life

cycle on every possible way by not compromising with the competitive concerns but optimizing the outcomes.

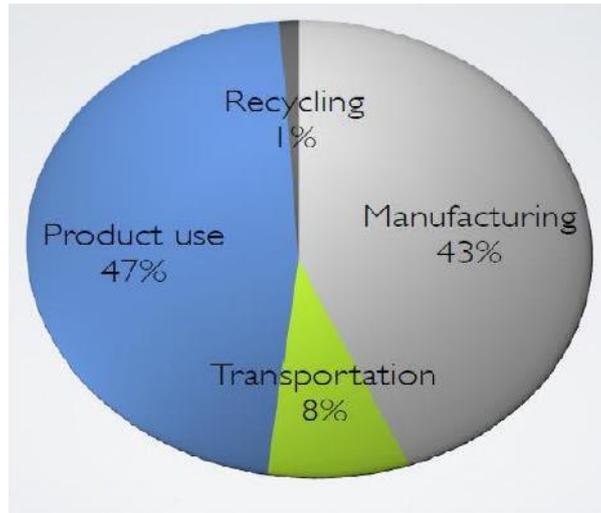
### Composition of Mobile Phone

Mobile phone has wiring board which is printed including ICs and some components like capacitors and resistors installed on it. The phone charger has transformer which is printed with a cable which connects the power source to the phone. The following figure illustrates the components (Pranshu Singhal, 2005).

### LIFE CYCLE OF A MOBILE, ASSESSMENT OF NOKIA 3G PHONE IN 2003: PRIMARY ENERGY CONSUMPTION (PEC)

The material extraction for phone and building phase of the parts deals with approximately 60% of the Initial energy taken over the life of a mobile, the utilization stage deals for approximately 29% of the ultimate energy consumption in the light customer Interface and approximately 35% in the heavier customer interface. During the utilization phase, the major contributor is the energy used during it is in sleep mode. The material collection and manufacturing of ICs is important when it comes to energy consumption.

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Project Stages	Objectives
Stage I	Analysis of impacts on environment of a mobile during its life-cycle
Stage II	Identifying of options of improvement during life cycle phases.
Stage III	Identifying aspects affecting mobile phone development. Effect on environment, Identifying social and economic Factors of improvement Selected in stage II
Stage IV	Selecting of improvement aspects based on sustainability study conducted in the stage III & implementation
Stage V	Implementation during the stage IV, by the participating Authorities
Follow up	Monitoring the phase after implementing of the commitments

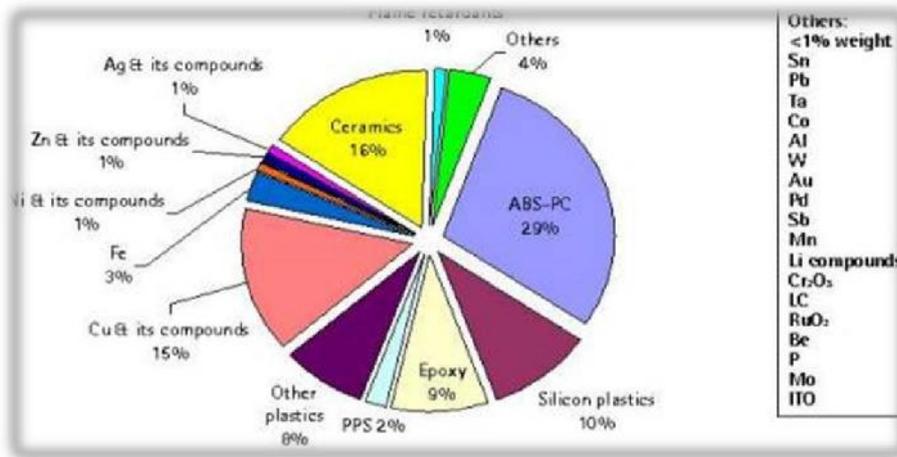


Fig 2. Composition of Mobile Phone

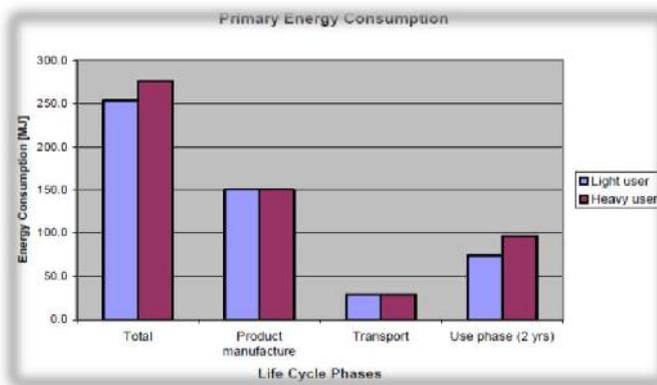


Fig. 3. Consumption of 3G mobile phone

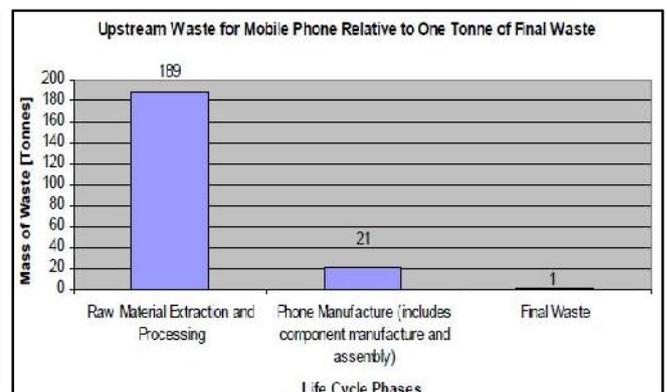


Fig 4: Rucksack Analysis [2] Comparative quantity of mobile waste

## Global Warming Potential (GWP) & Ozone Depletion Potential (ODP)

The LCA observed that raw material extraction and parts production and assembling phases as the major contributors to the global warming ability. These stages are jointly responsible for approximately 60% for GWP of the mobile phone. The next major significant contributor is the utilization phase which is responsible for 25% of the energy consumption in the light user scenario.

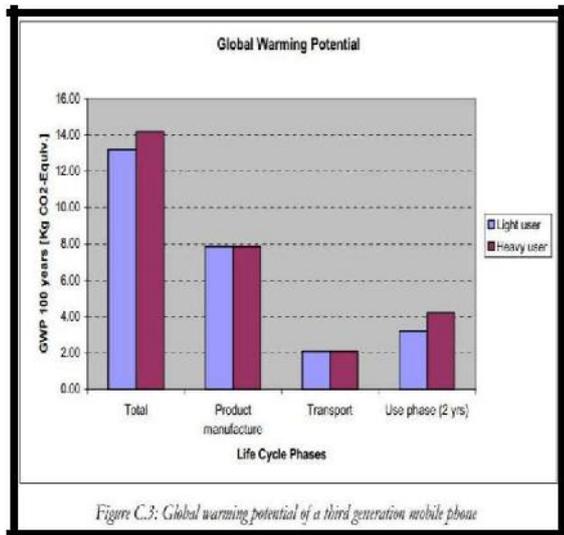


Fig 4: 3G phone analyzed for its life cycle

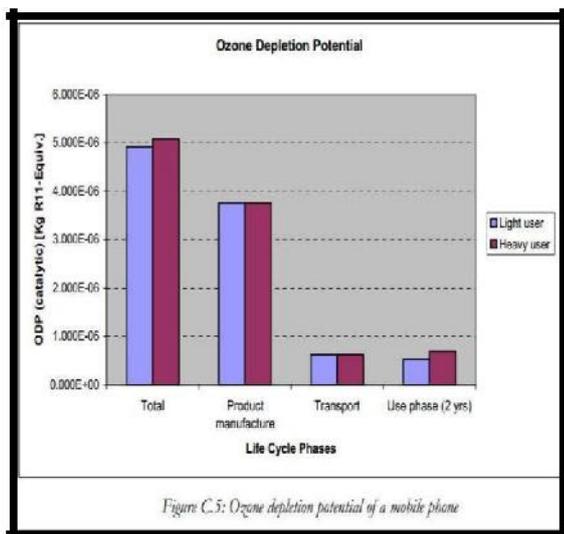


Fig 5: The figure illustrates the GWP of mobile phone for its life cycle

## Acidification Potential (AP) & Human Toxicity Potential (HTP)

It is due to emissions which have nitrogen oxides and sulphur dioxide from burning processes in industry, households, and traffic. In context of AP indicator, the life Cycle assessment observes that the raw material collection and parts production stage is responsible for about 71% of the AP from the life cycle of a mobile in the light customer interface and 66% in the heavier customer interface. The logistics of the components to assembly responsible for approximately 6% and the logistics of the mobile responsible for about 2% of total AP in both the scenarios.

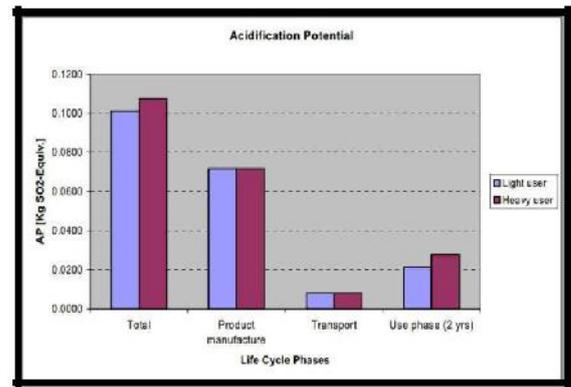


Fig. 6: This figure illustrates the AP of analyzed HTP mobile phone for its lifecycle

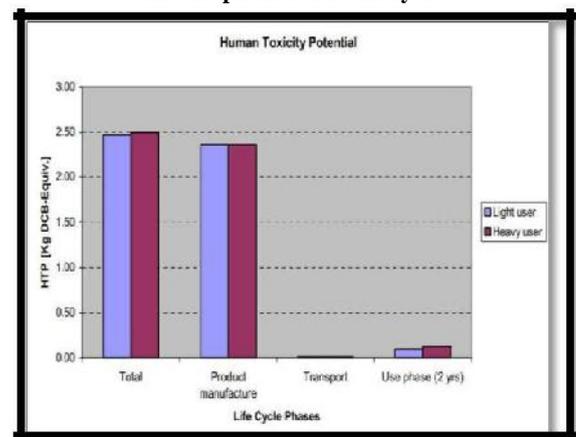


Fig 7. This figure shows the mobile over its life cycle

## NETWORK ANALYSIS OF LIFE CYCLE ASSESSMENT OF MOBILE PHONE

### Mitigation steps to be taken for improvement

- Reducing the unused power dissipation of the charger is responsible for a major part of the environmental impacts.
- The metal recovery from mobile is important which can reduce impact due to less mining also usable plastics to be recycled.
- Finding the alternatives for Bromine compounds that are held responsible for most of the toxicity of the phone and were followed by other semiconductor compounds in the toxicity.
- The manufacturing process should be efficient, so during the design phase, all necessary methods to be adopted so that it consumes less energy at initial phase.
- The IC should be made more integrated so that it can function better and efficiently, which will result in less components and less environmental impacts and energy consumption (Kevin Chin, 2005).
- Improved recycling methods during reuse phase. Recycling of cellphones will definitely reduce the mining and thus effect the energy consumption and carbon foot prints.
- The manufacturing companies should provide detailed information about their environmental performance. Constantly doing eco-audits and providing environmental sustainability report. By making LCA compulsory for every electronics company it might increase the competition and by "going green"



companies could gain the competitive advantage and become more sustainable and thus adhering to stricter health and safety rules.

- These toxic materials use should be reduced and also new material for substitution should be identified.
- Take back of old phones so that old phone shall be reused again.
- Efficient and environmentally sound treatment of mobile phones.
- Keeping mobile phones 1 m away from you most of the time and using wire for taking so that radiation has less effect on human health.
- The general Apple achievements in 2008 it was announced that Apple company in new product line removed hazardous chemicals like polyvinyl chloride and brominated flame retardants ,they also removed mercury and arsenic from display glass. In 2007, Apple recycling area grew about 57% as Apple collected almost 21 million pounds of e-waste (<http://www.apple.com/environment/faq/>; Romas Malevicius).

### Main findings in the report

The observations of the environmental assessments of mobile are as follows:-

The utilization phase and manufacturing stages are major contributors to the environmental impact. During utilization phase, the power consumed by the charger responsible for the environmental impacts. During components manufacture phase, the energy consumption of the manufacturing processes responsible for the damage. The major environmental problem for a mobile phone in all the life cycle phases is energy consumption during its charging. The Printed Wiring Board and Displays are the parts with most of the damage. During transportation phase, the airfreight is responsible for the environmental Problems. The collection of all the old phones should be proper to maintain and reduce the impacts caused in EOL phase of the mobile phones. The impact which is reduced by recycling is because of the recovery of the metal and other plastics or polymeric material used in the manufacturing which will reduce the impact by a large margin.

Man has been absorbing the harmful and unseen EM radiations without even knowing it , but now, with rapid advancement in

technology, the pollution due to radiation has started diseases like Alzheimer's disease, Parkinson's disease, chronic fatigue, depression, sleep disturbance, cardiac attacks, amyotrophic lateral sclerosis (ALS), low sperm count, neurological diseases, increased eye stress, renal impairment, DNA damage, leukemia, arthritis, cancer, miscarriage etc. Hence, the precautions need to be taken. We should start acting before it's too late and dangerous for human lives. In a new study it has been found that tomatoes release stress molecule just after 10 min of exposure of radiation, which was released only after the plant is damaged.

### Conclusion

This report presents cursory study on the environmental impacts by the cell phones during its life cycle and various factors are being analyzed and assessed. Cell phones contain materials which are harmful to the environment and humans and are classified as hazardous waste by the EPA and the State of California. They need to be examined carefully and made environmental friendly that minimum environmental pollution is met. Redesigning of cell phone, reducing of harmful metals in cell phone, adhering of ISO standards are the prime need of hour. Apple i Phone are the most environmental friendly devices as stated by ISO 14000 and environmental management standards: ISO 14040 and 14044. The cell phones should be recycled and reused and authorities should try extract as much as they can and avoid the land filling of cell phones which also contaminates the soil. These precautionary methods to be taken accordingly.

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