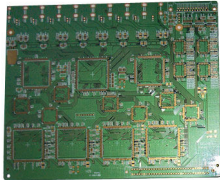


Mobile Phones and the Environment

What's in a Mobile Phone?

Mobile Phones are complicated gadgets capable of processing millions of calculations per second. Their components each have their useful functions however also contribute to the waste problem created when disposing of these devices. Mostly, mobile phones comprise of a handset (includes: Printed Circuit Board (PCB), Liquid Crystal Display (LCD), Keypad, Antennae, Microphone, Casing), a battery and a charger.



Printed Circuit Board (PCB)

Circuitry made mostly of copper is soldered to the board with protective coatings and adhesives. The board is made of epoxy resin or fibreglass and generally coated with gold plating. Other precious metals and hazardous substances in the PCB are arsenic (in chips made from gallium arsenide), antimony, beryllium, brominated flame retardants, cadmium, lead (used in the solder that joins the parts), nickel, palladium, silver, tantalum and zinc. The lead and brominated flame retardants have the highest environmental impact due to their levels of toxicity and persistence in the environment.



Liquid Crystal Display

The LCD as the name suggests contains liquid crystals which are embedded between layers of glass for illumination with transistors for an electric charge. The liquid crystalline substances can contain toxic substances such as mercury. Foil display systems are now under development which would make LCD's much more environmentally friendly, especially in small products.



Battery

Mobile phone batteries can contribute significantly to a device's environmental impact. Rechargeable batteries generate less waste than single-use batteries however, as with rechargeable batteries belonging to mobile phones, toxic components such as cadmium, nickel, zinc and copper can pose end of life hazards.



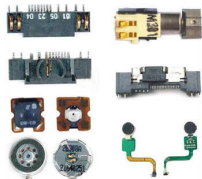
Charger

The charger used to recharge the battery often weighs more than the handset and battery combined. It is generally not interchangeable among different makes and models of phones, contributing significantly to the waste generated. The chargers consist of mainly copper wires encased in plastic, but materials such as gold, cadmium and brominated flame retardants may also be present.



Plastic Casing

The plastic used to case the phone together is usually polycarbonate (PC), acrylonitrile butadiene styrene (ABS), or a combination of the two. These plastics are difficult to recycle through a normal mixed plastic process as they often contain brominated flame retardants, to reduce the risk of fire. Brominated flame retardants are damaging to the environment and human health as they are persistent, bioaccumulative and toxic.



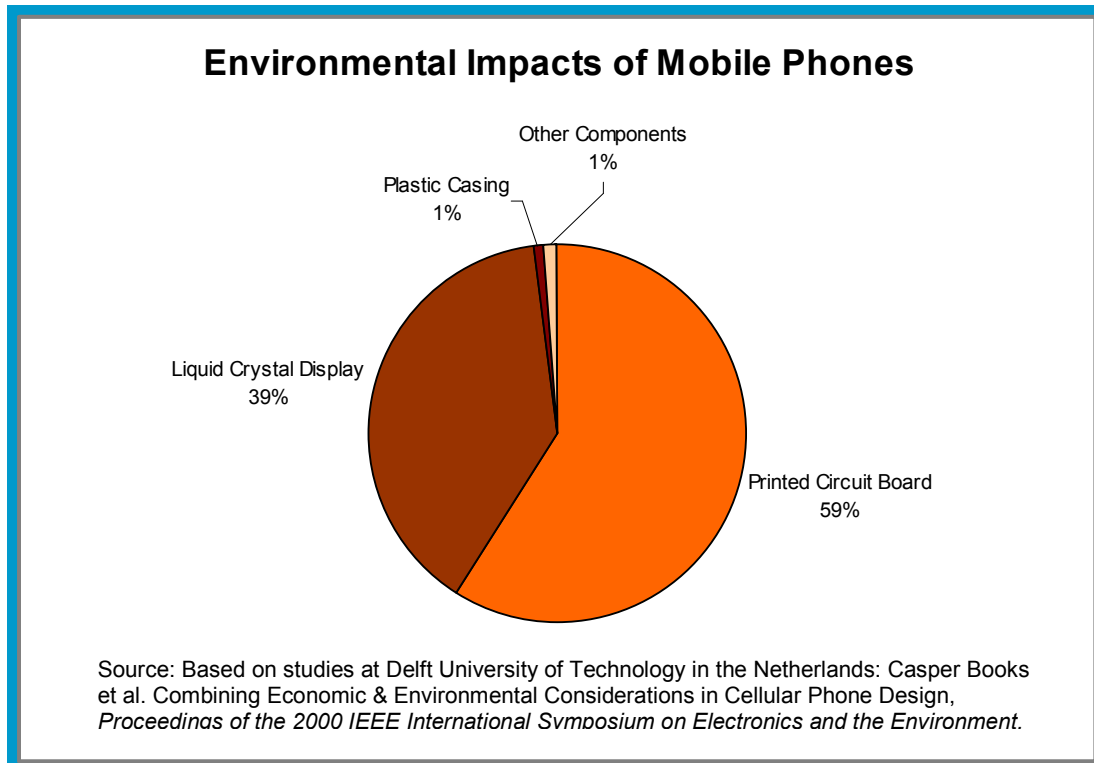
Other Components: Antenna, Speaker, Microphone, Keypad, Accessories
Most other components of the handset are very small however these too contain heavy metals and hazardous materials. Mobile phone accessories can also contribute to the waste problem.



Mobile Phones and the Environment

The danger of dumping mobile phones

Of all the components which make up a mobile phone, those which cause the most environmental impact can be seen in the chart below.



The toxic substances contained in each of these components pose a serious environmental problem by leaching from decomposing waste in landfills into ground water, contaminating the soil and entering the food chain.





Mobile Phones and the Environment

Harmful substances in mobile phones

Chemicals released from mobile phones in landfill can include antimony, arsenic, beryllium, copper, lead, nickel, mercury, manganese, lithium, zinc and cadmium. Even in small amounts, these hazardous chemicals can cause environmental contamination, affecting waterways and wildlife. They can also cause a variety of serious health issues in humans if released into the environment.

The main characteristics which cause these substances to be so dangerous are that they are persistent and bioaccumulative. Persistent refers to the fact that the compounds are not easily broken down and therefore stay in the environment for a very long time.

Bioaccumulative refers to the increase in concentration of a substance in the tissues of living organisms over time. The effects of these substances can be quite serious as seen in a few examples described below.

Brominated flame retardants

Brominated flame retardants (BFRs) are used to prevent fires occurring within mobile phones as plastics can be highly flammable. They contain PBDEs (polybrominated diphenyl ethers), a group of chemicals that are highly persistent and bioaccumulative. They are suspected hormone disruptors and can cause cancer and reproductive / developmental disorders, with particularly damaging effects on the thyroid (which controls brain development.). As a result, PBDEs may cause neuro-developmental disorders such as learning disabilities and behaviour problems. PBDEs have been found in significant quantities and distribution in Arctic Polar bears, explained by the bioaccumulation pathways in the arctic marine food web.

Source: Derek C. G. Muir et al, Brominated Flame Retardants in Polar Bears (*Ursus maritimus*) from Alaska, the Canadian Arctic, East Greenland, and Svalbard, 2005 American Chemical Society

Cadmium

This poisonous heavy metal is known to cause lung and prostate cancer, and is toxic to the gastrointestinal tract, the kidneys, and the respiratory, cardiovascular and hormonal systems. Cadmium is considered the seventh most dangerous substance known to humankind.

Lead

Lead is a suspected carcinogen, a known hormone disruptor, and can damage almost every organ and system in the human body, particularly the nervous system. Lead has been indicated as a cause of decreased mental ability, developmental delays, behavioural disorders and reproductive defects.

Lithium

Lithium-Ion batteries, are free of heavy metals however lithium has a high degree of chemical activity, and this in itself can create environmental problems when exposed to water (present in most landfills). The metal can burn creating underground fires which are difficult to extinguish.

Mercury

When inorganic mercury enters the environment, it is deposited in soil and water. Micro-organisms transform inorganic mercury into organic mercury compounds, such as methylmercury. Methylmercury can bioaccumulate in the fatty tissues of living organisms, particularly fish living in polluted waters, and the people who then eat those fish. Mercury is a recognized developmental toxin, and it is also a suspected hormone disruptor, neurotoxin, reproductive toxin and respiratory toxin.

Sources: Aussie Recycling Program www.arp.net.au & Environmental Defence www.environmentaldefence.ca/toxicnation

Mobile Phones and the Environment

Recycling mobile phones

Dumping mobile phones in landfill creates a long term pollution risk though fortunately through the capacity to recycle many mobile phone components, recycling your phone means you can contribute to a healthier environment.

Through the collection process, mobile phones are sent to a specialised recycler who can dismantle the components of the phone for recycling.

Mobile Phone Recycling

Batteries:

Nickel recovered can be used to make stainless steel
Cobalt and Cadmium can make new batteries



The printed circuit boards (PCBs) which contain precious metals can have silver and gold extracted which can be made into jewellery. In fact, 300 grams of gold can be recovered from approximately 1 tonne of recycled mobile phones. These 300 grams of gold when re-used saves mining 110 tonnes of gold ore. Mobile phone recycler MRI (see www.mri.com.au) is currently exploring ways to make recycling PCB's an economically viable activity.

Plastics from the casing can be granulated and reformulated through a mixed plastic process where lower grade products are made such as traffic management products and furniture components.

Plastic containing flame retardants is unable to be recycled through a normal mixed plastic recycling process. A company called Close the Loop in Melbourne can now recycle these plastics into a product called 'e wood' (see www.closeheloop.com.au)

The steel and non-ferrous metals can be grinded down to isolate the metals for extraction. This metal would purchased by metal recyclers in Australia. Materials containing precious metals are sent to a copper refinery for recovery of all metals.

Recycling Batteries

Batteries contain a range of metals which can be reused as a secondary raw material. There are well established methods for recycling most batteries containing lead, nickel-cadmium and mercury, but for some, such as newer nickel-hydride and lithium

systems, recycling is still in the early stages.

Nickel-cadmium batteries can be reprocessed through a thermal technique which recovers cadmium and iron-nickel for steel production. Batteries containing mercury are most commonly processed using a vacuum-thermal treatment in which the mercury vaporises. It condenses and eventually solidifies as temperatures are reduced and can then be reintroduced into the material cycle.

Nickel metal hydride batteries can be reprocessed by mechanically separating the individual materials (plastic, hydrogen and nickel) within a vacuum chamber to prevent the escape of hydrogen. The output of this process is a product with high nickel content that can be used in the manufacture of stainless steel. Lithium Ion batteries are reprocessed through pyrolysis (heat treatment) with the primary recovery the metal content.

Source: Waste Watch UK



Mobile Phones and the Environment

The Future

What does the future hold for mobile phones and e-waste?

Many companies now recognise the growing waste problem created by the high turnover of electrical and electronic equipment. It would be hoped that the manufacturers of phones would be looking to build phones which last longer than a couple of years. However, with technology moving so fast and the drive to sell more phones this may not be the most immediate solution.

Fortunately some technological advances will benefit the waste problem such as an alternative to the LCD display screen being developed by a number of companies including Sanyo, which is based on organic light-emitting diodes. This is a much simpler technology than LCD and would be cheaper, contain no mercury, be lightweight and less energy intensive to produce.

There is much work being done on the international stage to curb the growing e-waste problem. The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal is the most comprehensive global environmental agreement on hazardous and other wastes. The Convention has 170 Parties and aims to protect human health and the environment against the adverse effects resulting from the generation, management, transboundary movements and disposal of hazardous and other wastes. The Basel Convention came into force in 1992. For more information visit www.basel.int

The European Commission's Waste Electrical and Electronic Equipment (WEEE) Directive aims to tackle this fast increasing waste stream and complements European Union measures on landfill and incineration of waste. Increased recycling of e-waste will limit the total quantity of waste going to final disposal. Producers will be responsible for taking back and recycling electrical and electronic equipment. This will provide incentives to design electrical and electronic equipment in an environmentally more efficient way, which takes waste management aspects fully into account. Consumers in Europe will be able to return their equipment free of charge. In order to prevent the generation of hazardous waste, the WEEE Directive requires the substitution of various heavy metals (lead, mercury, cadmium, and hexavalent chromium) and brominated flame retardants (polybrominated biphenyls (PBB) or polybrominated diphenyl ethers (PBDE)) in new electrical and electronic equipment put on the market from 1 July 2006. For more information visit http://ec.europa.eu/environment/waste/weee/index_en.htm

Australia needs to regulate standards for design and recycling of electronic products. A national free take back and recycling scheme would provide a great mechanism for the community to take action and divert these products from landfill. Producers levied at the point of import to Australia could raise funds for this program.

With the scale of the problem increasing exponentially, mobile phones and e-waste need to be a priority for government in addressing waste concerns. With 17 million Australian's updating their mobile phone on average every 12-18 months, this is an urgent and important problem to address.



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