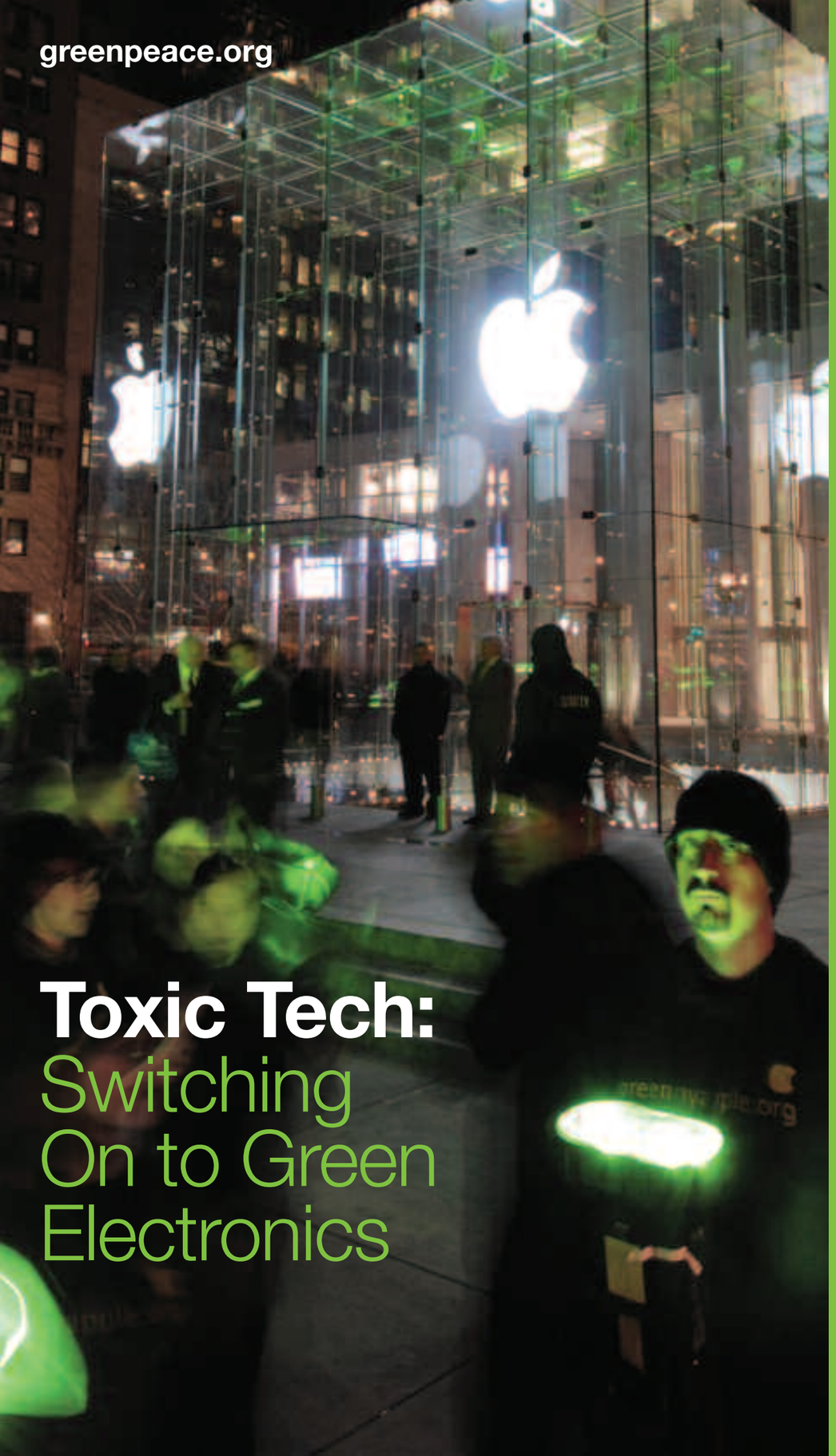

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Toxic Tech:
Switching On to Green Electronics

GREENPEACE

Creating a toxic-free future

Contents

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image Bangkok, Thailand – a child plays with electronic scraps. A looming e-waste problem in Thailand can pose health and environmental risks. Electronic waste is the fastest growing component in the global waste stream amounting to 20 to 50 million tons worldwide with Asia contributing about 12 million tons a year.

Switching on to green electronics

Electronic devices are a complex mixture of several hundred materials, many of which can contain hazardous chemicals such as heavy metals – highly toxic compounds of lead, mercury or cadmium– hexavalent chromium, beryllium, brominated flame retardants (BFRs) or the chlorinated plastic, polyvinyl chloride (PVC).

Recycling of electronics devices is one way of reducing environmental hazards associated with early production stages. However, recycling in this case is not the whole solution; because of hazardous chemicals currently being used in the manufacture of electronics products, recycling can bring its own problems.

If not reused either as whole equipment or components, obsolete e-products are being treated to reclaim metals and, sometimes, to recycle the plastics. Even with the best available technologies in western countries, recovering metals can be polluting, with potential exposure to metal fumes for workers and residents of recycling areas, and the formation of dioxins from smelting PVC-coated cables or BFR-treated plastics. This clearly shows how the choices made during the design of products determine the safety of waste management.

Greenpeace has been pushing the major electronics makers to:

- Embrace the principle of “Extended Producer Responsibility” by taking financial responsibility for their products, once discarded by their customers
- Design out toxics – clean up their products by eliminating hazardous substances, replacing harmful ingredients through use of safer alternatives or design changes. Greenpeace believes that the e-waste crisis should not be regarded only as a waste management issue but that the solution relies primarily in product design. Design influences the environmental fate of e-waste.

In *‘Toxic Tech: Switching On to Green Electronics’*, we show the problems caused by toxic chemicals in electronic products – at all stages of their lifecycle, from production, through manufacture and to the very end of a product’s life – and what measures need to be introduced to address these. We also show how industry is beginning to move forward, pulling the plug on dirty electronics, and what Greenpeace has been doing, and continues to do, in order to show companies the relevant steps that need to be taken. Finally, we show what you can do: the steps you can take towards helping the world switch on to green electronics.

image Chennai, India – computer scrap piled up in a workyard; the plastic has been separated and will be collected by a plastic dealer.

The rate at which these mountains of obsolete electronic products are growing will reach crisis proportions unless electronic corporations that profit from making and selling these devices face up to their responsibilities.

The toxic lifecycle of electronic products

What we recognise as branded products are just the visible links in a whole chain of industrial operations scattered across all continents of the globe, in constant search for material resources and labour forces at the lowest cost possible – often meaning at the lowest social and environmental standards.

Throughout the entire lifecycle of electronic devices, these dangerous substances can cause serious environmental pollution and put workers at risk of exposure when the products are produced or disposed of.

The first step in producing electronic devices is the extraction of raw materials through mining and processing ores.

Manufacturing locations, historically based in the Western world, have been shifting to reflect more and more the quest for cheap labour: maquiladoras in Mexico and other Latin American countries, sweatshops in South-East Asia, India and China, but also low-waged qualified workers in Central and Eastern Europe. In many locations where cheap labour is available it comes hand-in-hand with poor environmental standards, leading to environmental contamination due to the use of hazardous chemicals in the production process.

At the end of a product's life the problems still remain. While state-of-the-art waste facilities (smelters, recycling, landfills, incinerators) can be found in OECD (Organisation for Economic Cooperation and Development) countries, a worldwide waste trade, often illicit, feeds Asian countries, primarily China and India, practising rudimentary recycling, or African countries such as Nigeria and Ghana where lots of waste is simply dumped.

A dangerous, new waste stream is rapidly emerging. The UN estimates that some 20 to 50 million tonnes of e-waste are generated annually worldwide[1]. Hundreds of thousands of old computers and mobile phones are dumped in landfills, incinerated or processed in smelters. Thousands more are exported, often illegally - from the European Union, the United States, Japan and other industrialised countries – to Asia. There, workers at scrap yards – some of whom are children – are exposed to a cocktail of toxic chemicals and poisons when the products are broken apart.

Given the rudimentary conditions of recycling that prevail in Asia, the problem of hazardous ingredients in electronics is exacerbated by the poor working conditions in the scrapyards, affecting the environment and health of thousands of people working there. A recent study simulating the type of primitive recycling operations prevalent found alarming levels of chlorinated and brominated dioxins in air emissions and ash during the burning of PVC cables and circuit boards containing BFRs[2]. Such informal ways of recycling in China have been shown to cause severe environmental contamination with BFRs as well as chlorinated and brominated dioxins, including the highest documented values of chlorinated dioxins found in ambient air in the world[3]. Evidence indicates this is leading to increased body burdens of chlorinated dioxins for residents of recycling areas[4].

From e-companies' own statistics[5] it seems that responsible recycling is undertaken only for a very low fraction of branded PCs (between 8.8% and 12.4%) and an even lower percentage of branded mobile phones (between 2% and 3%), meaning that more than respectively 88% and 97% of branded PCs and mobile phones escape from any kind of producer's responsibility. While some might be accounted for by attic or garage storage, much might be disposed of with mixed waste in landfills and incinerators if not exported for rudimentary recovery by Asian informal recyclers or for dumping in Africa.

The rate at which these mountains of obsolete electronic products are growing will reach crisis proportions unless electronic corporations that profit from making and selling these devices face up to their responsibilities.

image Longgang, China – a worker sorts through a pile of e-waste. Much of modern electronic equipment contains toxic ingredients. Vast amounts are routinely and often illegally shipped as waste from Europe, the US and Japan to countries in Asia as it is easier and cheaper to dump the problem on poorer countries with lower environmental standards.

This unacceptable situation reflects both the lack of brand responsibility laws allowing e-waste to escape a more sophisticated management and the lack of brand consideration for green design, shifting a toxic burden of chlorinated, brominated and other hazardous substances on downstream recyclers.

image Nanyang, China - workers dismantle a pile of electronic circuits.

E-waste – ‘not in my backyard’

The UN estimates that some 20 to 50m tonnes of e-waste are generated worldwide each year, comprising more than 5% of all municipal solid waste. The quantities of e-waste generated are predicted to grow substantially in the future both in industrialised countries and in developing countries, which are expected to triple their output of e-waste by 2010[6].

Not in the EU backyard

The United Nations University’s latest estimate of current waste electrical and electronic equipment arising across the EU Member States is between 8.3 and 9.1m tonnes for 2005, while the estimated amount currently collected and treated is allegedly some 25% of that, leaving a ‘hidden flow‘ of 75% remaining to an unknown fate.

The total amount of waste electrical and electronic equipment arising in the EU is predicted to grow annually between 2.5% and 2.7%, reaching about 12.3m tonnes by 2020[7]. While producers in the EU have been made responsible for dealing with e-waste under new regulations, and e-waste exports fall under shipment regulation banning its export to non-OECD countries, evidence shows that such export is still happening – by either illegal means (trafficking), through regulatory loopholes or under the pretext of reuse and charity donations to developing countries.

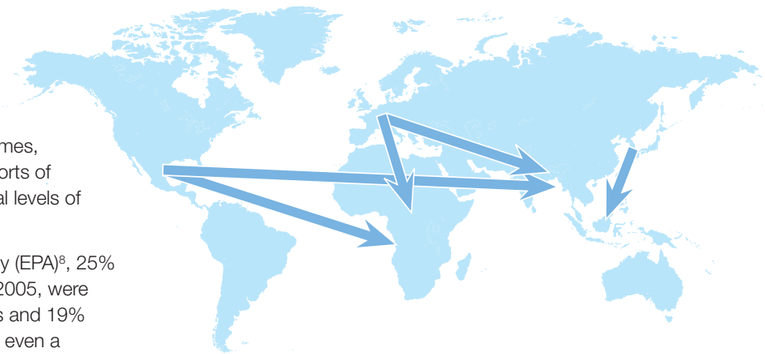
Somebody else’s backyard

For non-OECD countries such as China and India with large informal recycling sectors, it is simply not possible to even estimate the percentage of the hidden flow of e-waste. In these rapidly industrialising countries the demand for the recovery of valuable raw materials, as well as cheap labour, feeds the import of e-waste from developed countries, which adds to the growing domestic e-waste problem. In India, 99% of domestic and imported e-waste is estimated to end up in the informal recycling sector[9], with a high toll on health, safety and the environment and a rather poor rate of material recovery. Other regions are also under threat of illegal imports of e-waste, such as African countries where donations for refurbishment and reuse are simply a pretext for the dumping of non-repairable devices.

Hidden flows

- From the US to Africa/Asia: no laws, legal export
- From the EU to Africa: illegal export or under cover of reuse/donation
- From the EU to Asia: illegal export or under cover of recycling
- From Japan to South-East Asia: export under trade agreements

Not in the US backyard



The situation in the US is quite different. Despite certain US States implementing their own e-waste equipment initiatives and some of the major companies beginning to take producer responsibility by setting up voluntary take-back and recycling schemes, e-waste remains unregulated at the federal level, exports of e-waste to non-OECD countries are legal and national levels of collection are far too low to make an impact.

According to the US Environmental Protection Agency (EPA)[8], 25% of PCs, laptops and monitors reaching end-of-life in 2005, were collected for recovery in 2005, along with 13% of TVs and 19% of mobile phones. But without sound regulations and even a comprehensive data assessment, these figures are likely to be optimistic as the EPA’s definition of recovery includes exports of e-waste to developing countries, which is unacceptable. All in all, the hidden flow of e-waste escaping responsible recycling in the US may be as much as 80% or more.

image Delhi, India – a worker sorts rubbish in an electronic wastes recycling yard. The result of analysing dust from workshops such as this, as well as waste water, soil and sediment from local rivers, show conclusively that all stages in processing e-waste enable toxic chemicals to be released into the workplace and the surrounding environment.

© GREENPEACE / PRAKASH HATVALNE

It is possible to make clean, durable products that can be upgraded, recycled or disposed of safely and do not end up as hazardous waste in somebody else’s backyard.

image Guiyu, China – workers receive a truckload of electronic waste, including old laptops, keyboards, terminals and desktop computers.

© NATALIE BEHRING-CHISHOLM / GREENPEACE

image Nanyang, China – workers bake circuit boards from e-waste in a workshop. Workers and communities involved in dismantling e-waste are exposed to serious environmental problems and health hazard. Greenpeace is strongly urging major manufacturers to exclude toxic materials from their products.

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What you see…

Sales[10]

Mobile phones

In 2006 more than one billion mobile phones were shipped worldwide. In the emerging markets of India and Thailand, mobile phone sales were around 15.4 million and 21.7 million, respectively, in 2004-2005. By 2008 the number of mobile phone users around the world is projected to reach some two billion, and sales of mobile phones are rapidly increasing in emerging economies as well – it is estimated that over 150 million new mobile phones will have been sold in China alone during 2007.

Computers

In 2006, approximately 230 million consumer and business PCs were shipped worldwide. PC sales are growing globally (by 10.4% in 2006) – slowly in the US, Europe and Japan, but much faster in emerging markets.

In China and India, sales of PCs have risen by around 400% in the last five-to-six years, and an estimated 750,000 PCs and 550,000 monitors were sold in Thailand during 2004.

TVs

45.5 million TVs were sold in the period 2005 to 2006, a growth of 3% from the previous year. This was driven by fast market growth in China (17%) and North America (8%). In Thailand, an estimated 1.9 million TVs were sold in 2004. LCD (liquid crystal display) TVs are taking up a growing share of the market while the shift to digital TVs in western countries contributes to the renewal of a saturated market.

Game consoles

62.7 million units were sold in 2006. Growth of 14.9% in the year made it one of the fastest developing sectors in the field of electronic products. The market's volume is expected to rise to 80.6 million units by the end of 2011.

…and what you get

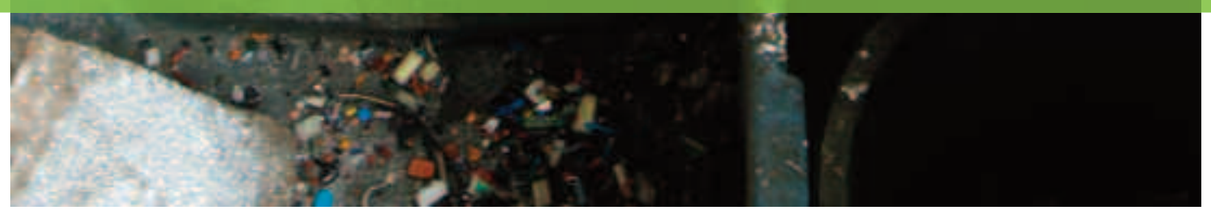
Hazardous chemicals in e-products

- Lead can be found in solders, although decreasingly, in the glass of cathode ray tube (CRT) monitors and as a stabiliser in PVC. Lead is highly toxic and exposure to lead can result in irreversible damage to the nervous system, particularly in children[11], which can lead to intellectual impairment.
- Mercury, used in lighting devices for most flat screen displays, can damage the brain and central nervous system, particularly during early development[12].
- Cadmium, used in rechargeable computer batteries, contacts and switches and in older CRTs, can accumulate in the body over time and is highly toxic, primarily affecting the kidneys and bones. Cadmium and its compounds are also known human carcinogens[13].
- Beryllium, used as a metal alloy in electrical contacts and as beryllium oxide in the semi-conductor industry, is a human carcinogen and inhalation of fumes and dusts can cause lung disease[14].
- Compounds of hexavalent chromium, used in the production of metal housings, are highly toxic and are human carcinogens[15].
- Some BFRs[16] used in circuit boards and plastic casings do not break down easily and can build up in the environment, and some BFRs are also highly bio-accumulative (build up in the body). Long-term exposure to certain polybrominated diphyenylethers (PBDEs) has been linked to abnormal brain development in animals, with possible impacts on learning, memory and behaviour. Some BFRs can also interfere with thyroid and oestrogen hormone systems and exposure in the womb has been linked to behavioural problems[17]. Incineration or any kind of burning of plastics containing BFRs can cause the release of persistent dioxins and furans[18].
- PVC is a chlorinated plastic used in some electronics products, including for insulation on wires and cables[19]. Although not directly toxic, PVC is a major source of pollution and chemical hazard at all stages of its life cycle. In its softened form (as found in cables), PVC requires the use of additives such as hazardous phthalates, including di(2-ethylhexyl) phthalate (DEHP) and di-n-butyl phthalate (DBP), which are known as reproductive toxins[20]. Incineration or any kind of burning of PVC can cause the release of persistent and toxic chlorinated dioxins and furans[21].

© SOPHIE GERRARD / GREENPEACE

image Mandoli, India – after being treated with hydrochloric acid to remove valuable copper, worthless acid-contaminated plastic circuit boards are dumped in a river.

The world's booming consumption of electronic and electrical goods has created a corresponding explosion in electronic scrap, much containing toxic and persistent chemicals.



Extended producer responsibility

The polluter pays

"Extended Producer Responsibility" means that the cost of waste management is incorporated into the product price, thereby enacting the 'polluter pays' principle. Producers either absorb the additional costs (evaluated at 0.1% of the price of a PC and 0.01% of a mobile phone), or increase the product price to take account of these costs. In a competitive market this will motivate producers to design more environmentally friendly products in order to lower the end-of-life costs. To be effective, such a programme should be aligned as close as possible to "Individual Producer Responsibility", meaning that each company pays for its own-branded discarded products.

Laws such as the EU Restriction of the use of certain Hazardous Substances (*RoHS*) Directive have proved useful but only tackle part of the problem. Extended Producer Responsibility and Individual Producer Responsibility programmes give additional incentives to companies to implement precautionary action, by designing out toxics above and beyond that which is currently required by law.

In recent testing of 18 laptops from different brands, Greenpeace was able to show that substitution of substances banned under RoHS has widely occurred without problems, while hazardous chemicals not regulated under RoHS were still present in all products[22]. However, the investigation found that for almost every type of component tested there were examples from among the 18 laptops that were free of PVC and BFRs, indicating the potential for the production of an entire laptop free from these harmful ingredients.

This means that substitution is possible and should be taken forward by the industry, while PVC and all BFRs should also be restricted by RoHS and other equivalent laws worldwide.

Legal Solutions in the EU

In the EU, from July 2006, six substances[23] are banned or restricted in products under the RoHS Directive. Greenpeace advocates RoHS should also cover, as a matter of urgency, PVC and all BFRs as well as other hazardous substances, including phthalates, beryllium and antimony.

The EU Waste Electrical and Electronic Equipment (WEEE) Directive makes producers individually and financially responsible, as of August 2005, for taking their e-waste back when their products are discarded. The WEEE Directive has been poorly implemented by half of the EU Member States – in this current state, it will not deliver the expected benefits in terms of design incentives. Greenpeace joined forces with positive business leaders to change this situation (see www.IPRworks.org).

Legal Solutions in the US

In the US, Greenpeace is working closely with local NGOs and progressive companies to get good individual producer responsibility legislation at federal level and defeat a lobby of (primarily) TV manufacturers, known as the ARF Coalition (Advanced Recycling Fee), wanting to shift the financial burden for dealing with e-waste onto consumers. This would force the US government to administer a collection and recycling program at the taxpayer's expense, and creates no incentive for the industry to develop cleaner designs.

Legal solutions in emerging economies

"Same products, same players, same responsibilities," is our philosophy. Although China has restricted hazardous substances in some electronic products and both China and Thailand have EU-type laws pending, they are the exceptions in the developing world. Several global mobile phone and PC companies are trying to avoid double standards by starting voluntary take-back and recycling programmes in those countries, but face the dual challenges of less-responsible brand competitors and the informal recycling sector. Designing an EPR legislative package tailored to the specificities of national situations is, for many reasons, not an easy task for developing countries. However, Greenpeace believes that the first steps can already be taken by governments in the form of RoHS-type legislation, bans on the import of e-waste (with the additional ban of export in OECD countries) and stricter controls on import for reuse.[24]

image Guiyu,China – a young girl displays a piece of e-waste. Workers at yards such as this one risk exposure to toxic ingredients when they break discarded electronic products apart by hand and under appalling conditions.

Greenpeace's recent testing of 18 laptops found that for almost every type of component tested there were examples that were free of PVC and BFRs, indicating the potential for production of an entire laptop free from these harmful ingredients.

image A laptop is dismantled to enable testing of individual components and materials for a range of hazardous substances, including heavy metals, BFRs and PVC.

Winds of change: what Greenpeace is doing

Greenpeace believes that manufacturers of electronic goods should take responsibility for the entire life-cycle of their products; from production, through manufacture and to the very end of the products' lives. We have been pressing leading electronics companies for change.

On 10 January 2007 at the International Consumer Electronics Show in Las Vegas, Michael Dell, Chief Executive Officer of Dell Inc., declared: *"Today, I challenge every PC maker to join us in providing free recycling for every customer in every country you do business, all the time – no exceptions."*

We are witnessing a massive improvement in the policies and practices of the major brands, and the race between companies for the greenest credentials is heating up. It is clear that companies are anticipating more detailed questions about their environmental standards during the next few years as businesses and consumers aim to purchase the most environmentally-sound electronic equipment.

On 2 May 2007, Steve Jobs, as a response to Greenpeace's GreenMyApple campaign, made an announcement about Apple's environmental aspirations : *"Our stakeholders deserve and expect more from us, and they're right to do so. They want us to be a leader in this area, just as we are in the other areas of our business. So today, we're changing our policy."*

However, this recent abundance of green statements runs the risk of companies taking only the easiest ways of green marketing, limiting the scope of initiatives or taking actions neither focussed on the whole production and supply chain nor greening the core activities of their business. The industry needs to gain for itself a better understanding of the full lifecycle of its products and innovate to reduce environmental impact implemented. Real, concrete steps in improving product design – substitution of toxic chemicals, and increased energy efficiency being introduced at the design stages - and responsible recycling practices need to be undertaken.

That is why, alongside direct actions to highlight that companies need to go green, Greenpeace has developed different campaign tools showing them how to go green, illustrating the relevant steps that need to be taken. The Greenpeace Guide to Greener Electronics, the GreenMyApple website and the 'Clash of the Consoles' website challenge brand leaders and channel their efforts in the right direction.

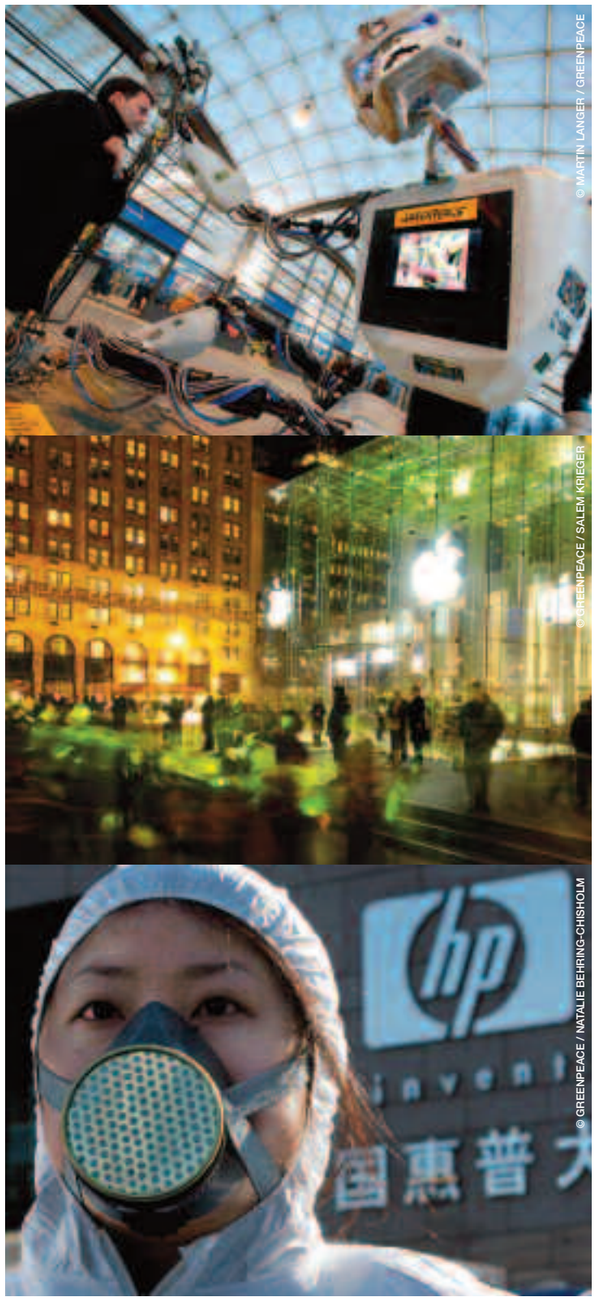


image 1 Greenpeace activists erect a giant robot made from electronic scrap at the entrance of the world's largest electronics fair, CeBit in Hannover, Germany.

image 2 The iconic Apple store on New York's 5th Avenue is bathed in green to highlight that Apple should go green too.

image 3 Greenpeace activists demonstrate against e-waste outside the Hewlett Packard (HP) Beijing headquarters.

GreenMyApple

Between September 2006 and May 2007, Greenpeace engaged the Apple fans' community through an interactive website based on Apple's own. GreenMyApple.com allowed Apple aficionados to express positively through creativity their wish to see their favourite company become a green leader at a time when Steve Jobs was still reluctant to compete in our ranking guide. As a result, on 2 May 2007 Mr Jobs committed to phasing out PVC and all BFRs by the end of 2008. GreenMyApple.org has won the 2007 Webby Award for the best activist site of the year.

Greenpeace Guide to Greener Electronics

Since August 2006, Greenpeace has been producing the 'Greenpeace Guide to Greener Electronics', which is updated on a quarterly basis. The Guide ranks 18 leading manufacturers of mobile phones, PCs and, as of its sixth edition, TVs and game consoles on their policies and practices on eliminating hazardous chemicals and on taking responsibility for their products once they are discarded by consumers.

The Guide aims at providing a useful tool for consumers willing to purchase greener products and support positive business while emulating a healthy and transparent competition between major brands to become green leaders.

Over a year of existence, the Guide has led many companies to embrace and promote the Precautionary Principle and Individual Producer Responsibility, to commit to substitution of the worst chemicals (starting with all PVCs and all BFRs) and to commit to global take-back of discarded products. Moreover, the Guide stimulates the increasing marketing of greener products and works as a watchdog to prevent corporate misbehaviours such as double standards, anti-environmental lobbying and other irresponsible practices.

Fuller details of specific companies' performance, and for each edition of the Greenpeace Guide to Greener Electronics, can be found at our website: www.greenpeace.org/rankingguide

Clash of the Consoles

Our investigations revealed that game console manufacturers – despite games consoles having components common to PCs, in which levels of hazardous chemicals are being reduced - have so far failed to achieve any progress in cutting back on the same substances in their products. We launched this mini-site at www.greenpeace.org/international/clashoftheconsoles/ in December 2007, to allow gamers to check how their favourite game console measures up and to urge the company that made it to commit to green production and taking responsibility for the products when they become obsolete.

What you can do: steps you can take towards helping to green the electronics sector

- Browse our campaign webpage on www.greenpeace.org/international/campaigns/toxics/electronics and engage with us in greening the electronic sector.
- Check regularly our 'Greenpeace Guide to Greener Electronics'; when buying electronic products, use the Guide to identify the makers of greener models available for purchase and to choose only manufacturers consistent in their efforts to green their act and who offer free take-back globally.
- If you're disappointed with your favourite brand's environmental performance, do let them know!
- When your device becomes obsolete return it to the manufacturers for them to ensure a sound waste management – if you face refusal, make a complaint and let us know what kind of response you receive!
- Talk to your friends and relatives about the dangers of toxic chemicals in electronic devices and the growing problem of e-waste – the more people who share your concerns, the more people will demand that producers live up to their responsibilities.
- Get involved! You can join our global community of online Greenpeace activists or use your own website or blog to spread the word, you can volunteer or work for us, make your life a little greener by following our tips for green living or you can share with us your own ideas. Details of how to do all of these things can be found on our website at www.greenpeace.org/international/getinvolved
- Or, you could donate to Greenpeace. We don't accept donations from governments or corporations, so the money needed to keep our campaigns running comes from people like you. Your support will make all the difference: www.greenpeace.org/international/supportus.

Further Reading: Greenpeace Reports

Apart from the Greenpeace Guide to Greener Electronics, we have also published several reports during the past year providing further information on toxic technology:

Toxic Tech: Not in Our Backyard
Published February 2008:
www.greenpeace.org/international/press/reports/not-in-our-backyard

Toxic Chemicals in Computers, Reloaded
Published October 2007:
www.greenpeace.org/international/press/reports/laptopreport2

Missed Call: iPhone's hazardous chemicals
Published October 2007:
http://www.greenpeace.org/international/press/reports/iPhones-hazardous-chemicals

Extended Producer Responsibility in a non-OECD Context
Published August 2007:
www.greenpeace.org/international/press/reports/extended-producer-responsibili

Cutting Edge Contamination: A Study of Environmental Pollution during the manufacture of Electronic Products
Published January 2007:
www.greenpeace.org/international/press/reports/cutting-edge-contamination-a

Other Campaigning Groups

- **On e-waste trade: Basel Action Network –** www.ban.org
- **On the social aspects of electronics: GoodElectronics (a coalition of NGOs and unions) –** www.goodelectronics.org
- **US Electronics Take-Back Campaign –** www.computertakeback.com
- **Indian NGO, Toxics Link –** www.toxicslink.org
- **Industry and NGO coalition on EU policies –** www.iprworks.org

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