

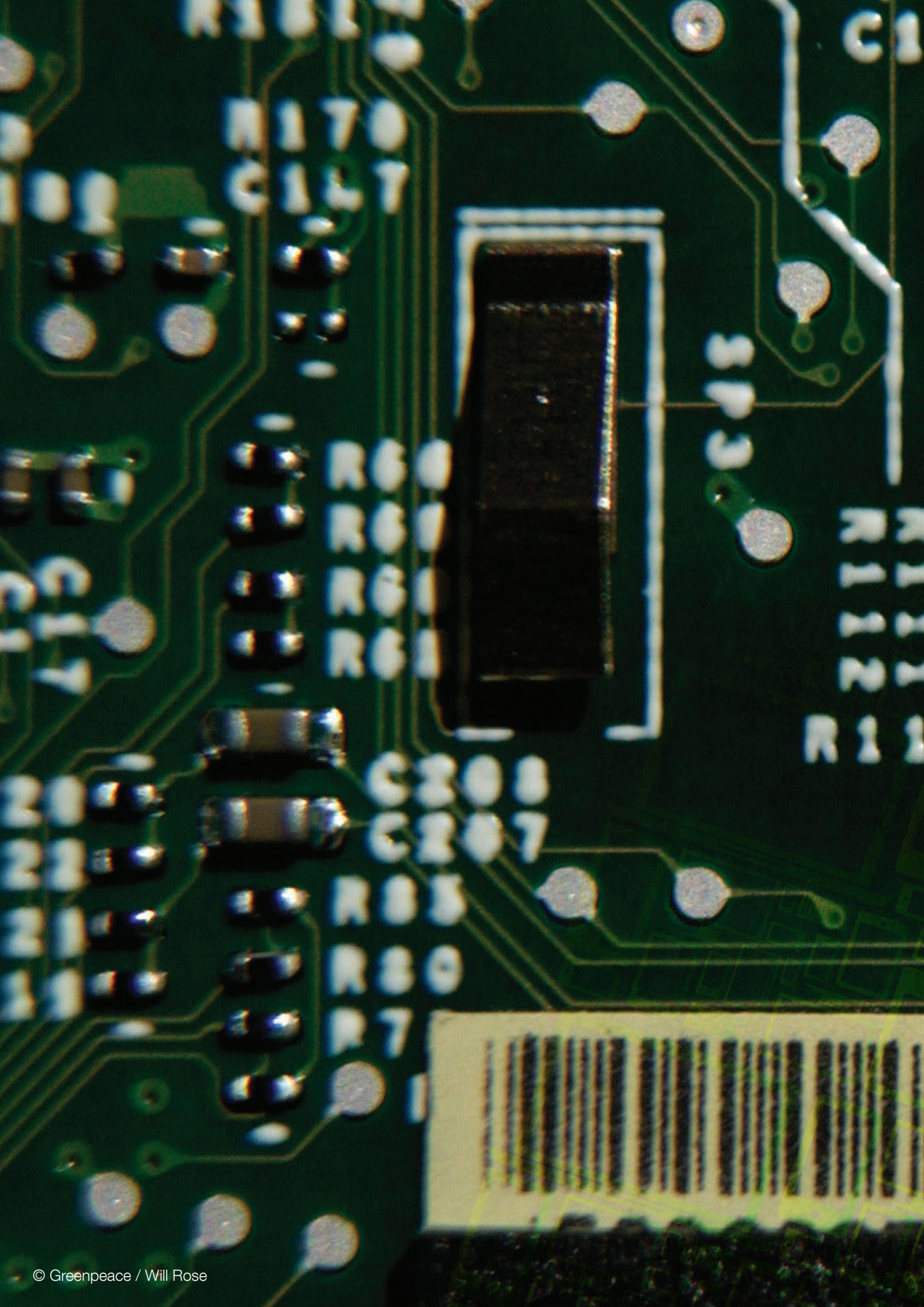


Green Gadgets: Designing the future

The path
to greener
electronics

September 2014

GREENPEACE



Menu



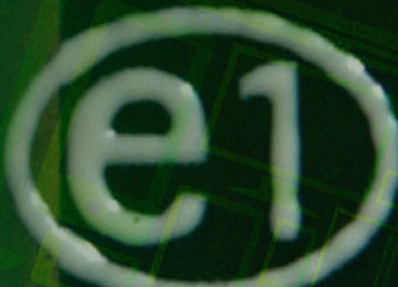
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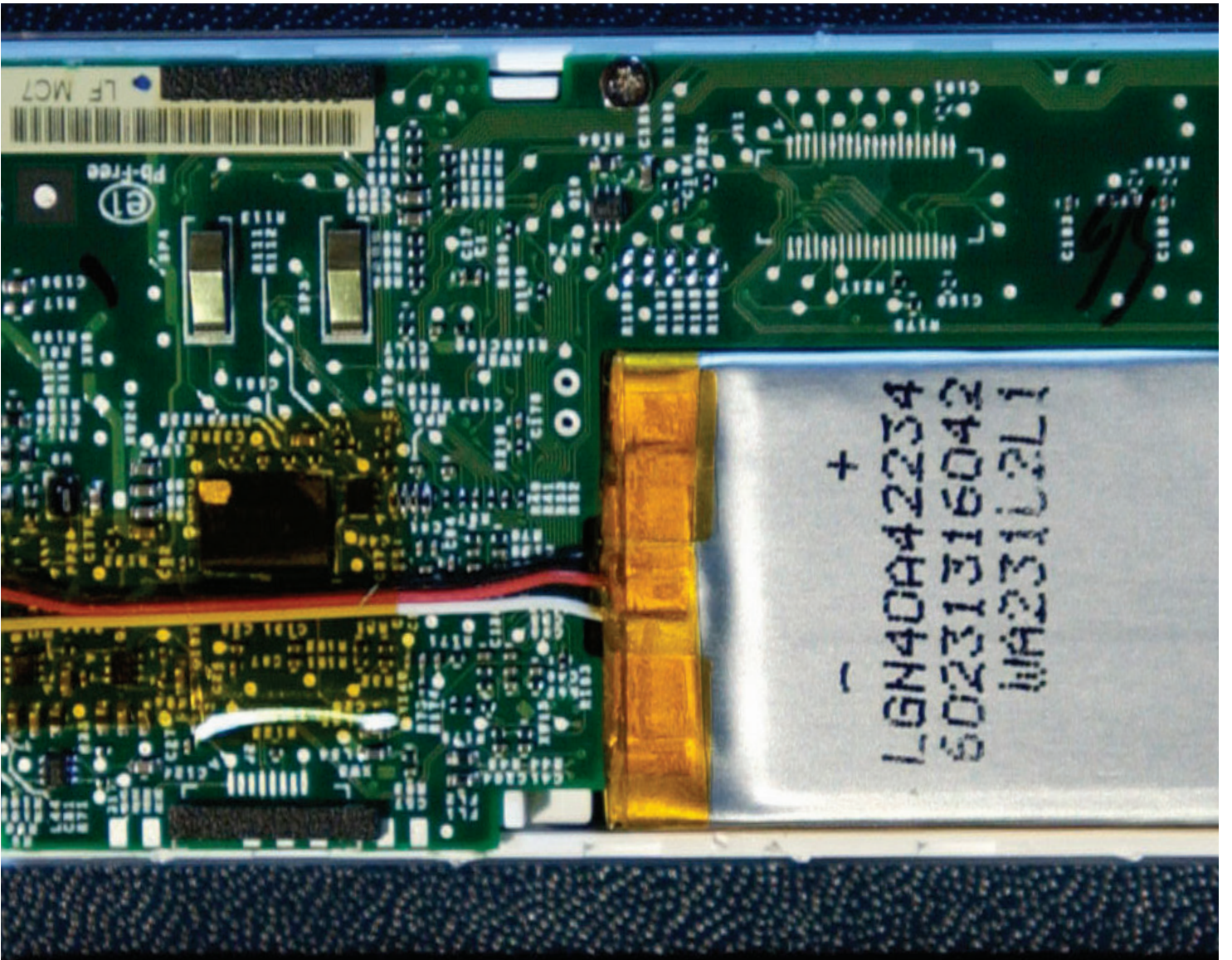
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Pb-Free







Executive summary

Today, more and more people around the world rely on laptops, phones and tablets as an essential part of their everyday lives. However, the rate at which they purchase and discard these devices is having a serious impact on our planet. There is an increasing demand for greener, longer-lasting electronic devices, and the industry has shown progress is possible. When companies apply their know-how and innovative spirit, change can happen, from increasing the energy efficiency of our devices to progressively eliminating the hazardous substances contained in them.

While the electronics industry has taken several steps in the right direction, crucial and growing problems remain. The massive quantity of dirty energy used in the manufacture of electronics – mainly by suppliers in East Asia – has not yet been properly addressed. While the elimination of the worst hazardous substances from products by leading electronics brands can be judged as a partial success, many major companies are still lagging behind. Large quantities of hazardous PVC are still used in electric cables for PCs and TVs in particular. These dangerous substances will remain in discarded e-waste for many years.

Toxic e-waste is predicted to grow to 65.4 million metric tons in 2017. The recycling of this e-waste becomes even more problematic when it is exported to countries in the Global South where dangerous backyard recycling often takes place, posing great health risks to the local communities. While electronic take-back programmes are growing, the speed of collection cannot keep pace with the rate of consumption. In 2013 alone 1.8 billion mobile phones were sold globally, and it is predicted that sales of the most popular gadgets (mobiles, tablets and PCs) will increase by 6% to almost 2.5 billion products in 2014. This worldwide growth in consumption is multiplying the environmental and human health problems associated with an electronics industry currently built on an unsustainable model.

Eliminating hazardous substances

Products

When talking of the products themselves, significant progress has been made on the phase-out of certain hazardous chemicals. Much of this has been in response to initiatives and campaigns by environmental and consumer campaigning groups – such as Greenpeace's campaign for Greener Electronics, including the successive editions of the *Guide to Greener Electronics*, first launched in 2006.¹

- There are now considerably more products free from the worst hazardous substances, compared to 2006.² More than 50% of the mobile phone market is currently represented by brands – led by Nokia, Sony Ericsson³ and Apple – that have completely eliminated the use of hazardous PVC plastic and brominated flame retardants (BFRs) in these products.
- In contrast, Apple is the only company that has eliminated the use of PVC and BFRs in all PC components, including external cables.⁴ Other PC makers continue to use PVC in cables and other external components, despite the fact that companies representing over 50% of the market have virtually eliminated PVC/BFRs in other computer parts.

-
- Currently, no TVs on the market are completely free from PVC and BFRs. Samsung, as one of the largest TV producers, has seriously compromised progress by dropping its previous commitment to eliminate these hazardous substances from its TVs.

The electronics industry needs to up its game in order to complete the elimination of PVC and BFRs from all of these product sectors, and in all components, with a priority on electric cables, representing a high volume use of hazardous PVC.

Recent market changes could also threaten the significant progress made so far on mobile phones. Manufacturers of low cost smartphones – such as Huawei, Xiaomi and Micromax – that are taking an increasing share of the market, urgently need to adopt plans to eliminate hazardous substances to ensure that the environmental progress made over the past five years is not lost.

Supply chain

The elimination of hazardous substances from the products themselves is the first step in addressing the wider problem of hazardous substance use across the supply chain.

Substantial concerns exist for many chemicals currently used in this industry, both for possible exposure in the manufacturing workplace and the potential environmental consequences following their release into waste streams. The electronics industry has yet to sufficiently address this challenge. The following steps are needed:

- **Transparency – from the product to the supply chain.** The principle of transparency is essential for the evaluation of company policies and practices. This must extend to supply chain emissions, with the disclosure of hazardous chemical discharges to wastewater for individual facilities.
- **Eliminate the use and discharge of ALL hazardous chemicals from supply chains.** The electronics industry needs to implement a credible, hazard-based approach⁵ to its supply chain emissions, building on its success in the phase out of hazardous substances from products. Together with transparency, this is the starting point for the progressive reduction and elimination of hazardous chemicals.



Reducing the energy footprint

A combination of public pressure and Greenpeace's campaigning efforts on climate and energy have also influenced the actions taken by electronics companies to address their energy footprint. There have been positive developments, notably, the adoption of policies and practices to reduce greenhouse gas (GHG) emissions during product manufacture. Despite some reductions in GHG emissions per device produced, the ever-growing demand means cumulative emissions from most companies – and the industry as a whole – continue to rise.

The rapid growth in the consumption of electronics devices in both developed and developing markets has led to increased energy demand for electronic manufacturing, mainly in East Asia. In this region, dirty coal power still dominates energy production and is the leading cause of climate change. To tackle this growing issue electronics companies must firstly address the lack of transparency about their greenhouse gas (GHG) emissions resulting from the whole lifecycle of their products. On the basis of this data, companies must then prioritise the following actions:

- Disclose greenhouse gas (GHG) reduction targets, which should include ambitious renewable energy use in their own operations and in their supply chains.
- Improve the energy efficiency of all products beyond the minimum legal requirements.
- Implement clear strategies for reducing GHG emissions and shifting to clean energy.
- Support proposed Clean Energy policies in regions where they have operations.

Currently, most of the leading electronics companies have only made incremental progress on all of these issues, with few standout examples of companies that are willing to put transformational energy goals and strategies in place.

Manufacturing

For all electronics companies, the biggest energy footprint comes from manufacturing, undertaken across several tiers of suppliers. One estimate is that mobile devices alone will produce 122 megatonnes of CO₂ (more than Belgium) by 2017, with over 60% of that total due to manufacturing.

Only a large-scale switch to renewable energy sources combined with aggressive energy efficiency targets can reduce the carbon footprint of electronics manufacturing.

- It is critical that companies that outsource electronics production to suppliers in China – such as HP, Dell and Apple – work with suppliers to encourage investment in renewable energy – such as large-scale on-site solar PV.
- The same approach also needs to be taken in Japan, South Korea and Taiwan, particularly by those electronics companies that also manufacture Solar PV technology such as Sharp, Panasonic, Samsung and LGE.
- Proactive and positive lobbying for clean energy policies by electronics companies – such as Acer's lobbying in Taiwan – is also necessary.

Using sustainable materials and reducing consumption

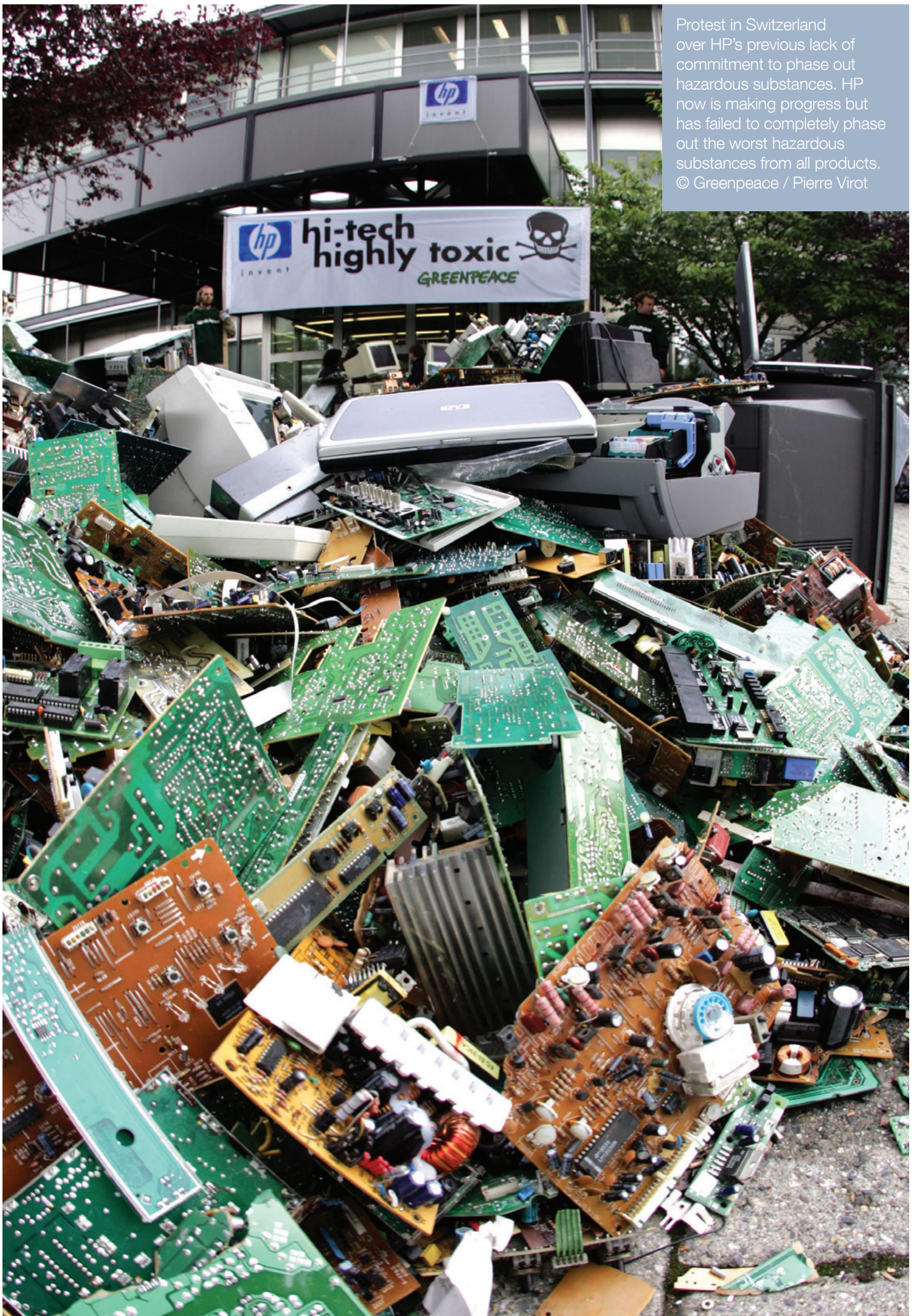
The consumption of electronic gadgets continues to grow, with ever-shorter replacement cycles based on the latest trend or model multiplying the lifecycle impact of hazardous substances and dirty energy. Alongside efforts to counter these two issues it is critically important that the raw materials used to make these products are sourced responsibly, packaging is sustainable and kept to a minimum, lifespans are longer, and end-of-life materials are re-used for new devices.

There are examples where electronics companies have made significant progress in all of these areas, from recycling the plastics used in their products, to avoiding illegally logged forest products and conflict minerals. However, the current manufacturing model for most electronics remains inherently unsustainable.

Ultimately, the industry needs to strive towards a more sustainable business model that will reduce the rate of consumption and waste resulting from new electronic devices. This new model should generate profits from services rather than the consumption of devices, while products should be made using resources that are continuously re-used within a closed-loop system.

Designing the future




The electronics industry has a crucial role to play to help bring about a renewable energy revolution, ensure a toxic-free future, protect the health of its workers, and prevent environmental pollution. However, the clean up of manufacturing methods or the elimination of hazardous chemicals in products and processing is only part of the solution. To ensure a credible response to these urgent environmental issues, major companies need to rethink the way that electronic devices are used and made in order to reverse the ever-increasing consumption of consumer electronics. As the demand for greener electronics from the public grows, companies should prove their ability to innovate, building on their progress so far and going beyond what we think is possible now. The electronics market is perfectly placed to lead the way towards a truly greener, more sustainable future.



Protest in Switzerland over HP's previous lack of commitment to phase out hazardous substances. HP now is making progress but has failed to completely phase out the worst hazardous substances from all products. © Greenpeace / Pierre Viot

Greener Electronics Campaign Timeline

2007

- ▶ **April** Version 3 *Guide to Greener Electronics*. Lenovo takes the top spot, Apple is now last.
- ▶ **May** Victory: Steve Jobs announces an end-2008 deadline to remove PVC and BFR from all new products. 
- ▶ **June** Version 4. Apple jumps to 10th place, Nokia regains lead.
- ▶ **July** Greenpeace study exposes alarming toxic contamination in Guiyu, China due to the disposal of electronic waste. 
- ▶ **October** *Missed Call: iPhone's hazardous chemicals*. Tests reveal presence of hazardous substances in iPhone. 
- ▶ **November** Version 6. TV and games consoles manufacturers Philips, Sharp, Microsoft and Nintendo are added to the Guide.


2005

- ▶ **January** Greenpeace launches the Toxic Tech Campaign, calling for real environmental leadership from the electronics industry.
- Sony Ericsson agrees to phase out toxic chemicals.
- Nokia releases the first PVC-free mobile phone.
- ▶ **August** Greenpeace releases the report *Toxic Tech: Recycling of Electronic Waste in China and India*, exposing toxic pollution to workers and the environment from recycling e-waste containing toxic chemicals. 

2006



- ▶ **March** HP commits to produce a phase-out plan for a range of hazardous chemicals in its products. 
- ▶ **June** Dell announces 2009 deadline to eliminate PVC and BFRs from all its products.
- ▶ **August** Samsung commits to phase out BFRs in all products by 2010, and PVC in all products by January 2011.
- ▶ **September** LGE states that all new models released in 2010 will be BFR free and that all remaining use of PVC will be phased out by the end of 2010.
- The first *Guide to Greener Electronics* is launched. Nokia and Dell share the top spot – Apple, Motorola and Lenovo are at the bottom.
-  Greenpeace launches the GreenMyApple campaign website, which receives over 100,000 visitors in the first three days.
- ▶ **December** Version 2 of the *Guide to Greener Electronics*. More companies make commitments, Lenovo and Acer commit to eliminate PVC and BFRs by the end of 2009.

2008

- ▶ **January** Version 7. Steve Jobs launches the new MacBook Air at Macworld, with BFR and PVC-free wiring.
- ▶ **February** Greenpeace releases the report *Toxic Tech: Not in My Backyard*, which exposes a highly dangerous and often illegal e-waste trail from rich countries to dumping in developing countries.
- ▶ **March** Greenpeace launches its first Product Survey of greener electronics, headed by Sony and Sony Ericsson products.
- Version 7. Samsung and Toshiba share the top spot
-  Greenpeace calls on Philips to take responsibility for its e-waste.
- ▶ **June** Version 8. *Guide to Greener Electronics* upgraded, adding criteria on climate change, the elimination of additional toxic chemicals and the use of recycled plastic in products.
- ▶ **August** Greenpeace releases the report *Poisoning the Poor - Electronic Waste in Ghana*.
- Greenpeace pressure helps to dismantle the Electronic Manufacturers' Coalition for Responsible Recycling (EMCRR), a regressive coalition of electronics companies.
- ▶ **September** Version 9. Nokia regains the lead as its penalty point is lifted due to improved take-back practice in India
- ▶ **October** Greenpeace calls on Philips to "Simply Take Back and Recycle" in Moscow
- ▶ **November** Version 10. Companies stall on real climate action.

2009





- ▶ **January** Greenpeace launches second Product Survey, *Greener Electronics: The Search Continues* at the Consumer Electronics Show 2009.
- ▶ **February** Philips sets ambitious take-back policies for electronic waste
-  Greenpeace tracks the journey of one television from a recycling center in the UK to a scrapyards in Nigeria.
- ▶ **March** Apple becomes the first company to eliminate all PVC/BFRs from its computing products (with the exception of power cords).
- Version 11. Dell, Lenovo and HP backtrack on commitments to phase out PVC and BFRs and receive penalty points.
- ▶ **July** Version 12. HP, Dell and Lenovo continue to be penalised for breaking promises..
-  HP called out for delaying its own deadline to eliminate toxic chemicals
- ▶ **September** Version 13. HP's penalty point is lifted following release of a PVC/BFR-free notebook, Apple opens up on carbon emissions, and LGE is served a penalty point for broken promises.
- ▶ **December** By the end of 2010 all new Sony Ericsson mobile phones and accessories will be completely free from PVC and BFRs.

2011

- ▶ **January** Greenpeace releases 3rd edition of Product Survey at the Consumer Electronics Show.
- ▶ **November** Version 18. HP takes the lead at 5.9 out of a possible 10 points, followed by Dell, Nokia and Apple.

2010

- ▶ **January** Version 14. HP is congratulated for releasing the first Windows-based desktop free from BFRs and PVC, Samsung is penalised for missing its deadline to phase out BFRs.
Nokia achieves its goal to phase out BFRs, CFRs and antimony trioxide in all new products.
- ▶ **March** Greenpeace carries out its "Samsung = Broken Promises" action, in response to the company failing to meet its commitments.
-  Greenpeace protests demand that Michael Dell sticks to his commitment to eliminate PVC and BFRs.
-  Indian companies Wipro and HCL launch PVC and BFR-free computing products, with a desktop from Wipro in January and a laptop from HCL in March.
- ▶ **May** Version 15. Dell continues to delay in phasing out PVC and BFRs. Toshiba is penalised for missing its phase-out deadline along with Samsung.
- ▶ **September** Philips releases industry's first PVC and BFR-free television in Europe.

2012

- ▶ **November** The 18th version of the *Guide to Greener Electronics* shows improvement on renewable energy investment and climate leadership from a number of companies, including Wipro.



Recycling dangerous e-waste by hand in China.

It is critical that all electronics companies phase out the worst hazardous substances in all products to enable safer and easier responsible recycling of electronics.

© Greenpeace / Natalie Behring



Hazardous substances and the electronics lifecycle

The threat to the environment and human health

The presence of hazardous substances in obsolete electronics (e-waste) leads to the release of these substances and their by-products during recycling and disposal. This is particularly problematic when e-waste is exported to countries where backyard recycling takes place. Greenpeace documented the e-waste problem in a 2005 investigation that exposed the disposal and recycling of electronic trash in Guiyu, China⁶, and also revealed the global scale of the problem⁷, with vast amounts of hazardous electronic waste unaccounted for. A 2013 UN study estimated that e-waste will grow from 48.9 million metric tons worldwide in 2012 to 65.4 million metric tons in 2017.⁸

The extensive use of hazardous chemicals in consumer electronics means that recycling workers, including children, are exposed to a cocktail of toxic chemicals and by-products. The presence of polyvinyl chloride (PVC) plastic and brominated flame retardants (BFRs) results in the release of highly toxic dioxins, among other hazardous chemicals, when scrap is burnt. Other examples of hazardous chemicals commonly used in electronics also pose a range of environmental and human health problems. Phthalates, used widely as softeners for PVC, migrate out of plastics over time. Some are classified as “toxic to reproduction” and are known to be hormone disruptors. Antimony trioxide is recognised as a possible human carcinogen; exposure to high levels in the workplace, as dusts or fumes, can lead to severe skin problems and other health effects. Beryllium and beryllium compounds, when released as dusts or fumes during processing and recycling, are recognised as known human carcinogens. Exposure to these chemicals, even at very low levels and for short periods of time, can cause beryllium sensitisation that can lead to chronic beryllium disease (CBD), an incurable and debilitating lung disease.

Greenpeace’s first campaign demand is for electronics companies to eliminate the use of these hazardous chemicals as a priority, with the initial focus on PVC and BFRs, to ensure that in the future, recyclers of e-waste will not have to deal with these toxic substances and their by-products. The second demand is for companies to take responsibility for their own obsolete products and ensure their collection and safe recycling.

Progress on hazardous chemicals: the leaders and laggards as of 2014

By 2010, a transformation had taken place with commitments to phase out PVC and BFRs from almost all of the **18 companies** Greenpeace evaluated in its *Guide to Greener Electronics*, and from **two Indian companies** in Greenpeace India’s version of the Guide. Fifteen of these commitments were considered credible, with a reasonable timeline. Similar commitments were also made to eliminate other **hazardous chemicals** – antimony and compounds, beryllium and compounds and phthalates, on slightly later deadlines.

Nokia, Sony Ericsson (now Sony Communications) and **Apple** were the first to implement their commitments, with the introduction of PVC and BFR-free products. In Apple’s case, public pressure galvanised by Greenpeace’s “Green My Apple” campaign helped lead to the company’s decision to phase out these hazardous substances on an ambitious timeline. The sector made the fastest progress on the introduction of PVC/BFR free mobile phones, followed by PCs. In contrast, progress on phasing out PVC, BFRs and other hazardous substances has been much slower for TVs and domestic appliances.



Mobile Phones		
Early movers, from 2008	★	Nokia, Sony Mobile Communications (formerly Sony Ericsson), Apple
Followers, now also PVC/BFR free	★	LGE, Samsung, Acer, RIM
Laggards	★	Panasonic

PCs and Tablets		
Early movers, from 2008, PVC/BFR free including cables	★	Apple
Followers – mostly PVC/BFR free, but all still use PVC in cables	★	HP, Dell, Acer, Wipro, LGE, Lenovo, HCL, Samsung, Toshiba
Laggards – continue to use PVC/BFR in some parts with no clear phase out plan	★	Sony, Panasonic

Televisions			
Early movers, 2010 – one product only	★	Philips launched the Econova LED-TV, the first (and only) PVC/BFR free TV	
TV brands still using PVC/BFR in certain components but showing credible progress	★	LGE	★
Laggards – continue to use PVC/BFR in some parts and have no credible phase-out plan	★	Samsung, Sony, Panasonic	★

Full details of individual product ranges and the extent of the company phase-out of PVC/BFRs are provided in Appendix 1. Details on the elimination of other hazardous substances (in particular antimony and compounds, beryllium and compounds, and phthalates) are in Appendix 2.

KEY

-   External power cables and other peripherals (eg. mouse, keyboards) are free from polyvinyl chloride (PVC) (green) or still made from PVC (red)
- ★ Products free of worst hazardous substances especially PVC and brominated flame retardants (BFRs)
- ★ One or more examples of whole product systems free from hazardous substances

- ★ Limited products free from hazardous substances, no whole product systems
- ★ No products free of the worst hazardous substances in this category

Market share of PVC/BFR free products

There are considerably more products that are free from the worst hazardous substances on the market today, compared to 2006, when no products were completely free of these substances.⁹ More than 50% of the mobile phone market is currently represented by brands that have completely eliminated PVC and BFRs from these products.

The picture for PCs is not quite as clear. All of the PC brands apart from Apple continue to use PVC power cables as well as PVC and BFRs in some minor components. If the PC market leaders completed the phase-out of PVC in power cables, over 50% of the market would be represented by companies whose products are virtually PVC/BFR free.

Unfortunately, this pattern does not hold true for TVs. Apart from a single example (the only completely PVC/BFR-free TV is the Econova LED-TV, which was launched by Philips in 2010¹⁰) there are no TVs on the market that are completely free from PVC/BFRs. Progress towards this goal has been seriously compromised by market leader Samsung, which dropped its commitment to eliminate these hazardous substances from its TVs. The only market leader with a credible plan is LGE, which continues to make reasonable progress on its programme to eliminate PVC/BFRs in TVs. Toshiba, with a much smaller market share, also remains committed to its plan to phase out PVC, BFRs and other hazardous substances by FY2015 from all of its consumer products, if alternatives are available – standing out as the only Japanese company to have made this commitment. Nevertheless, TVs from many companies have individual components that are free from PVC/BFRs, such as halogen-free internal wiring and casings.

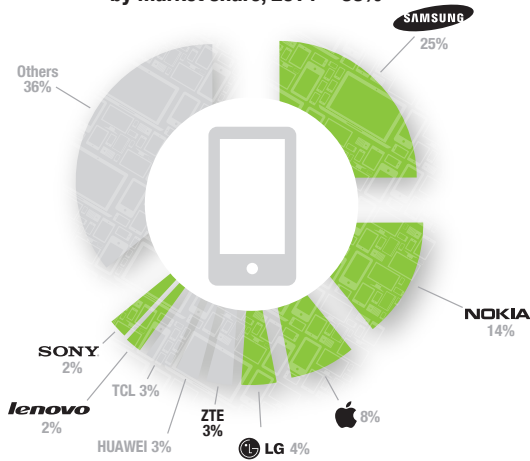
The following charts show the most recent market share of the leading brands for mobile phones¹¹, PCs¹², tablets and PCs combined¹³, and TVs¹⁴, highlighting those with PVC/BFR-free products, to a greater or lesser extent. This is a snapshot of the situation as it is now. The electronics market, however, is very dynamic, with new products and brands appearing all the time.



Old mobile phones are a recycling plant. Short upgrade cycles and aggressive marketing of new products leaves many working gadgets consigned to the scrap heap
© Greenpeace / Juraj Rizman

Figure 1: Market share of PVC/BFR free mobile phones, PCs, tablets and TVs

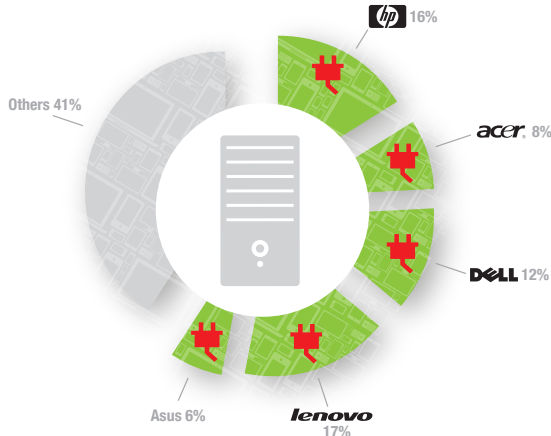
Mobile phones, percentage of PVC/BFR products by market share, 2014 = 55%



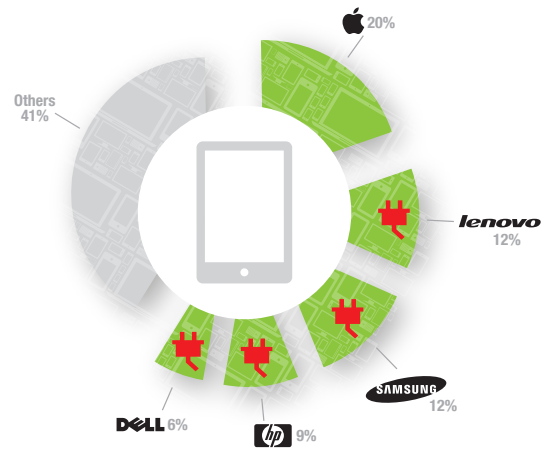
KEY

- Products are free from PVC/BFR
- Products are free from PVC/BFR apart from some external peripherals (eg cables, mice, keyboards)
- Products are partially free from PVC/BFR and phase-out is continuing
- Products are partially free from PVC/BFR but there is no confidence the phase-out is continuing
- No information

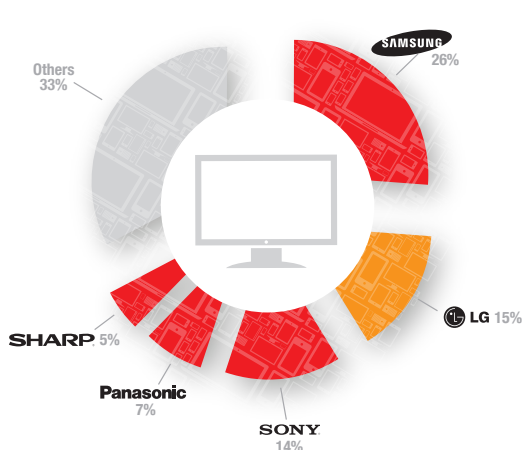
PCs, percentage of PVC/BFR products by market share, 2013



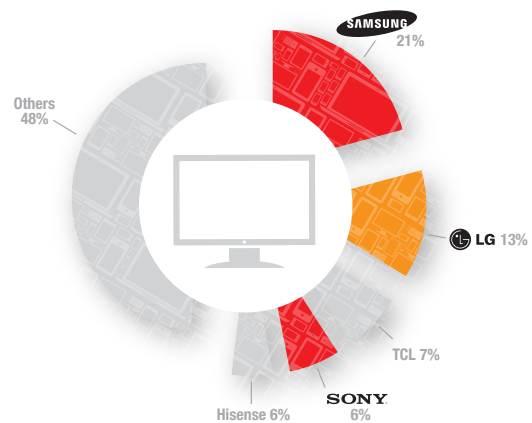
PCs including tablets, percentage of PVC/BFR free products, Q4 2013 = 59%



Global smart TV market share, percentage of reduced use of PVC/BFR in TVs, Q4 2013



Flat panel TVs global market share, percentage of reduced use of PVC/BFR in TVs, Q4 2013





Who met their commitments, who didn't, and challenges that remain

Leaders and implementers

In 2013, **RIM**, the manufacturers of the Blackberry smartphone, joined **Apple**, **Nokia** and **Sony Ericsson** as the only companies to act on their commitments to phase out PVC and BFRs in all of their products. Apple was also the first brand to phase out PVC/BFRs from its notebooks and PCs, and is still the only brand that has also phased out PVC/BFRs in external cables and other peripherals, despite difficulties in ensuring the adoption of new safety standards for PVC alternatives in power cables.¹⁵

Backtrackers and compromisers

As their deadlines for phasing out PVC/BFRs approached, several companies – HP, Dell, Lenovo, LGE, Samsung, Toshiba and Microsoft¹⁶ – backtracked on their original promises. New commitments were made after public pressure, with longer phase-out dates. In many cases, the companies reduced the scope of the products covered by their commitments, notably Samsung, which dropped its commitment on TVs. Other companies had already compromised on the scope of their commitments. Both HP and Dell's phase-out programmes are limited to computing equipment, and Sony does not include all BFRs. Panasonic's phase-out of BFRs is for mobile products only. Even worse, Sharp and Indian PC Company HCL now appear to have given up, and are not currently updating their progress on phasing out PVC, BFRs and other hazardous chemicals.¹⁷

In for the long haul

Within this muddy picture, a few companies remain committed and are working on credible plans to phase out PVC and BFRs from their entire product range: PC maker **Lenovo**, consumer lifestyle brand **Philips**, and **Toshiba**, which manufactures a wide range of consumer products. Also of note is the Indian company **Wipro**, which committed to remove PVC/BFRs from all its products and achieved this goal for a significant portion of its PCs before it sold its PC business.¹⁸ The global consumer electronics market has undergone large market-share shifts that have contributed to the mixed picture on phase-out progress. Explosive growth and the growing dominance of Apple and Samsung have pushed competitors such as Dell, HP, RIM, HTC and Acer into financial difficulties. Microsoft took over former mobile market leader Nokia, while Google bought Motorola and subsequently sold it to Lenovo. Microsoft and Amazon are gaining market share in the US tablet market.¹⁹ Low-cost Chinese companies are taking an increasing market share in the mobile market. Huawei has 7% of the global smart phone market, and newcomers Xiaomi and Micromax have seen huge growth in China and India respectively, taking over Samsung's market leader position during the second quarter of 2014 in the world's biggest smart phone markets.²⁰ It is currently unclear if any of these Chinese companies will follow best practice on hazardous substance phase-out, as established by other mobile manufacturers. Microsoft has dropped its previous commitment to PVC and BFR phase-out, and no longer has a commitment to eliminate these hazardous substances. Amazon is moving aggressively to expand its dominance of the e-reader segment to tablets, and most recently the mobile market with the launch of its Fire Phone in June 2014. Amazon fails to provide any public information on the environmental performance of its consumer electronics devices.

If the recent trend for rapid growth continues for low-cost smartphone makers, then it is critical that all consumer electronics makers adopt hazardous substance phase-out plans, to ensure that the environmental progress seen in the last five years is not lost.

Finishing the job – completing the phase out of hazardous substances from electronics

While such economic factors may have impeded progress towards the phase-out of hazardous substances, the electronics industry nevertheless still generates large profits, which should not be made at the expense of people and the environment. Clearly the technical barriers to phasing out PVC and BFRs have been mostly overcome. In 2010, the Industry Association INEMI published a timeline showing that halogen-free components for PCs (notebooks and desktops) would be widely available in the supply chain by the end of 2011, including the evaluation and qualification of parts for high performance printed circuit boards and power cords.²¹ Today, this transformation has largely taken place, apart from power cords, even though legislative barriers to using PVC alternatives for these have also mostly been overcome. Apple reports that only South Korea and India have not yet licensed PVC alternatives in power cables.

Electronics companies rated in the *Guide to Greener Electronics* have made significant progress phasing out specific hazardous substances from consumer electronics, most notably in mobile phones. However, this elimination programme still needs to be completed for both PCs and TVs. The continued use of PVC/BFRs in cables – a high volume use of PVC – and other peripheral accessories (keyboards, mice) is undermining what should be a success story for PCs. All of the main PC brands, apart from Apple, need to fulfil their commitments and complete the phase-out of these substances.

To encourage this process, several companies, notably Apple, HP, Dell and Acer, are actively lobbying for EU regulation to restrict the use of all BFRs and PVC, to level the playing field and enforce the need to eliminate these hazardous substances across the whole sector. As a result, the European Commission has listed PVC on its third level priority list for future restriction in its recasting of the RoHS Directive, although the problem of brominated and chlorinated flame retardants as a *class of hazardous materials* has still not been addressed.^{22,23} A recent review recommended that PVC should have the highest priority due to the volumes used.²⁴ Unfortunately, the slow legislative process means that the possibility of a restriction will not be on the agenda until 2018. The only responsible course to take in the present circumstances is for PC companies to anticipate the legislation and unilaterally eliminate the use of PVC in their power cords, or to collaborate together to do so.

Finally, a great number of other products still contain PVC, BFRs or other hazardous substances to an even greater extent, notably the high volume TV market. This is due to the lack of ambition by brands with a large market share, in particular market leader Samsung, which backtracked on its original commitment and no longer plans to eliminate PVC and BFRs in TVs. Real leadership is now needed by Samsung to transform this market and other product groups where it is a significant player, such as household electrical appliances (white goods).



E-Waste - voluntary take-back programmes

Electronics products are commonly recycled using rudimentary methods in the Global South. Due to the presence of hazardous chemicals in these electronics, this practice has led to significant environmental and human health impacts. The continued presence of PVC, BFRs and other hazardous substances is therefore a very real threat, in particular to the workers – some of whom are children – recycling our gadgets. The increase in the number of devices bought and sold only multiplies these negative effects.

Therefore, Greenpeace also monitored and encouraged the development of voluntary take-back programmes for a company's e-waste – implementing the principle of Individual Producer Responsibility whereby a company takes responsibility for its own end-of-life products.²⁵ The adoption of these programmes and the extent of their geographical coverage generally follows a similar pattern to the phase-out of hazardous substances, according to the different product types.

Companies have developed the most extensive take-back programmes for **mobile phones**, with comprehensive global systems in place from both Nokia and Apple. **PC** manufacturers also have developed relatively comprehensive take-back programmes, with Dell offering the most extensive system. In contrast, there are virtually no voluntary take-back programmes for **TVs** – a high volume waste stream – beyond the US, and some projects in India from LGE and Panasonic.

Of all the companies in the *Guide to Greener Electronics*, the highest recycling rate has been achieved by Apple, which consistently achieves a worldwide recycling collection rate of 85% of the total weight of the products sold seven years earlier, although this generic figure does not reveal the recycling rate for products with a shorter average lifespan, such as mobile phones.²⁶

Updates since November 2012 include:

- Blackberry's participation in a programme in Mexico;²⁷
- Philips actively setting up new take-back schemes in Africa, Latin America and Asia;
- Dell's new target, aiming to recover 2 billion pounds of used electronics as part of its "Dell 2020 Legacy of Good Plan".²⁸
- HP winning an award for an e-waste recycling project in Kenya that is reported as an example of how to build a unique, scalable and replicable model for sustainable recycling in the developing world; this project is part of HP's wider take-back programme.²⁹

Individual e-waste recycling projects should be in the context of a company's wider take-back programme, which should aim to take-back and recycle obsolete products wherever they are sold.

Once again, the biggest challenge on e-waste collection rests with the TV manufacturers. The relative lack of action on hazardous substance elimination in TVs is likely to mean that this waste stream will also contain greater quantities of PVC and BFRs, as well as being high volume by nature. In general, despite the growth of voluntary and government take-back programmes for e-waste, the speed of collection is not keeping pace with the rate of consumption, which is creating ever greater amounts of toxic e-waste, a challenge for all electronics companies.

Hazardous chemical use in the supply chain

Until now, companies have focused on the need to remove hazardous substances from consumer electronics products in order to address chemical pollution from recycling and disposal, including backyard recycling of e-waste. For some product groups, the phase-out of hazardous substances has been relatively successful. However, the electronics industry has not yet sufficiently addressed the challenge of reducing the environmental impact that results from the manufacture of their products.

How severe is hazardous chemical pollution from the electronics supply chain?

The manufacturing of electronics involves many suppliers, largely located in East Asia. This industry has high resource intensity, in terms of chemicals, energy and water demands. This is especially the case for printed wiring board (PWBs) and semiconductor chip manufacture. Processes used in both sectors are highly complex and chemically intensive; many of the chemicals employed do not form part of the final product (for example, solvents).³⁰ Substantial concerns exist for many chemicals used in this industry, both for potential exposure in the manufacturing workplace and the potential for environmental consequences following their release in waste streams. Particularly in China there are increasing reports of factories manufacturing electronics using toxic chemicals that can cause cancer (carcinogens such as benzene), nerve damage (neurotoxins such as n-hexane), and are suspected of causing birth defects and miscarriages.

Greenpeace has documented the release of hazardous chemicals into local waterways from the manufacture of electronics.³¹ Three sectors were investigated: the manufacture of printed wiring boards (PWBs); semiconductor chip manufacturing; and component assembly in industrial sites in China, Mexico, the Philippines and Thailand. Sample results revealed that some of the electronics industry's largest brands and their suppliers were contaminating waterways with a wide range of hazardous substances, including BFRs (such as polybrominated diphenylethers (PBDEs)) and phthalates. Groundwater aquifers at a number of sites, particularly around semiconductor manufacturers, were also found to be contaminated with chlorinated volatile organic chemicals (VOCs) and heavy metals.

A 2009 report, *Poisoning the Pearl*³² – based on seven months of fieldwork in the Pearl River delta by Greenpeace China – investigated five separate manufacturing facilities and/or industrial areas. Three of these facilities were printed circuit board manufacturers. Hazardous chemical pollutants that were found in effluent from these electronics manufacturers included brominated flame retardants, alkylphenol ethoxylates, phthalates and bisphenol-A. Two of the facilities were discharging heavy metals at concentrations in excess of the limits set by Guangdong province. Several of the facilities were also discharging various hazardous chemicals which are not monitored or regulated under Guangdong's effluent standards. The breaching of legal discharge limits by electronics supply chain manufacturers in China was also highlighted in a later study by BSR.³³



More research is needed today to learn the full extent of the use and release of hazardous chemicals – many of which are persistent, toxic or bioaccumulative – in the electronics manufacturing supply chain. This should also take into account the size of the electronics sector and the location of many suppliers in countries in the Global South, where regulations may not be as stringent as in Europe or North America. Companies should lead the way in investigating their own supply chains and revealing the results to their customers, so that they can begin addressing the problems.

In addition to impacts on workers, local communities living near some electronics manufacturing facilities suffer from pollution of their water and their air, with potential effects on the health of citizens and impacts on livelihoods such as farming and fishing, which depend on clean water. The textiles industry, which also uses and releases hazardous chemicals into waterways, is a useful example for comparison. Public pressure in response to Greenpeace's Detox campaign has resulted in increased transparency about the use and discharge of these chemicals by suppliers, which has been a necessary starting point to eliminating their use and release.

From textiles to electronics – supply chain transparency

Greenpeace's investigations into textiles found that, in spite of decades of regulation and corporate responsibility programmes, hazardous chemicals – including 11 priority groups, where some chemicals are already regulated³⁴ – continue to be used by supply chain manufacturers of clothes for many well-known brands.

So-called “acceptable” limits of these chemicals, set by regulations in some countries and adopted by many textile companies,³⁵ have allowed releases from a multitude of sources, from the manufacturing processes through to the final products.³⁶ For some of these chemicals this has resulted in their build-up in the environment, and in some cases their accumulation in animals and humans.

One of the actions taken by textile companies that committed to Detox was to implement the public's “Right to Know” about the chemical-by-chemical discharge from an individual supply chain facility used by a company. Once rejected by the textiles industry as unrealistic, a number of major fashion and sportswear brands have ensured the publication of data from their individual suppliers about discharges of hazardous chemicals, on the global online platform IPE.³⁷

Communities local to textiles manufacturers and the wider public have now begun to gain their “Right to Know” about pollution from these textile facilities. This is the starting point for the progressive reduction and elimination of hazardous chemicals into local waterways. The electronics companies now need to take up this challenge.

Transparency – from products to the supply chain

The principle of transparency is essential for the evaluation of company policies and practices in the *Guide to Greener Electronics*, based almost entirely on published information available on company websites that can be verified by anyone using the Guide. However, transparency now needs to extend to supply chain emissions, with the disclosure of hazardous chemical discharges to wastewater for individual facilities.

Currently, electronics companies do not report on their supply chain emissions in this way. However, there are examples of brands that report the emission of hazardous chemicals identified in national Pollutant Release and Transfer (PRTR) or Toxic Release Inventory programmes, which are applied to their operations worldwide.

- Sony: in countries where no legal reporting requirements exist for chemical management, Sony sites apply standards based on Japan's Pollutant Release and Transfer Register (PRTR) as internal rules. Compiled data is presented on its website.³⁸
- HP reports its chemical releases of TRI substances for its own operations worldwide, in the form of collective data, which also highlights the percentage releases by substance.³⁹

Unfortunately, individual facility data on emissions of hazardous chemicals from supply chain facilities does not appear to be available, but these examples do demonstrate that both HP and Sony already have credible systems and data that should allow the disclosure of hazardous chemical releases from individual facilities. Like the textile brands, transparency will need to be the first step in addressing pollution from supply chain facilities in a manner that customers can trust.

Box 1: Detox basics for electronics

An **effective, credible Detox commitment and action plan** – aiming at zero discharges of hazardous chemicals – consists of commitments and actions under three headings:

- core principles;
- transparency; and
- elimination.

An adequate approach needs to be hazard-based, comprehensive and include credible definitions for the “**Precautionary Principle**”,⁴⁰ zero discharge of hazardous chemicals, individual corporate accountability,⁴¹ and the public's “**Right to Know**”⁴² about the use and discharge of hazardous chemicals from a company's supply chain facilities and their presence in the final product. Together, a commitment to these principles frames the practices that are necessary to progress toward zero hazardous chemical use.



Implementing a Detox programme for electronics

Restricting Substances for use in manufacturing

Eliminating hazardous chemical use and discharges in the electronics supply chain is a new challenge. However, the restriction of substances of use in factories is not new to the electronics sector. As well as restricting the presence of hazardous substances in products, some electronics companies also identify restricted substances for manufacturing, or specify “no use” on their Restricted Substances Lists (RSLs).

For example, Panasonic publishes an extensive Restricted Substances List for Manufacturing (M-RSL). Its list of hazardous chemicals used in factories that are prohibited or for “reduction” shows the quantity and variety of hazardous chemicals used in the manufacture of electronics: out of a total of 4,931 substances, 771 are prohibited, with 3,626 for reduction.⁴³ Such an extensive list – together with the large number of regulations covering hazardous chemicals in electronics (in the EU and elsewhere), and the results from Greenpeace’s sampling of effluent from electronics manufacturers (above) – shows the scale of the potential hazardous chemical pollution problem from electronics manufacturing facilities. The publication of such RSLs on the use of hazardous chemicals in manufacturing is the critical first step to addressing the problem in a credible manner.

In a welcome move, Apple recently published its “Regulated Substances Specification” for the first time, which describes its global restrictions on the use of certain chemical substances or materials in its products, accessories, manufacturing processes, and packaging. Other progressive electronics brands – for example Nokia, which has an extensive product RSL but has not yet published its M-RSL⁴⁴ – also need to be more transparent about their policies and practices on the restriction of hazardous chemicals in their supply chains.

Hazard, the Precautionary Principle and identifying new substances of concern

A credible approach to selecting and rapidly acting on hazardous chemical elimination is “hazard based”. Such an approach considers the intrinsic or inherent properties of hazardous chemicals – such as toxicity, persistence, and ability to bioaccumulate, cause cancer or disrupt the endocrine system⁴⁵ – as the only basis for immediate action to eliminate them. An important component of this hazard-based approach is to act on the basis of the Precautionary Principle to avoid the use of and exposure to intrinsically hazardous chemicals, where there are legitimate reasons for concern. The use of a thorough and credible screening methodology such as GreenScreen⁴⁶ is necessary to identify future substances of concern for action. PC manufacturer HP already implements this hazard-based approach in its use of GreenScreen, for example, as a tool for alternatives assessment when replacing a restricted substance.⁴⁷

Box 2: When zero is not zero

To achieve zero discharges it is necessary to eliminate the use and release of hazardous chemicals to the greatest extent possible, according to best current testing technology.⁴⁸ This needs to be clearly applied both to hazardous chemicals remaining in products and those used and released from manufacturing processes, and is being implemented by certain textile brands, such as Mango. In contrast, electronic products described as “PVC/BFR-free” and “halogen-free” could contain BFRs and chlorinated chemicals at unacceptably high levels, according to company RSLs.⁴⁹ Greenpeace does not accept such levels of halogens in materials that are misleadingly defined as “halogen-free”, which could even exceed the legal limits for certain BFRs specified by the European RoHS Directive.⁵⁰

Although these are considered to be “low” levels, significant quantities of halogenated chemicals will ultimately be released to the environment – both from products and in the production process – when they are multiplied many times over by the large volume of consumer electronics that are produced and disposed of. Full elimination of PVC, BFRs and other hazardous chemicals from electronics products requires much lower permissible limits. The same principle applies to supply chain emissions during their manufacture. Zero is the goal and zero also needs to be implemented and verified, to the lowest possible detection limit.

It is not acceptable for supply chain pollution to remain hidden due to a lack of transparency. Local communities living with the impacts of pollution have a right to know what is being released into their local environment, as do users of electronic products, even if they are a long way away. Companies will need to develop comprehensive and credible plans to clean up their supply chain, starting with the disclosure of the hazardous chemicals used and discharged.

The wide range of hazardous chemicals that are used in the complex electronics supply chain may appear to be an obstacle for these giant companies. However, the example of the textiles sector shows that there can be a shift toward clean production with ambitious timelines for eliminating the use and release of hazardous chemicals in manufacturing. The concrete steps taken by some textile companies to publish data on supply chain emissions to waterways and their progress on the elimination of hazardous substances shows that it is possible. It is not only the environment that benefits from non-polluting production; removing hazardous chemicals from production would lead to immediate improvements in workers’ safety and in the livelihoods and health of local communities. Apple’s recent decision to update its restrictions on benzene and n-hexane, to explicitly prohibit their use in final assembly processes, shows the power of global brands to demand a toxic-free supply chain.

Electronics manufacturing is a significant contributor to severe pollution of rivers in China.
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Renewable energy, especially wind and solar power are growing rapidly in China and Japan. To reduce the carbon footprint of all electronics it is critical electronics companies use more renewable energy during production.
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Electronics and climate change

Progress on sourcing clean energy

Consumer electronics have a large energy footprint throughout their lifecycle – from resource extraction and energy intensive manufacture, to electricity consumption during use. The rapid growth of electronics consumption in both developed and developing markets has led to increased energy demand for electronic manufacturing, mainly in East Asia, where dirty coal power still dominates power production and is the leading cause of climate change.

Individual devices are becoming more efficient during use, especially TVs, and as a result of the trend for laptops and tablets to replace desktop PCs. However, continued growth in the number of electronic devices people own has resulted in the overall energy demand for devices continuing to grow in most countries despite those gains. In 2013 alone, 1.8 billion mobiles were sold globally, and it is predicted that sales of the most popular gadgets (mobiles, tablets and PCs) will increase 8% to almost 2.5 billion products in 2014.⁵¹ In the UK, an Energy Saving Trust report found that UK households possessed an average of 41 electrical products in 2011, up from 13 in the 1970s.⁵² American homes gained almost one billion extra electronic devices between 2010 and 2013. Efficiency gains reduced the cumulative power demand but the study excluded the energy required to manufacture these one billion devices.⁵³ The 14 billion electronic devices in the world today are still wasting the equivalent electricity consumption of the UK and Norway combined due to inefficient technology.⁵⁴

UNEP estimates e-waste at 48.9 million metric tons in 2012, approximately 7kg for every person on the planet, and is predicted to grow 33% by 2017.⁵⁵ Embedded energy from manufacturing is lost when e-waste is dumped, and resources are wasted that are far more energy intensive to extract as raw materials than they are to recycle.

To address this growing climate impact, electronics companies must firstly address the lack of transparency on their greenhouse gas (GHG) emissions resulting from the whole lifecycle of their products. On the basis of this data, companies need to then prioritise the following actions:

- Disclose greenhouse gas (GHG) reduction targets, which should include ambitious renewable energy use in their own operations and in their supply chains.
- Improve the energy efficiency of all products beyond the minimum legal requirements.
- Implement clear strategies for reducing GHG emissions and shifting to clean energy.
- Support proposed Clean Energy policies in regions where they have operations.

Currently, most of the leading electronics companies have only made incremental progress on all of these issues. There is increased transparency from some companies on reporting of GHG emissions from their own operations, and the beginnings of progress on reporting supply chain emissions, known as “scope 3 emissions.” Most companies have improved their reporting on the energy efficiency of their products, to show

the percentage of a company's products that exceed the minimum Energy Star standards. However, there are few stand-out examples of companies who are willing to put transformational energy goals and strategies in place. Indian company Wipro led the field on energy in the November 2012 Guide, with high reduction targets and ambitious renewable energy use, especially given the low levels of renewable energy currently available in India.

Most leading electronics companies rely on other companies to make their products, so the biggest environmental benefits will come from using renewable energy to reduce the huge carbon footprint of electronics manufacturing, which is mostly concentrated in East Asia. In Japan alone, electronic manufacturing generated 15,850,000t-CO₂ (on average in 2008-2012), accounting for 1.24% of Japan's total CO₂ emissions, increasing 43% since 1990.⁵⁶

Supply chain carbon footprint

For all electronics companies, the biggest energy footprint comes from manufacturing, undertaken by several tiers of suppliers, which are often not owned by the company. One estimate is that mobile devices alone will produce 122 megatonnes of CO₂ (more than Belgium) by 2017, with over 60% of that total due to manufacturing.⁵⁷ Apple's 2012 carbon footprint was 33.8 million metric tonnes, with nearly 70% coming from manufacturing.⁵⁸ Apple has started to address the issue of renewable energy use in its supply chain by announcing that its new US factory for iPhone glass screens will be powered by 100% renewable energy from solar and geothermal power.⁵⁹

Some companies have also made progress by disclosing the carbon footprint of specific products, but most have yet to adopt carbon footprint reporting across their product ranges. Comparisons of product carbon footprints between similar products from different companies are impossible. Some companies either do not disclose the methodologies used for their calculations, or the number of models with carbon footprints that are externally verified against publicly available standards is too low. Samsung reports that only 23.9% of its 2012 GHG emissions of 47.6 million metric tonnes comes from manufacturing with 54% from product use, compared to 22% from Apple product use. This shows how a lack of common industry-wide reporting standards contributes to inconsistent data on the GHG impact of electronic manufacturing.

The combined GHG emissions from manufacturing reported by Apple (2013) and Samsung (2012) totals 35 million tonnes, equivalent to the GHG emissions from Slovakia in 2010.⁶⁰





More comprehensive disclosure of product carbon footprints would help inform customers about the impact of electronics products across their entire lifecycle. Figures vary, but up to 80% of the carbon footprint of a mobile phone comes from manufacturing (iPhone 5s 83%⁶¹, Samsung Note2 79%⁶²). Samsung's limited public disclosure of specific carbon footprints shows that 69% of GHG emissions from the Galaxy Note2 come from its manufacture. Samsung does use external standards, such as the UK Carbon Trust, but it needs to expand beyond the handful of product carbon footprints currently available. The limited data currently available underlines the need for all companies to implement comprehensive plans to reduce the carbon footprint of products during manufacture.

Apple is currently one of the only companies to publicly disclose the carbon footprint of all its products. Apple needs to publicly disclose the methodology it uses to spur more disclosure and progress across the industry. Only with a dramatic increase in the transparency and scope of product carbon footprinting will the industry be able to meet the challenge of significantly reducing all product carbon footprints.

HP's policy, requiring all suppliers to reduce emissions by 20% by 2020,⁶³ is one of the few current examples of a company addressing the biggest source of GHG emissions from electronics.

The elephant in the room: electronics manufacturing's carbon footprint

The majority of electronics manufacturing is outsourced by major consumer electronics companies to less well known manufacturers. Hon Hai Precision Industries (Foxconn), Quanta, Compal, Wistron and Flextronics are some of the biggest electronics manufacturing service companies, with the majority of production in mainland China.

Electronics manufacturing is highly resource- and energy-intensive. In China, that energy comes from an electricity grid dominated by coal, contributing to the high carbon footprint of electronics devices. In 2005, it was estimated that electronics exports accounted for 22% of China's GHG emissions due to exported products.⁶⁴ The lack of more comprehensive recent data on GHG emissions from the global electronics sector underlines the need for more transparency from the industry on the impact of its GHG emissions and its strategy for reducing overall emissions.

The electronics supply chain is making energy efficiency gains, but the increasing demand for electronics products, driven by ever shorter upgrade cycles, continues to drive absolute emissions higher. Only a large-scale switch to renewable energy sources combined with aggressive energy efficiency targets can reduce the carbon footprint of electronics manufacturing.

Until 2012, any company plugging into the grid in China had no choice over its source of power. However, the Chinese government is now acting to cap the growth of coal power in key regions to tackle its air pollution crisis, and is introducing ambitious renewable energy targets to transition China's electricity generation toward clean energy. In 2013, China increased its solar target to 35 GW by 2015 and enacted new policies to allow private solar installations to connect to the grid and achieve attractive economic terms for the power they generate. In 2014, the solar target has been increased to 70 GW by 2017.⁶⁵ These changes represent a crucial opportunity for consumer electronics companies and major suppliers in China to invest directly in clean energy and slash their growing energy bills. Among the companies ranked in the Guide, Lenovo is the only electronics company currently using solar PV in China on a trial basis at its Shanghai factory. This PV installation provides 10-15% of the annual electricity consumption of the Shanghai factory,⁶⁶ an amount that needs to increase but is a step in the right direction for the industry. Huawei has a 4 MW solar rooftop on its Dongguan Campus in China, which reduced emissions by 3,228 tonnes in 2013.⁶⁷ Huawei has plans to expand solar rooftops to other company sites, but all electronics companies need to match business growth with ambitious expansion of renewable energy use.

All companies that own electronics production facilities in China should invest in large-scale on-site solar PV, which has huge potential to reduce carbon emissions from manufacturing and significantly reduce demand for polluting coal power, one of the main contributors to China's deadly air pollution. Companies like HP, Dell and Apple that outsource manufacturing can play a crucial role by requiring Chinese suppliers to increase use of solar and other renewable energy sources.



Asian solar tigers?

Beyond mainland China, significant electronics manufacturing also occurs in Japan, South Korea and Taiwan. New opportunities for sourcing renewable energy are growing in Japan as solar and wind power expand to partly fill the gap left by the majority of Japan's nuclear reactors being shut down since the 2011 Fukushima disaster. Solar PV is growing particularly fast; Japan was the second biggest solar market behind China in 2013, with 7.04 GW installed.⁶⁸

Electronics manufacturing was responsible for 1.24% of Japan's GHG emissions in 2012. Solar could provide a growing portion of the industry's electricity requirements and reduce GHG emissions. Despite Sharp being the third largest global supplier of PV modules globally in 2013 and Panasonic being in the top 20,⁶⁹ no Japanese electronics company has yet set ambitious renewable energy goals for its own manufacturing. Energy market liberalisation in 2016 is likely to provide more choice for companies to source renewable energy in Japan, beyond the current regional utility monopolies that are heavily reliant on nuclear power.

South Korea and Taiwan are lagging behind China and Japan in promoting renewable energy uptake to reduce emissions. In South Korea, Samsung and LG Electronics both operate solar PV manufacturing businesses. By using their own solar PV, both companies could significantly reduce the carbon footprint of their products and provide a powerful example of the change to a renewable energy future that's crucial to reducing South Korea's GHG emissions.

Major Taiwanese manufacturer Acer is one of a group of companies who successfully pushed the Taiwanese government to introduce a green energy tariff for businesses, an example of the positive lobbying for clean energy that electronics companies need to do. This scheme, which is not yet available, will allow companies to pay a premium to purchase renewable energy from the national power company. For that programme to truly add new renewable energy to Taiwan's grid, it must demonstrate the principle of additionality, meaning that funds from participating companies must go directly to finance renewable energy projects that would not otherwise be able to be developed. Launched in July 2014 for a three-year trial, it is critical that Acer, as a large electricity consumer, makes full use of this new renewable energy purchasing opportunity and advocates to improve the scheme.

Electronics companies and the industry as a whole need to undertake more comprehensive research in order to fully understand the GHG emissions and energy consumption of electronics manufacturing in East Asia. This would provide more accurate information and highlight priority options to reduce emissions from making the gadgets we use every day.



Short product lifespans and aggressive promotion of new products continues to increase consumption of electronics products.
©Greenpeace / Will Rose



Using sustainable materials and reducing consumption

Built to last? Extending lifecycles and re-using resources

Sales of the most common consumer electronics (PCs, tablets and phones) are projected to reach 2.5 billion units in 2014, up 6.9% over 2013.⁷⁰ Electronics companies sold 226 million TVs globally in 2013.⁷¹ In addition to the hazardous substances and energy required to make these billions of devices every year, it is critically important that raw materials are sourced responsibly, packaging is minimised and sourced sustainably, lifespans are longer and end-of-life materials are reused for new devices.

Use of recycled plastic

Using post-consumer recycled plastic is one way of “closing the loop” and ensuring that resources recovered from waste products are used in new products. Such recycling is more difficult if waste plastics are contaminated with hazardous substances, therefore companies that aim for product sustainability need to design out hazardous substances and ensure minimal residual contamination of products, to the best available testing technologies.

Some companies report on their use of post-consumer content (PCC) recycled plastic as a way of reducing waste from obsolete products, saving energy used for raw materials processing and moving towards a more circular production cycle. There are many technical challenges to using PCC recycled plastic, but Lenovo has consistently led the way on this issue and currently reports that from March 2013 100% of its products contain at least 5% PCC recycled plastics relative to total plastics weight.⁷²

Product lifecycle

The durability of our products, and the rate at which we replace them, is critical to their environmental impact. Greenpeace and others have urged companies to give greater consideration to the durability of their devices, including streamlining of devices, re-usability and ease of repair, and many customers have echoed those demands. As evaluated in the *Guide to Greener Electronics*⁷³, many companies do not publicly disclose the length of warranty and spare parts availability for their main product lines to enable a fair assessment, with a particular lack of information from Wipro, Nokia, Acer, Dell, Sony, Philips, Sharp and RIM. Since this evaluation Philips has provided Greenpeace with more information on its warranties⁷⁴ and includes product “lifetime reliability” as one of its “Green Focal Areas”.⁷⁵ The two companies that stand out for providing slightly more information on warranties and examples of products designed with product lifecycle in mind are Panasonic and Samsung.

Sourcing of sustainable raw materials – forests, conflict minerals

Forests – sourcing of fibres

The destruction of rainforests is a critical issue for the protection of our climate as well as for biodiversity. Greenpeace evaluates companies on their paper-sourcing policy, with the requirement to prohibit the use of fibre from rainforest sources,⁷⁶ by excluding suppliers that are involved in deforestation and illegal logging as well as reducing paper use and increasing the use of both recycled and FSC fibre. Two companies were the stand-out leaders on this issue: Dell and HP. LGE has also improved its practice by sourcing FSC pulp for its packaging, and has revised its suppliers code of conduct to reflect its policy to avoid illegally logged timber.⁷⁷ However, while LGE sources FSC pulp, it permits its suppliers to include less rigorous PEFC-certified sources for its packaging as well.⁷⁸ Wipro, Apple, Lenovo, Philips, HCL, Sharp and Toshiba do not have policies to exclude illegally sourced fibres. Lenovo has recently published a new paper-sourcing policy that prohibits suppliers from using forest products derived from illegal sources, places a preference on 100% recycled content materials and recommends FSC-certified fibres where virgin fibres are used.⁷⁹

Conflict minerals

The extraction of minerals, which are vital ingredients for electronic gadgets, has not only often damaged the environment but has become entangled with human conflict in the eastern Democratic Republic of Congo (Congo), where the profits from mining fund armed groups.

Several companies led the industry effort to push for reforms on the supply of conflict-free minerals from the Congo, before the passage of the 2010 Dodd-Frank law on conflict minerals. The Enough Project identifies these as HP, Apple, Philips, RIM, Acer, Dell, Nokia and Panasonic, while Sharp scored less than 10% and has not provided an update on progress. The Enough Project reports⁸⁰ that the Dodd-Frank law has helped to significantly reduce the involvement of armed groups in Congo in the mines of three out of the four conflict minerals. Conflict minerals audit programmes from the electronics industry had an important role to play, in particular the leaders mentioned above who set up industry-wide auditing systems to better weed out conflict minerals from their supply chains. As a result of this, and related reforms begun by African governments in the region but not yet fully implemented, it is now much less economically viable for armed groups and Congo's army to mine tin, tantalum, and tungsten, known as the 3Ts. Minerals were previously major sources of revenue for armed groups, generating an estimated \$185m US dollars a year for armed groups and the army. However, artisan-mined gold continues to fund armed commanders. The Enough Project recommends that further reforms are needed to address conflict gold and close loopholes on the other minerals.

Apart from funding conflict, the extraction of resources is also associated with environmental destruction and the use of child labour, for example in Bangka, Indonesia. Market leaders Apple and Samsung were both identified by a Friends of the Earth report⁸¹ as significant users of tin from Indonesia who were failing to act to ensure responsible sourcing. Both have since responded to this pressure. An assessment by Friends of the Earth in the Netherlands (*Milieudefensie*) on whether manufacturers of smart phones, tablets, laptops and games consoles are honest about consumption of resources⁸² now includes Apple and Samsung, along with Acer, Apple, Blackberry, HP, Lenovo, LG, Nokia, Philips, Samsung and Sony in their ranking as "green", for supplying sufficient information about their sourcing of tin and for working to improve the situation. Dell and Toshiba were ranked as "orange" for supplying information but not taking responsibility for improving the situation.



Addressing over-consumption through disruptive business model innovation

Even if electronics devices were produced more efficiently – using a higher proportion of renewable energy, with full recycling of e-waste to ensure minimal raw material extraction, and enabled by the avoidance of hazardous substances wherever possible – the current model of ever-increasing consumption of electronic devices would still be inherently unsustainable. Despite increasing awareness about the environmental impact of electronics, there have not been any significant initiatives from within the industry to address the increased threat to the environment that arises from a business model based on ever-increasing levels of consumption. The only real innovation is happening at the fringes of the industry, for example, the Fairphone project⁸³ and Phonebloks⁸⁴. Google has launched Project Aura to build an open source modular smart phone that is designed by customers. The popularity of both the Fairphone and the Phonebloks concepts shows that there is demand from customers for longer lasting electronics products with reduced environmental and social impacts. This momentum has led to Phonebloks, Project Aura and Fairphone announcing collaboration on a new type of technology,⁸⁵ starting with “a phone worth keeping”. This new vision has struck a chord with people who love the benefits technology brings but are increasingly frustrated with products that are often “designed for the dump”.

All major companies have been conspicuously quiet on the need for more sustainable business models that do not rely on an ever-increasing level of device consumption.

Disruptive innovation is needed to shift away from rapid product consumption as the main driver of profits for the electronics industry. Ultimately, new business models are required that generate profits from services rather than the consumption of devices, such as yearly upgrades to existing durable products that are designed to last, as an alternative to automatic replacement with a brand new product. Mobile phone contracts show that a service-based model can gain wide acceptance, however, the marketing of “free” handsets and regular phone upgrades to attract customers has only increased the environmental impact of mobile phones by encouraging the public perception of these gadgets as disposable fashion items. Instead of the replacement of whole products, phone upgrades should be limited to upgradable components and improved services for existing devices. This is critical if the electronics industry is to become truly sustainable. This need for upgradeability to be included at the design stage is also vital for other consumer electronics, such as tablets, PCs, TVs and other electronic goods; extending their lifecycles needs to be an easier, more economic and more attractive option for consumers than simply replacing the device with a new model.



Chemical testing of the original iPhone in 2007. All new Apple products are now completely free of the worst hazardous substances.
©Greenpeace / Will Rose








Conclusion

While it has made environmental progress in some areas, the consumer electronics industry as a whole still has a long way to go before it can be considered a sustainable industry. None of these challenges are simple, but it is possible for a globally innovative industry to deliver huge benefits for the environment and people who depend on it.







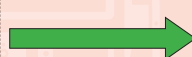


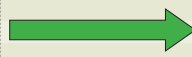
Electronics manufacturing remains at the cutting edge of technological development and has a strong economic future. There is no reason why it should not also be at the cutting edge when it comes to clean design and technology; this includes a crucial role in the renewable energy revolution, the substitution of hazardous chemicals, greater worker health protection; and the prevention of environmental pollution at its source. However, it is not enough for the industry to only clean up its manufacturing methods for these devices, from its choice of energy to the selection of raw materials and chemicals used in processing. It needs to reinvent the way that electronic devices are used in society to reverse the ever-increasing consumption of consumer electronics. If this requires a change in culture around the way we view our gadgets, then the electronics industry has to be the driving force behind that change.






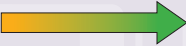











Table 1: Which companies are phasing out PVC and BFRs?





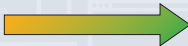












Consumer electronics free from polyvinyl chloride (PVC) and brominated flame retardants (BFRs), June 2014





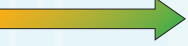



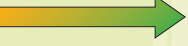
-  External power cables and other peripherals (eg. mouse, keyboards) are free from polyvinyl chloride (PVC) (green) or still made from PVC (red)
-  Products free of worst hazardous substances especially PVC and brominated flame retardants (BFRs)
-  One or more examples of whole product systems free from hazardous substances
-  Limited products free from hazardous substances, no whole product systems
-  No products free of the worst hazardous substances in this category
















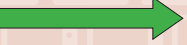
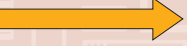
-  Company has met commitment to phase out PVC and BFRs and has all products free from these substances
-  Company is still working towards completing its phase out of PVC and BFRs, based on a credible commitment; it is showing progress by bringing products free of these substances onto the market
-  Company's phase out of PVC and/or BFRs is only partial and its commitment to future action is unclear, or there is insufficient progress

Company	Mobile phones	PCs (desktop & laptop computers, monitors)	Desktop monitors and other products	Televisions	Other products	Progress
 ⁸⁶	 PVC and BFRs were eliminated from Apple products in 2008.	 PVC and BFRs were eliminated from Apple products in 2008, with the exception of PVC cables, which were eliminated in 2013 (as of 2014 regulatory approval for PVC-free cables is still pending in India and South Korea).	 PVC and BFRs were eliminated from Apple products in 2008, with the exception of PVC cables, which were eliminated in 2013 (as of 2014 regulatory approval for PVC-free cables is still pending in India and South Korea).			 Apple led the way on eliminating toxic PVC and BFRs from all its new products with the new iMac and MacBook being the first PCs completely free of PVC and BFR and met its commitment to phase these substances out by the end of 2008.
NOKIA ⁸⁷	 All Nokia phones are free of toxic PVC and BFRs.					 In line with its commitment, all of Nokia's new models of mobile phones are free of all brominated and chlorinated compounds and antimony trioxide from the start of 2010. Nokia's new models have been free of PVC since the end of 2005.
 ⁸⁸	 BlackBerry has eliminated all BFRs, PVC and phthalates in BlackBerry products as of the end of 2013. BlackBerry products introduced after 2013 are halogen free.					 In September 2012 Research In Motion made its commitment to eliminate PVC and BFRs from BlackBerry smartphones by the end of 2013.

Company	Mobile phones	PCs (desktop & laptop computers, monitors)	Desktop monitors and other products	Televisions	Other products	Progress
 ⁸⁹		  All of HP's notebook products and 60% of the company's non-mobile product families are low halogen, as of January 31, 2014 (apart from external components such as keyboards, mice, cables, and cords are not low halogen). ⁹⁰ HP's Windows tablets and hybrid/split products are also low halogen; however, lower priced Android tablets are not yet low halogen.	  Examples of three HP models of monitor that are virtually free of PVC and BFRs are the HP Compaq LE19f and LA22f widescreen LCD commercial monitors and the HP 2310e LED consumer display. The HP ENVY 100 e-All-in-One is the first PVC-free printer.			 HP needs to complete its phase-out of PVC by investing in PVC-free cables for all its computing products, and complete its phase-out of all PVC, BFRs and other hazardous substances in all its products. HP maintains that the entire industry needs to shift towards PVC-free cables to maintain a competitive playing field and is advocating with its suppliers.
 ⁹¹	 According to Acer, 90% to 99% of parts in the BOMs (Bill of Materials) of newly introduced Acer products are free of PVC/BFRs as of the end of 2013. Smart phone A9 models and ICONIA SMART are PVC/BFR free.	  Acer provides a list of many desktops and notebooks that are PVC and BFR free (apart from power cables), launched since 2010. According to Acer, 90% to 99% of parts in the BOMs (Bill of Materials) of newly introduced Acer products are free of PVC/BFRs as of the end of 2013.	  Acer provides a list of six monitors that are PVC and BFR free, launched since 2010.			 Acer is calling for regulatory action on the use of PVC and BFRs, to ensure the take up of alternatives by the entire market. Acer needs to complete its phase-out of PVC by investing in PVC free cables and set deadlines for the elimination of other hazardous chemicals.
 <i>Applying Thought</i>		  Wipro launched its first PVC and BFR free product a "Greenware" desktop in January 2010. PVC and BFRs were eliminated from the new Wipro Greenware line of desktops launched in 2010. As of November 2012, 80% of Wipro PCs were PVC/BFR free. However, no information on whether power cables are PVC is available.				 Wipro's sustainability report states that "a significant portion of our desktops launched continue to be PVC and BFR free". ⁹² However, WIPRO's PC business has now been sold




Company	Mobile phones	PCs (desktop & laptop computers, monitors)	Desktop monitors and other products	Televisions	Other products	Progress
 <p>93</p>		 <p>Dell product families that are PVC/BFR free are: - XPS Notebooks and Tablets - Mobile Precision Workstations - Latitude1 Notebooks (excludes 3 series) - OptiPlex 9020 USFF Desktop and Micro Desktop (However, peripheral accessories and power cables are not included)</p>	 <p>Dell product families that are PVC/BFR free are: - P-Series Flat Panel Displays (excluding peripheral accessories)</p>		 <p>All removable media storage devices, memory and hard drives became BFR/CFR/PVC-free in 2011. However, Dell's PVC/BFR phase out is limited to personal computing products.</p>	 <p>Dell has progressed with the phase out of PVC and BFRs from its products, in line with its commitment for all newly introduced Dell personal computing products to be BFR/CFR/PVC-free from the end of 2011. Dell reports that technical issues still exist for specific applications.</p>
 <p>94</p>	 <p>All LGE mobile phones and tablets are free from PVC and BFRs, as from 2010.</p>	 <p>As from 2013, all newly developed laptop computers and "all-in-one" type desktops are PVC/BFR free, with the exception of: FPCB, Bare PCB, Adapter, Battery (laptop) Key board, Touchpad/Mouse, Cable, Thermal Module and Power Cord</p>	 <p>As of 2013, there are 79 models of monitors that have cabinets, stands, back covers and LCD modules free from PVC/BFRs.</p>	 <p>LCD, UHD and OLED TVs have PVC/BFR free parts: All new models – PVC free LCD panels and PVC/BFR free insulation and deco sheet. 29 models – PVC free internal cables 314 models – PVC/BFR free housings and stands 412 models – PVC/BFR free modules PVC/BFR free remote controller cases. The number of TV models with PVC/BFR components is increasing year on year.</p>	 <p>Over 1,700 refrigerator models have had their PVC "skirt lower" replaced with a TPE alternative, representing the substitution of 24.59 tons of PVC. Recently LGE removed PVC substances completely from refrigerator gaskets. 144 top loader washing machines use PVC-free exterior film as from 2013, representing the substitution of 1,410 tons of PVC.</p>	 <p>LG is in the process of phasing out PVC, BFRs, phthalates, antimony and beryllium from its TVs, monitors and PCs (targeted for 2012) and its household appliances (targeted for 2014), considering technical and quality issues.</p>
 <p>95</p>		 <p>The Thinkpad notebook range is mostly PVC/BFR free. All IdeaPad notebooks and IdeaCentre desktops have many low halogen components; ThinkCentre desktops have low halogen chassis and CPUs</p>	 <p>The LT2452p monitor is PVC/BFR free apart from cables; all IdeaVisual monitors are low halogen except PCBs and cables; all other current Lenovo monitors are PVC/BFR free with the exception of their PCBA and external cables.</p>		 <p>As well as notebooks and monitors, Lenovo has phased out PVC/BFRs from many of its components and commodities.</p>	 <p>Lenovo is focused on eliminating PVC/BFRs (halogens) from its top selling products and across as many commodities as possible. However, power supply cables are not PVC free and PVC is still used in some other external cables.</p>

Company	Mobile phones	PCs (desktop & laptop computers, monitors)	Desktop monitors and other products	Televisions	Other products	Progress
HCL		 <p>As of November 2012, HCL had 29% of its product-line free from PVC and BFR. HCL changed its PVC/BFR phase timeline from December 2011 to December 2012. 98% of HCL notebooks from series 40, 44 and, 54 ranges (apart from power cords) are PVC/BFR free. The Infiniti M A330 Pro is HCL's first PVC-BFR free Desktop computer. However, there are no further details of progress in 2014.</p>				 <p>Currently, HCL states that is working on economically viable and safe alternatives to replace PVC and BFR. HCL has introduced a PVC free laptop computer in this direction. For completely eliminating BFR from its product, HCL is working towards the targeted date of December 31, 2012. However, this information is out of date.⁹⁶</p>
PHILIPS ⁹⁷				 <p>Philips was the first company to introduce a PVC and BFR-free TV; the Econova LED-TV; since then its television business has been sold as part of joint venture with Hong Kong-based TPV.</p>	 <p>More than 80% of Philips shaving and grooming products are completely PVC/BFR-free. Philips lighting products are 78% PVC free and 29% BFR free. In 2013 Philips Consumer Lifestyle product portfolio was 55% PVC free, 55% BFR free.</p>	 <p>Philips is committed to the phase out of PVC and BFRs in new consumer products placed on the market after January 2011. As well as the Econova TV, a large number of PVC/BFR free product ranges such as Oral Healthcare, vacuum cleaners and shavers have been put on the market.</p>
TOSHIBA ⁹⁸		 <p>Many PCs have halogen (BFR) free main printed wiring boards and Toshiba R-series notebook PCs are PVC-free in the PC main body including internal cables, chassis and printed circuit boards. In March 2011 Toshiba released a PC which is 100% PVC and BFR free, the Tecra A11-EV1, on US market.</p>		 <p>Most Toshiba TVs have no BFRs in their casings. Toshiba aims to phase out PVC and BFRs in all of its product groups.</p>	 <p>Toshiba provides examples of PVC/BFR free products, including an OCR scanner with PVC-free AC cable and BFR free printed circuit board.</p>	 <p>Committed to phase out PVC, BFRs, antimony and compounds, beryllium and compounds and phthalates by FY2015 from <i>all</i> its consumer products, if alternatives are available. 17 product groups had reduced PVC/BFRs in 2012 and Toshiba reports that this will increase to 30 groups in FY2013.</p>

Company	Mobile phones	PCs (desktop & laptop computers, monitors)	Desktop monitors and other products	Televisions	Other products	Progress
	<p>99</p> <p></p> <p>All models of mobile phones have been free from BFRs as of January 2010 and PVC from April 2010.</p>	<p> </p> <p>Samsung phased out BFRs and PVC from notebooks developed from January, 2011 (except adapter and power cord).</p>		<p> </p> <p>The housings of some TVs and all monitors are BFR free. However, there is no commitment to a full phase out of PVC and BFRs in TVs.</p>	<p></p> <p>All models of MP3 players have been free from BFRs as of January 2010 and PVC from April 2010. All HDD models launched after April 2009 are free from PVC and BFRs. All new models of LCD panels have been PVC-free since 2007. Other products that are partly PVC/BFRs free are: all models of digital cameras and camcorders, and home theatres. However, Samsung has an extensive product range, including household appliances, where it continues to use PVC and BFRs.</p>	<p></p> <p>As a market leader, Samsung's phase out of PVC and BFRs in its mobile phones, notebooks and other products is significant. However, it does not plan to phase out PVC in power cables. Furthermore, Samsung no longer plans to completely phase out the use of PVC and BFRs in its other products, including TVs and household appliances.</p>
	<p>100</p> <p></p> <p>Sony Mobile Communications (formerly Sony Ericsson) Xperia mobile phones are free from PVC and BFRs. Sony Ericsson was one of the first brands to phase out PVC/BFRs from its mobile phones.</p>	<p> </p> <p>Sony has phased out PVC in the casings and internal wiring of all of its VAIO PCs. Three BFRs (PBBs, PBDEs & Deca BDE) have been eliminated in the PWBs, casings and cables</p>		<p> </p> <p>Sony does not provide details about the PVC/BFR free status of its TVs.</p>	<p></p> <p>Sony provides an extensive list of products (including model numbers) that are "PVC/BFR-free", including MP3 players, Walkman, cameras, DVD and BluRay players and PSP (PlayStation Portable). However, there are many exemptions from its ban on PVC and its ban on BFRs covers all uses but is limited to PBBs, PBDE and Deca BDE (and therefore does not go beyond regulatory requirements)</p>	<p></p> <p></p> <p>In line with its commitment, all Sony Ericsson (now Sony Mobile Communications) products have been free of PVC since 2007 and all new products are free from BFRs.</p> <p>However, Sony's elimination of hazardous substances in its other products is only partial and the company is behind its competitors in removing these substances from PCs and TVs. Not all BFRs are included; external cables and some wiring boards are also not included.</p>

Company	Mobile phones	PCs (desktop & laptop computers, monitors)	Desktop monitors and other products	Televisions	Other products	Progress
<p>Panasonic¹⁰¹</p>	<p>★</p> <p>All mobile phones (sold in Japan only) have been PVC-free (excluding internal wiring in a charger) from FY2005 models onwards. Panasonic has launched a BFR-free mobile phone (P-02D), apart from accessories, although this is no longer in production. Apart from this, there are no BFR-free products.</p>	<p>☒ ★</p> <p>Since April 2007, Panasonic has been selling PVC-free notebook computers (excluding separate AC cord), in Japan only. Panasonic has launched a BFR-free notebook (CF-B10) apart from accessories. Apart from this, there are no BFR-free products.</p>	<p>☒ ★</p>	<p>☒ ★</p>	<p>★</p> <p>There are many examples of PVC-free products, including healthcare products and LED panel display units. Panasonic gives examples of fluorescent ceiling lamps that are free of BFRs – and is manufacturing halogen-free printed wiring boards for certain applications and markets. As from March 2011, Panasonic has discontinued the use of PVC internal wiring in all of its products globally. However, 54% of products – such as washing machines, are exempted due to technological problems.</p>	<p>→</p> <p>Panasonic has not met its commitment to remove PVC and BFRs from notebooks and BFRs from mobile phones by the end of 2011. In addition, it has no commitment to remove these toxic substances across its product range.</p> <p>There has been minimal progress in the phase out of PVC/BFRs or other hazardous substances since the last assessment done by Greenpeace in November 2012.</p>
<p>SHARP¹⁰²</p>				<p>☒ ★</p> <p>Some LCD TVs put on the market in 2011 were free from PVC and phthalates, with casings free from BFRs, however, no up to date information is available.</p>	<p>★</p> <p>In 2011 Sharp listed solar modules, LED lighting, small household appliances, mobile phones, calculators, electronic dictionaries as PVC and phthalate free. BFR and antimony free products were listed as: LED Lighting, and water purifier. Products that had BFR free casings were: blue-ray recorders, players, video projectors, copiers/MFPs, mobile phones Theatre Racks, Home Video System and electronic dictionaries.</p>	<p>→</p> <p>Sharp did not meet its commitment to phase out the use of PVC, phthalates, BFRs and antimony by fiscal year 2010; it no longer lists products that are free from PVC, BFRs and other hazardous substances on its website. Its full list of banned and restricted substances is no longer available. Associated documents list PVC, certain phthalates and beryllium and compounds as banned; previous lists also banned antimony and compounds, with BFRs listed as managed.</p>

Table 2: Which companies are phasing out other hazardous substances?

Company	Mobile phones	PCs (desktop & laptop computers, monitors)	Desktop monitors and other products	Other products	Progress
 ¹⁰³	Apple products are also free from phthalates (see PVC), lead, mercury and arsenic. Apple has not yet reported on its elimination of beryllium and antimony.	Apple products are also free from phthalates (see PVC), lead, mercury and arsenic. Apple has not yet reported on its elimination of beryllium and antimony.	Apple products are also free from phthalates (see PVC), lead, mercury and arsenic. Apple has not yet reported on its elimination of beryllium and antimony.		
NOKIA ¹⁰⁴	All Nokia phones are free from antimony trioxide, beryllium compounds; phthalates have been restricted since 2005. Nokia also restricts certain PFCs and organotins.				
 ¹⁰⁵	All phthalates were phased out by the end of 2013. Beryllium was eliminated in 2011. BlackBerry plans to eliminate all antimony oxides by the end of 2014.				
 ¹⁰⁶		Certain phthalates in new computing products, beryllium and compounds, and antimony and antimony trioxide have been phased out since 2013. Remaining uses of phthalates, antimony and the BFR HBCDD are still to be phased out.			
acer ¹⁰⁷	In the future, suppliers will be required to ban the usage of beryllium, antimony and all phthalates.				
DELL ¹⁰⁸		Dell has phased out the use of antimony and three phthalates (with a fourth, DIBP, to be phased out by 2015), beryllium and other phthalates are monitored for possible future restriction. Other substances such as mercury, arsenic, lead, PAHs and MCCPs have been phased out.			

Company	Mobile phones	PCs (desktop & laptop computers, monitors)	Desktop monitors and other products	Other products	Progress
WIPRO <i>Applying Thought</i>		<p>In November 2012, Wipro reported it had launched its first products – two desktop models, WSG68F55W7 and WIV68F55 – free from antimony, beryllium and phthalates. These two products constituted 20% of its product range free from these three hazardous chemicals. Its timeline to complete phase-out of antimony, beryllium and phthalates from its entire product range was FY-2012.</p>			<p>Wipro's sustainability report does not include an update on its phase-out of antimony, beryllium and phthalates.¹⁰⁹ WIPRO's PC business has now been sold</p>
 ¹¹⁰ LG	<p>LGE mobile phones are also free from beryllium, phthalates and antimony trioxide.</p>				
¹¹¹ lenovo		<p>Antimony and beryllium and their compounds have a phase-out target date of 2012. Three phthalates, DEHP, DBP and BBP are listed as restricted. Other phthalates are listed as reportable substances, which may be candidates for further restrictions in the future.</p>			
HCL		<p>Antimony and compounds, beryllium and compounds and phthalates were targeted for elimination by the end of 2012. As of November 2012, 21% of its products are already free from antimony and beryllium. As well as being PVC/BFR-free, the HCL ME series 54 laptop is also free of antimony and beryllium. However, no up to date details of products are given.¹¹²</p>			


Company	Mobile phones	PCs (desktop & laptop computers, monitors)	Desktop monitors and other products	Other products	Progress
PHILIPS <small>113</small>				<p>All Philips products are free from beryllium and bisphenol A is phased out in food contact products. Philips is also phasing out the use of phthalates and antimony compounds for consumer products, as part of its PVC/BFR-free policy.</p>	
TOSHIBA <small>114</small>					<p>Toshiba does not report on its progress to phase out antimony and compounds, beryllium and compounds and phthalates.</p>
 <small>115</small>	<p>Antimony and compounds, beryllium and compounds and phthalates have been phased out from mobile phones (new products) as from January 2013.</p>	<p>Antimony and compounds, beryllium and compounds and phthalates have been phased out from notebook computers (new products) as from January 2013.</p>		<p>Antimony and compounds, beryllium and compounds and phthalates have been phased out from MP3 players.</p>	
SONY <small>116</small>	<p>Sony Mobile Communications has eliminated certain phthalates, antimony trioxide and beryllium; antimony is not yet eliminated.</p>	<p>Beryllium oxide is not used in any Sony products.</p>			<p>Phthalates have been eliminated in PSPs and AC adapters. Beryllium oxide is not used in any Sony products.</p>
Panasonic <small>117</small>					<p>There has been minimal progress in the phase out PVC/BFRs or other hazardous substances since the last assessment done by Greenpeace in November 2012.</p>
SHARP <small>118</small>					<p>Sharp's full list of banned and restricted substances is no longer available. Associated documents list PVC, certain phthalates and beryllium and compounds as banned; previous lists also banned antimony and compounds.</p>

Table 3: Guide to Greener Electronics – Criteria 2006-2012

Criteria v.1 – v.8 (2006 – 2008)

CHEMICALS	Precautionary Principle	Chemicals Management	Timeline for PVC phase-out	Timeline for BFR phase-out	PVC-free and/or BFR-free models on market
E-WASTE	Support for Individual Producer Responsibility	Provides voluntary take-back where no EPR laws	Provides info for individual customers on take-back in all countries where sales of product	Reports on amount of WEEE collected and recycled	

Criteria v.8 – v.17 (2008 – 2011)

CHEMICALS	C1. Precautionary Principle	C2. Chemicals Management	C3. PVC and BFR phase-out and timeline ¹¹⁹	C4. Phase-out of additional substances with timeline(s)	C5. PVC-free and/or BFR-free models (product systems) on the market
E-WASTE	W1. Support for Individual Producer Responsibility ¹²⁹	W2. Provides effective ¹²¹ voluntary takeback where no EPR laws	W3. Provides info for individual customers on takeback in all countries where sales of product	W4. Reports on amount of WEEE recycled ¹²²	W5. Use of recycled plastic content across all products and timelines for increasing content
CLIMATE & ENERGY	E1. Support for global mandatory reduction of GHG emissions	E2. Disclosure of carbon footprint (GHG emissions) of company's own operations and two stages of the product supply chain	E3. Commitment to reduce GHG emissions from a company's own operations with timelines ¹²³	E4. Amount of renewable energy ¹²⁴ used as proportion of total electricity use in own operations	E5. Energy efficiency of new models of specified products ¹²⁵

Criteria v.18 (2012)

ENERGY	E1. Disclose own operational GHG emissions	E2. GHG emissions reductions and targets	E3. Clean Electricity Plan (CEP)	E4. Clean Energy Policy Advocacy	
GREENER PRODUCTS	P1. Product Energy Efficiency	P2. Avoidance of Hazardous Substances in Products	P3. Use of Recycled Plastic in Products	P4. Product Lifecycle	
SUSTAINABLE OPERATIONS	O1. Measure and reduce energy consumption in the supply chain	O2. Chemicals Management and Advocacy	O3. Policy and practice on sustainable sourcing of fibres for paper.	O4. Policy and practice on avoidance of conflict metals	O5. Provides effective voluntary take-back where no EPR laws

References

- 1 Initially, the focus of the *Guide to Greener Electronics* was solely on the issue of hazardous chemical use in electronics and the resulting environmental problems from the release of these chemicals when obsolete e-waste is dumped in countries in the Global South. These objectives were maintained throughout the 18 editions of the Guide, with other environmental issues added in two subsequent revisions to the criteria. The first was in July 2008, when criteria on Climate and Energy were added, from version 8 onwards. The second major revision was in November 2011, for version 17 and 18, when criteria were re-organised under Energy, Greener Products and Sustainable Operations, which allowed the addition of new issues such as conflict minerals, the sourcing of sustainable paper products, and the product lifecycle of electronics.
- 2 Nokia mobile phones were free from PVC at the end of 2008 and Sony Ericsson phones had no PVC from 2007. Both companies also phased out BFRs from 2010. Apple's products were free from PVC/BFRs from 2008 (see Appendices, Table 1).
- 3 Sony Ericsson is now part of Sony Mobile Communications.
- 4 Apple has eliminated the deliberate use of PVC, BFRs and several other hazardous substances in all of its products (see Appendices, Table 1 and 2).
- 5 An adequate approach needs to be hazard-based, comprehensive and include credible definitions for the "Precautionary Principle", zero discharge of hazardous chemicals, individual corporate accountability, and the public's "Right to Know" about the use and discharge of hazardous chemicals from a company's supply chain facilities and their presence in the final product. See Box 1. Detox basics for electronics
- 6 Brigden K, Labunska I, Santillo D & Allsopp M (2005). Recycling of electronic wastes in China and India: workplace and environmental contamination. Greenpeace Research Laboratories Technical Note 09/2005, Publ. Greenpeace International, August 2005: <http://www.greenpeace.to/greenpeace/?p=832>
- 7 Greenpeace (2008). Toxic Tech: Not in Our Backyard. <http://www.greenpeace.org/international/en/publications/reports/not-in-our-backyard-summary/>
- 8 United Nations University (2013), StEP launches interactive World E-Waste map. <http://unu.edu/media-relations/releases/step-launches-interactive-world-e-waste-map.html#info>
- 9 Nokia mobile phones were free from PVC at the end of 2008 and Sony Ericsson phones had no PVC from 2007. Both companies also phased out BFRs from 2010. Apple's products were free from PVC/BFRs from 2008 (see Appendices, Table 1).
- 10 Philips website (2014), http://www.newscenter.philips.com/main/standard/news/press/2010/20100902_ifa_green.wpd#.U5CQH8LQfml, 5/6/2014
- 11 Gartner (2014a). Gartner says annual smartphone sales surpassed sales of feature phones for the first time in 2013, Table 4 <http://www.gartner.com/newsroom/id/2665715>
- 12 Gartner (2014b). Gartner says worldwide PC shipments declined 6.9% in fourth quarter of 2013 <http://www.gartner.com/newsroom/id/2647517>
- 13 Canals (2014). PC shipments up 18% in Q4 as tablets reach almost 50%, Palo Alto, Shanghai, Singapore and Reading – Monday, February 3, 2014. Percentages calculated from data in article. <http://www.canals.com/newsroom/pc-shipments-18-q4-tablets-reach-almost-50#sthash.t0Vw0rjy.dpuf>
- 14 Broadband TV News (2014). Samsung global smart TV market share reaches 26%. February 18, 2014, <http://www.broadbandtvnews.com/2014/02/18/samsung-global-smart-tv-market-share-reaches-26/>
- 15 Existing safety standards for cables are country specific and relate specifically to PVC. It has been necessary to develop new standards for the materials replacing PVC; this has still not been achieved in some geographies (ie. Apple reports that it continues to seek government approval for our PVC replacement for PC cables in India and South Korea, <http://www.apple.com/environment/toxins/>)
- 16 <http://www.greenpeace.org/international/en/campaigns/toxics/electronics/Campaign-timeline/>
- 17 HCL Infosystems website, chemical policy implementation. The commitment for elimination of PVC and BFRs by the end of 2009 and 2010 respectively is now out of date. <http://www.hclinfosystems.in/about-us/community-initiative/hcl-ecosafe/chemical-policy-implementation>
- 18 Wipro (2013), Sustainability @ Wipro 2012-2013, <http://www.wiprosustainabilityreport.com/update-wipro-green-computing>
- 19 http://www.phonearena.com/news/Apple-loses-tablet-market-share-to-Amazon-and-Microsoft-after-Christmas_id50925
- 20 <http://www.bbc.com/news/business-28675901>
- 21 INEMI Timeline for HFR-Free Electronics and PVC-Free Cabling for Notebook and Desktop Products, October 2010, http://thor.inemi.org/webdownload/projects/ELSC/HFR-Free_PVC-Free_Timeline.pdf
- 22 European Commission (2011). Directive 2011/65/EU of the European Parliament and of the Council, of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment. <http://www.ce-mark.com/Rohs%20final.pdf>
- 23 EEB (2013). Letter to the European Commission: EU Commission still fails to prioritize brominated flame retardants in electronics products for restriction: International concerns grow that the EU RoHS Directive will not protect global health nor support innovation in safer substitutes. Signed by 160 civil society groups. <http://www.eeb.org/EEB/?LinkServID=577CC427-5056-B741-DBEC81A49F6B7FEF>
- 24 ÖkolInstitut (2014). Study for the Review of the List of Restricted Substances under RoHS 2: Analysis of impacts from a Possible Restriction of Several New Substances under RoHS 2. ÖkolInstitut/Eunomia, May 2014. For PVC, the report recommends (p. 82): "Higher priority to assess if environmental benefits justify restriction - check if there are sub-substances that need to be reviewed as with PVC rigid, soft and recycled." http://rohs.exemptions.oeko.info/fileadmin/user_upload/reports/20140604_Substance_Review_plus_Dossier_final.pdf
- 25 It is important for a company to support and demand Individual Producer Responsibility (IPR), as this shows positive action in getting its own-branded products back for re-use and recycling, to be able to profit from product eco-design. Companies supporting IPR believe that their product design innovations should be rewarded. Greenpeace expects responsible companies to support, at minimum, financial responsibility for their own-branded end-of-life products. Physical responsibility is not always feasible and could result in duplicated infrastructures e.g. for e-waste collection.

26 <http://www.apple.com/environment/finite-resources/>

27 Blackberry is part of the Programa Verde (Green Program) in Mexico, a programme that was formed by the National Association of Telecommunications (ANATEL) and the group's member companies, to encourage the recycling of mobile devices and promote a culture of recycling.

28 www.dell.com/2020

29 http://www8.hp.com/hpnext/posts/hp-wins-guardian-sustainable-business-award-collaboration#.U9F9_cLQfIU

30 Greenpeace (2007). Cutting Edge Contamination – A Study of Environmental Pollution during the manufacture of Electronic Products. February 8, 2007

<http://www.greenpeace.org/usa/Global/usa/report/2007/7/cutting-edge-contamination-a.pdf>

31 Greenpeace (2007), op cit.

32 Greenpeace (2010). Poisoning the Pearl: An investigation into industrial water pollution in the Pearl River Delta, 2nd edition.

<http://www.greenpeace.org/raw/content/eastasia/press/reports/pearlriver-report-2.pdf>

33 <http://www.greenpeace.org/international/Global/international/planet-2/report/2009/12/poisoning-the-pearl.pdf>

34 BSR (Business for Social Responsibility) (2010). Electronics Supply Networks and Water Pollution in China, November 2010, http://www.bsr.org/reports/BSR_Electronics_Supply_Networks_Water_Pollution_in_China.pdf

The 11 priority hazardous chemical groups are:

1. Alkylphenols and their ethoxylates (APEOs & APs)
2. Phthalates
3. Brominated and chlorinated flame retardants (BFRs, CFRs)
4. Azo dyes that can release carcinogenic amines
5. Organotin compounds
6. Per- and polyfluorinated chemicals (PFCs)
7. Chlorobenzenes
8. Chlorinated solvents
9. Chlorophenols
10. Short-chain chlorinated paraffins
11. Heavy metals such as cadmium, lead, mercury and chromium (VI).

Many examples of chemicals within these groups are subject to regulations in the EU, the US and elsewhere (although these chemical groups are not regulated as a whole and some members of these groups are not regulated).

35 American Apparel and Footwear Association (AAFA) Restricted Substances List (RSL). <https://www.wewear.org/industry-resources/restricted-substances-list/>

36 Greenpeace investigative reports on the hazardous chemicals found in discharges to waterways from textile manufacturers in China, Mexico and Indonesia, as well as several reports on the hazardous chemicals found in a variety of textile products, are listed here: <http://www.greenpeace.org/international/en/campaigns/toxics/water/detox/>

37 Several companies – including Mango, Fast Retailing(Uniqlo), Inditex, H&M, Benetton, Valentino, G-Star, M&S, Limited Brands, C&A, Puma, Coop, Canepa and Esprit – have ensured the publication of data from some of their suppliers about discharges of hazardous chemicals, on the global online platform IP – Chinese Institute for Environmental Affairs, which is a credible global chemical discharge disclosure platform.

38 Sony website, Reinforcing Standards for Managing Chemical Substances, http://www.sony.net/SonyInfo/csr_report/environment/chemical/site/index2.html

39 HP 2013 Living Progress Report, p.123 -124, <http://h20195.www2.hp.com/V2/GetPDF.aspx/c03742918.pdf>

40 The precautionary principle means taking preventive action where there are legitimate reasons for concern regarding the intrinsic hazards of a chemical, even if information is insufficient to verify those hazards. It is based, in part, on the premise that some hazardous substances cannot be rendered harmless by the receiving environment (i.e. there are no “environmentally acceptable” or “safe” use or discharge levels) and that prevention of potential damage is required. The process of applying the Precautionary Principle must involve an examination of the full range of alternatives, including, where necessary, substitution through the development of sustainable alternatives where they do not already exist.

41 Any company needs to take corporate responsibility for a clear Individual Action Plan that identifies the steps it will take to follow through on its Detox commitment and continuously review and update these steps.

42 “Right to Know” is defined as practices that allow members of the public access to environmental information – in this case, specifically about the uses and discharges of chemicals based on reported quantities of releases of hazardous chemicals to the environment, chemical-by-chemical, facility-by-facility, at least year-by-year.

43 Panasonic (2014). Substance List for Chemical Substances Management Rank Guidelines (For Factories), v.5. <http://panasonic.net/procurement/green/> and http://panasonic.net/procurement/data/listf_e.pdf

44 Nokia has a Restricted Substances List for processing by its supply chain: Nokia Supplier Requirements for Environmental Management. These requirements can be found in the Nokia Global Supply Web (NGSW) which is not accessible via its public webpages.

45 All hazardous chemicals means all those that show intrinsically hazardous properties: persistent, bioaccumulative and toxic (PBT); very persistent and very bioaccumulative (vPvB); carcinogenic, mutagenic and toxic for reproduction (CMR); endocrine disruptors (ED), or other properties of equivalent concern, (not just those that have been regulated or restricted in other regions). This will require establishing – ideally with other industry actors – a corresponding list of the hazardous chemicals concerned that will be regularly reviewed.

46 Clean Production Action's “Greenscreen” intrinsic hazards assessment tools and criteria is currently the only process that comes closest to meeting the necessary requirements for a thorough and credible hazards-based screening methodology. See: <http://www.cleanproduction.org/Greenscreen.php> and http://www.cleanproduction.org/library/GreenScreen_v1_2-2e_CriteriaDetailed_2012_10_10w_all_Lists_vf.pdf .

- 47 GreenScreen website, GreenScreen in practice/Hewlett Packard. <http://www.greenscreenchemicals.org/practice/hewlett-packard>
- 48 Greenpeace (2013), The Detox Catwalk Explained. The credible definition of “zero” hazardous chemical use must be continually verified by employing the best and latest technology (“best current testing technology”) to detect hazardous chemicals across all discharge pathways. The chemical testing methods employed must be regularly updated to reflect best practice, in order to continuously progress towards zero hazardous chemical use. http://www.greenpeace.org/international/Global/international/artwork/toxics/2013/detox/catwalk/pdf/Detox_Catwalk_Explained_context_criteria_and_function.pdf
- 49 Electronics companies Restricted Substances Lists commonly refer to industry association standards which use a definition of “halogen-free” for products that allows up to 900 ppm (parts per million) of total chlorine and 900 ppm of total bromine, with a maximum total halogen level of 1,500 ppm. These standards include JPCA’s (Japan Printed Circuit Association) JPCA-ES-01-1999, IEC’s (International Electrotechnical Commission) 61249-2-21 and IPC’s (Association Connecting Electronics Industries) 4101B.
- 50 A material containing total bromine below 900 ppm, and described as “halogen-free” could still contain certain BFRs (e.g. penta-BDE) over 1,000 ppm – exceeding the levels for BFRs permitted by the EU RoHS Directive.
- 51 <http://www.gartner.com/newsroom/id/2645115>
- 52 <http://www.energysavingtrust.org.uk/Publications2/Corporate/Research-and-insights/Powering-the-nation-household-electricity-using-habits-revealed>
- 53 <http://www.ce.org/CorporateSite/files/e4/e4d65f2d-bbd3-49f5-b3d6-8634268aa055.pdf>
- 54 <http://www.iea.org/newsroomandevents/pressreleases/2014/july/name-108223-en.html>
- 55 <http://www.step-initiative.org/index.php/newsdetails/items/world-e-waste-map-reveals-national-volumes-international-flows.html>
- 56 http://www.jema-net.or.jp/Japanese/info/news/pdf/131129_2.pdf;
http://www.nikkei.com/article/DGXNASDD2900K_Z21C13A1TJ0000/;
http://www.env.go.jp/earth/ondanka/ghg/2012_gaiyo.pdf
- 57 <http://www.juniperresearch.com/viewpressrelease.php?pr=465>
- 58 Apple website, 2013 carbon footprint, <http://www.apple.com/environment/climate-change/>
- 59 <http://www.treehugger.com/green-investments/apple-wants-massive-arizona-sapphire-plant-run-renewable-energy-day-one.html>
- 60 <http://www.eia.gov/cfapps/ipdbproject/iedindex3>.
- 61 http://images.apple.com/environment/reports/docs/iPhone5s_product_environmental_report_sept2013.pdf
- 62 <http://www.samsung.com/us/aboutsamsung/sustainability/sustainabilityreports/>
- 63 <http://www8.hp.com/us/en/hp-news/press-release.html?id=1489007>
- 64 <http://www.newscientist.com/article/dn14412-33-of-chinas-carbon-footprint-blamed-on-exports.html#.U59Dyjj4KYV>
- 65 <http://thinkprogress.org/climate/2014/05/16/3438810/china-solar-goals/>
- 66 http://www.lenovo.com/social_responsibility/us/en/GreenPaper_Addressing_Climate_Change_at_Lenovo.pdf
- 67 <http://huawei.com/en/about-huawei/sustainability/environment-protect/climate-change/index.htm>
- 68 http://www.pv-tech.org/news/bnef_swaps_japan_for_china_as_biggest_solar_market_in_2013
- 69 http://www.pv-tech.org/guest_blog/top_10_pv_module_suppliers_in_2013
- 70 <http://www.gartner.com/newsroom/id/2692318>
- 71 <http://press.ihs.com/press-release/design-supply-chain-media/tv-market-declines-again-2013-sales-both-developed-and-emerg>
- 72 http://www.lenovo.com/social_responsibility/us/en/materials.html
- 73 Guide to Greener Electronics v.18, op cit.
- 74 Lifetime reliability is one of the 6 Green Focal Areas in Philips EcoDesign approach. Philips is recognized (e.g. via net promoter scores) for its long lifetimes and high lifetime reliability. Lifetimes of LED lamps vary between 25,000 and 50,000 hours. On average, Philips consumer products have a 2-year warranted guarantee. Philips has some products that are designed for high performance markets such as the “Robust kitchen” series, which have up to five-years’ warranty. See http://www.philips.co.uk/c/robust-collection/38892/cat/#/Robust_Engineers/Wolfgang_Srebotnig. Wear parts are made available as consumables (such as lamps, tooth brush heads, shaver heads). Last year Philips joined the Ellen McArthur Foundation and implements the Circular Economy framework, which will enable Philips to provide even more extended lifetime, refurbishment of products, spare part harvesting and recycling. See: <http://www.philips.com/about/sustainability/ourenvironmentalapproach/greeninnovation/circulareconomy.page> Philips is partner in the ENIAC JU project GreenElec, which aims to develop the strategies and processes needed for the efficient recycling of electronics equipment and the first products have been released now based upon the design rules for recyclability. http://www.eniac.eu/web/downloads/projectprofiles/pp_call4_greenelec.pdf
- 75 <http://www.philips.com/about/sustainability/ourenvironmentalapproach/greenproducts/index.page>
- 76 Companies must have and implement a public paper procurement policy which excludes suppliers that are involved in deforestation and illegal logging and includes a plan with targets and timelines to (1) reduce paper use; (2) increase use of both recycled and FSC fibre; and (3) report on progress towards these targets.
- 77 <http://www.lg.com/global/sustainability/csr-framework/global-membership.jsp>
- 78 <http://www.lg.com/global/sustainability/environment/greener-products/green-product-strategy>
- 79 http://www.lenovo.com/social_responsibility/us/en/Lenovo_Paper_Sourcing_Policy.pdf
- 80 Enough Project (2014), The Impact of Dodd-Frank and Conflict Minerals Reforms on Eastern Congo’s War. June 10, 2014. <http://www.enoughproject.org/reports/impact-dodd-frank-and-conflict-minerals-reforms-eastern-congo%E2%80%99s-war>
- 81 Friends of the Earth (2012). Mining for smartphones: the true cost of tin. http://www.foe.co.uk/sites/default/files/downloads/tin_mining.pdf

- 82 Milieuddefensie, Ranglijst: hoe verantwoord zijn bedrijven met tin? [How responsible are companies on tin?] In Dutch. <https://milieuddefensie.nl/tinmijnbouw/wat-schuilt-er-achter-jouw-scherm>
- 83 <https://www.fairphone.com/>
- 84 <https://phonebloks.com/en/about>
- 85 <https://phonebloks.com/en/partners>
- 86 <http://www.apple.com/environment/toxins/>
- 87 <http://www.nokia.com/global/about-us/people-and-planet/sustainable-devices/materials/management/substance-management/and> <http://company.nokia.com/sites/default/files/download/nokia-people-planet-report-2012-pdf.pdf> See p.86, Nokia's 2013 report is at: http://company.nokia.com/sites/default/files/download/nokia_people_planet_report_2013.pdf See p.67
- 88 <http://ca.blackberry.com/company/about-us/corporate-responsibility/product-sustainability.html#sustainable-at-the-source>, http://ca.blackberry.com/content/dam/bbCompany/Desktop/Global/PDF/Investors/Governance/BlackBerry_Policy_for_Control_of_Substances_Dec18.pdf
- 89 <http://www.hp.com/hpinfo/globalcitizenship/environment/materials.html>, <http://h20195.www2.hp.com/V2/GetPDF.aspx/c03742575.pdf> See p.42
- 90 HP (2014). Living Progress Report 2013, p.92 <http://h20195.www2.hp.com/V2/GetPDF.aspx/c04152740.pdf>
- 91 <http://www.acer-group.com/public/Sustainability/environment/products-1.htm>
- 92 Wipro (2013), op cit.
- 93 <http://www.dell.com/learn/us/en/uscorp1/corp-comm/earth-greener-products-materials?c=us&l=en&s=corp&cs=uscorp1>
- 94 <http://www.lg.com/global/sustainability/environment/greener-products/green-product-strategy> (see pdf Voluntary Replacement of Hazardous Substances)
- 95 http://www.lenovo.com/social_responsibility/us/en/materials.html
- 96 HCL Infosystems website, op cit.
- 97 <http://www.philips.com/about/sustainability/ourenvironment/chemicalmanagement.page>, http://www.annualreport2013.philips.com/content/en/sector_performance/consumer_lifestyle/ecovision_commitments.html
- 98 <http://www.toshiba.co.jp/env/en/products/chemical.htm>, http://www.toshiba.co.jp/dm_env/eng/ecp/pc/index.htm#v834
- 99 <http://www.samsung.com/us/aboutsamsung/sustainability/environment/chemicalmanagement/managementoftargetsubstances.html>
- 100 http://www.sony.net/SonyInfo/csr_report/environment/chemical/products/index1.html and http://www.sony.net/SonyInfo/csr_report/environment/chemical/products/index3.html
- 101 <http://panasonic.net/sustainability/en/eco/chemical/actions.html>
- 102 <http://sharp-world.com/corporate/eco/environment/business/chemical/index.html>, http://sharp-world.com/corporate/eco/supplier/g_procure/img/Report_Env_Impact_Substances_ver70_en.pdf
- 103 <http://www.apple.com/environment/toxins/>
- 104 <http://company.nokia.com/sites/default/files/download/nokia-people-planet-report-2012-pdf.pdf> See p.86
- 105 <http://ca.blackberry.com/company/about-us/corporate-responsibility/product-sustainability.html#sustainable-at-the-source>, http://ca.blackberry.com/content/dam/bbCompany/Desktop/Global/PDF/Investors/Governance/BlackBerry_Policy_for_Control_of_Substances_Dec18.pdf
- 106 <http://www.hp.com/hpinfo/globalcitizenship/environment/materials.html>, <http://h20195.www2.hp.com/V2/GetPDF.aspx/c03742575.pdf> See p.42
- 107 <http://www.acer-group.com/public/Sustainability/environment/products-1.htm>
- 108 <http://www.dell.com/learn/us/en/uscorp1/corp-comm/earth-greener-products-materials?c=us&l=en&s=corp&cs=uscorp1>
- 109 Wipro (2013), op cit.
- 110 <http://www.lg.com/global/sustainability/environment/greener-products/green-product-strategy> (see pdf Voluntary Replacement of Hazardous Substances)
- 111 http://www.lenovo.com/social_responsibility/us/en/materials.html
- 112 HCL Infosystems website, op cit.
- 113 <http://www.philips.com/about/sustainability/ourenvironment/chemicalmanagement.page>, http://www.annualreport2013.philips.com/content/en/sector_performance/consumer_lifestyle/ecovision_commitments.html
- 114 <http://www.toshiba.co.jp/env/en/products/chemical.htm>, http://www.toshiba.co.jp/dm_env/eng/ecp/pc/index.htm#v834
- 115 <http://www.samsung.com/us/aboutsamsung/sustainability/environment/chemicalmanagement/managementoftargetsubstances.html>
- 116 http://www.sony.net/SonyInfo/csr_report/environment/chemical/products/index1.html and http://www.sony.net/SonyInfo/csr_report/environment/chemical/products/index3.html
- 117 <http://panasonic.net/sustainability/en/eco/chemical/actions.html>
- 118 <http://sharp-world.com/corporate/eco/environment/business/chemical/index.html>, http://sharp-world.com/corporate/eco/supplier/g_procure/img/Report_Env_Impact_Substances_ver70_en.pdf
- 119 The lower level of commitment on either PVC or BFRs will determine the score.
- 120 See W1. Support for Individual Producer Responsibility for full clarification.
- 121 Effective means free and convenient for the customer. Free means "no recycling fee", but companies can charge a shipping fee.
- 122 Reporting is targeted at specific product groups: mobile phones, PCs, TVs and game consoles (depending on brand portfolio), for which companies need to report the global recycling rate.
- 123 Commitment to percentage cut in GHG emission using GHG emission data calculated in E1 as baseline.
- 124 The definition of "renewable energy" is the RECS internationally-accepted standards at: <http://www.recs.org/>
- 125 Greenpeace uses the Energy Star programme requirements and definitions for the following "specified products": Battery chargers, computers and televisions at: http://www.energystar.gov/index.cfm?fuseaction=find_a_product.



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Greenpeace is an independent global campaigning organisation that acts to change attitudes and behaviour, to protect and conserve the environment and to promote peace.

greenpeace.org