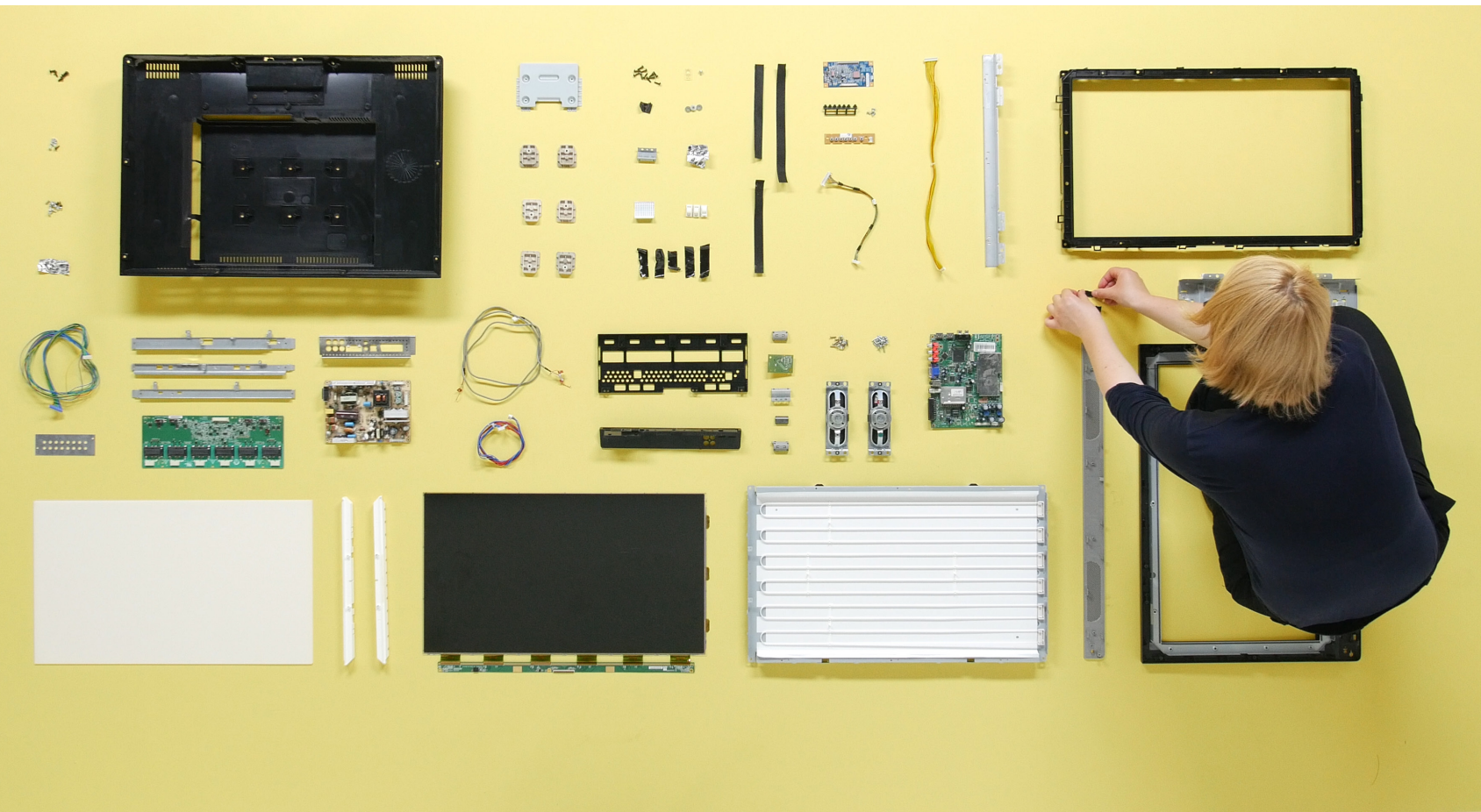




ELECTRIC SHOCK

Reclaiming usable materials from the 50 million tonnes of electronic waste stacking up across the world every year is a tough task, but Katie Treggiden meets makers who are rising to the challenge – fashioning furniture from computer components and mining mobile phones for gold



Designer Jorien Wiltenburg proposed that copper harvested from electronic cables could be used to knit and weave fabrics

Most of us remember learning the periodic table at school – neat rows of boxes filled with mystifying combinations of letters and numbers, each representing one of the 94 naturally occurring elements that are the building blocks of everything on earth. Sitting on those science lab stools, none of us imagined they might run out, but today some are already in short supply. In fact, the European Chemical Society has released a new periodic table, putting 12 elements on an ‘endangered’ list. Gone are the ordered lines that appeared in our chemistry books. In their place, amorphous shapes depict the comparative availability of each element, and a colour-coding system highlights which elements are most at risk and those that come from minerals mined in conflict zones. Thirty-one of the elements carry a smartphone symbol, spotlighting that they are used in every one of the 1.56 billion smartphones made annually. Five of these are already coded red – their availability under ‘serious threat in the next 100 years’.

Precious metals such as gold, copper and silver are among those becoming scarce, while antimony (used in batteries) and lead both look set to dry up in the next decade. Their availability is not hampered by limited existence – there is as much gold on the planet as ever – but there are few effective recycling processes, which means that the

decreasing supplies underground and their location in conflict zones is starting to bite, prompting rising prices. Approximately 10% of gold produced annually and a third of silver is used to produce electronic goods, and yet less than a fifth of e-waste is recycled – even during recycling, most rare earth metals are lost. Increasingly, the elements we need are not in the earth, but in landfill. According to one estimate, so-called ‘e-waste mountains’ hold precious metals such as gold in concentrations 40–50 times higher than can be mined underground.

Ghanaian artist Ibrahim Mahama’s large-scale installation made from e-waste, reclaimed from a scrapyards and salvage site in Accra, is at the heart of the Design Museum’s exhibition *Waste Age: What Can Design Do?*. The work, *Fadama 40* (2021), exposes the dumping of European electronic and digital waste in his country. It features alongside a film by design studio Formafantasma showing research from its three-year investigation into the reuse of electronic waste. Another output from *Ore Streams* – its multimedia project first commissioned by NGV Australia and Triennale Milano – is office furniture made from iron and aluminium extracted from computer cases and components. ‘The biggest problem in electronic waste is the fragmentation of responsibility and knowledge,’ says Simone Farresin, co-founder of Formafantasma.

Previous page: Studio Plastique | Ore Streams, courtesy NGV Melbourne, Triennale di Milano. Photo Formafantasma

If the challenge is being highlighted in the exhibition in London, a potential solution took centre stage in Tokyo this summer, where medals at the Summer Olympics and Paralympics were made from recycled electrical devices. Approximately 78,985 tonnes of discarded devices were collected, classified, dismantled and melted down and then used to create bronze, silver and gold medals.

Designers and craftspeople are already thinking along similar lines. In 2015, the designer Jorien Wiltenburg put forward a ‘future design scenario’ as part of her graduate project at the Willem de Kooning Academy in Rotterdam – her *Micro Urban Mining* project proposed that copper harvested from electronic cables could be used to weave and knit baskets and fabrics. ‘Restoring the connection between the creation and the use of an object gives us the strange but exciting feeling of having brought back to life something that was considered obsolete,’ she said at the time. It was entirely conceptual, but now pioneering makers and designers such as Sandra Wilson, Studio Plastique and Marta Torrent Boix are making such ideas a reality.

Previous page: mountains of electronic waste. Left: *Ore Streams*, Taxonomy, video frame, 2017/18. Right: Jorien Wiltenburg’s *Micro Urban Mining* in action, extracting aluminium and copper from e-waste to use as a material for knitting and weaving, above



Wilson is a silversmith, jeweller, researcher and educator at Duncan of Jordanstone College of Art & Design in Dundee, Scotland. She is interested in what she calls the 'edges of things'. Her research exists in the spaces between jewellery and metal design and other fields – biology, psychology, anthropology and, recently, chemistry. For her *Urban Gold Rush* project, she collaborated with the Love Chemistry Laboratory at Edinburgh University to recover copper and gold from old computer circuit boards she sourced on eBay, using a technique called hydrometallurgy. 'The process works with aqueous solutions using acids to recover precious metals,' she explains. She used hydrochloric acid to recover all the metals from the circuit boards, and then employed chemical compounds or ligands (molecules or atoms which bind reversibly to a protein) to separate them. 'I spend a lot of time shaking flasks with different solutions and filtering chemicals,' she says. 'I feel like a modern-day alchemist.'

Using traditional hand-raising techniques to create sterling silver vessels, Wilson paints the surfaces with her recovered metals in solution, allowing the water to evaporate and the metals to react with the silver, creating distinctive patinas. She has discovered that the process, known as electro-chemical displacement plating, was once used by pre-Hispanic Andean metalworkers. 'We can learn a lot from historical processes that will enable us to address sustainability,' she says. 'Craft values that emphasise materials, where they come from, and how we work with them are incredibly important – and craft practitioners, alongside other disciplines, are central to addressing the big cultural issues of our time.'

Wilson is now collaborating with the National Institute for Design (NID) in Ahmedabad to create a new value chain for female jewellers in India. Such artisans are often charged more for raw materials and paid poorly for their finished products. 'This project aims to connect female jewellers to e-waste recyclers and create a new "chain of custody" mark for their finished products, so they can charge a premium,' she says. The project has been hampered by funding cuts and COVID-19, but she is hopeful for its impact. 'It feels like we are only now getting going,' she says.

Over in Brussels, Studio Plastique mines electronic waste for glass, rather than precious metals. Silicon (Si) is still categorised as in 'plentiful supply' on the European Chemical Society's new periodic table, but sand (SiO₂) is scarce, driven by an exponential increase in demand for concrete – China has used more in the last 11 years than the USA used throughout the 20th century. The problem is that desert sand – eroded by wind – is too smooth to lock together and form materials such as concrete and glass, so it is the angular, water-eroded sand that is used – and it's running out.

But there is plenty of glass in landfill. The 'odd material out' in electronic waste, the glass windows found in washing machines, kettles and microwaves are often difficult for facilities to recycle, despite being eminently suitable. Theresa Bastek and Archibald Godts, co-founders of Studio Plastique, spotted an opportunity. 'It is downright stupid to neglect those materials. It is common sense to find



'Craft practitioners are central to addressing the big cultural issues of our time' SANDRA WILSON



applications for them,' says Bastek. *Common Sands* – a play on 'common sense' – is their collection of vessels, tableware and home accessories made from glass recovered from electronic waste. The colours and textures of each piece are a result of the metal oxides and coatings used within common household appliances, and each is marked with the origin of the glass from which it is made, in an attempt to restore the relationships between resource, producer and user.

The first prototypes were made using traditional craft techniques, such as glass blowing and glass pulling, and the pair is now investigating semi-industrial processes to enable them to scale up. 'Our generation is facing the consequences of poor resource management and poor design,' says Bastek. 'There is too much nonsense in the way we harvest, produce and consume – long-established, yet illogical cycles that are harmful to nature. There is no way around designing with waste in the future. What once seemed utopian will become obvious. But it has to be done right, it has to be done beautifully.'

It wasn't obvious to start with for Spanish product designer and maker Marta Torrent Boix, who began working

Opposite page, *Pendant*, 2018, recovered e-waste plastic fragments, and left: *Exemplar*, 2018, concentrated gold chloride bowl, both by Sandra Wilson. Below: glass vessels from Studio Plastique's *Common Sands* collection, made from recycled electronic waste



with electronic waste out of necessity. When she wanted to explore pottery but did not have access to a wheel, she set about making one. Realising that she would need an electric motor if she didn't want to power the wheel by foot, she called a mechanic friend to see whether he might have one to spare. He didn't, but offered her a broken washing machine instead. 'I only ever intended to use its motor, but when I started disassembling it, I realised that inside this "white box" were hundreds of useable parts,' she says. 'I ended up making the whole wheel from washing machine parts.' She has been making machines from electronic waste ever since.

For *Urban Mines* – her final project for her Material Futures MA at Central Saint Martins this year – Boix collected dumped electronic goods from the streets of London and repurposed them into both a table and a clay extruder to add to her potter's wheel. She now uses these machines to make ceramic tableware. '*Urban Mines* highlights the contrast between the intangible and mechanical parts of e-waste and the tactile part of ceramics,' she says. 'Through this project, I am combining old craft techniques with new and wasted technology to create unique ceramic pieces.' The pottery forms have their own distinctive style. Relatively straight-sided and oversized terracotta bowls and mugs feature chunky extruded handles that bear the marks of her machines. Although Boix is making use of electronic waste, she's not convinced that what she's doing is the solution. 'The problem starts in the way these products are produced,' she says. 'Complex artefacts like electronic devices have to be designed, not just for assembly and use, but for disassembly. If there was a simple way to separate and classify the integrated materials, they would be easier to recycle.'

Of course, these problems call for legislative intervention, and rules that go beyond the recently enacted 'right to repair bill' in the UK, but in answer to the question posed by the Design Museum – 'what can design do?' – Formafantasma's Simone Farresin agrees with Boix; it starts long before the end of a product's life. 'When you open an electronic product up, there's no clear colour coding or labelling that tells you what is hazardous, because you're not supposed to open it,' he says. 'A simple, universal colour coding system would not only increase the rare earth materials that can be salvaged, but also protect workers in the global south. Designers need to be involved because they can spot where things can be improved.'

Re-channelling the electronic waste stream is going to require imagination and expertise at every stage, drawing on the creative thinking of craftspeople and designers. Luckily, it's clear from the work of Wilson, Boix, Studio Plastique, Wiltenburg and Formafantasma that both already exist; it's simply a matter of making the connections – a little 'thinking around the edges', as Wilson might put it. '*Waste Age: What Can Design Do?*' is at the Design Museum, London, until 20 February 2022. designmuseum.org

Right: Marta Torrent Boix has created a ceramics workshop out of discarded electronics including microwave pieces, washing machine parts, and a clay extruder (top) made from a vacuum cleaner



Extruder: photo Mael Hénaiff | Boix: courtesy the artist

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