

How To Spend It Wisely: the sustainability special 2023

HTSI Sustainability

Meet Daisy – she wants your waste tech

Rhodri Marsden. Photography by Valentina Vos OCTOBER 17 2023

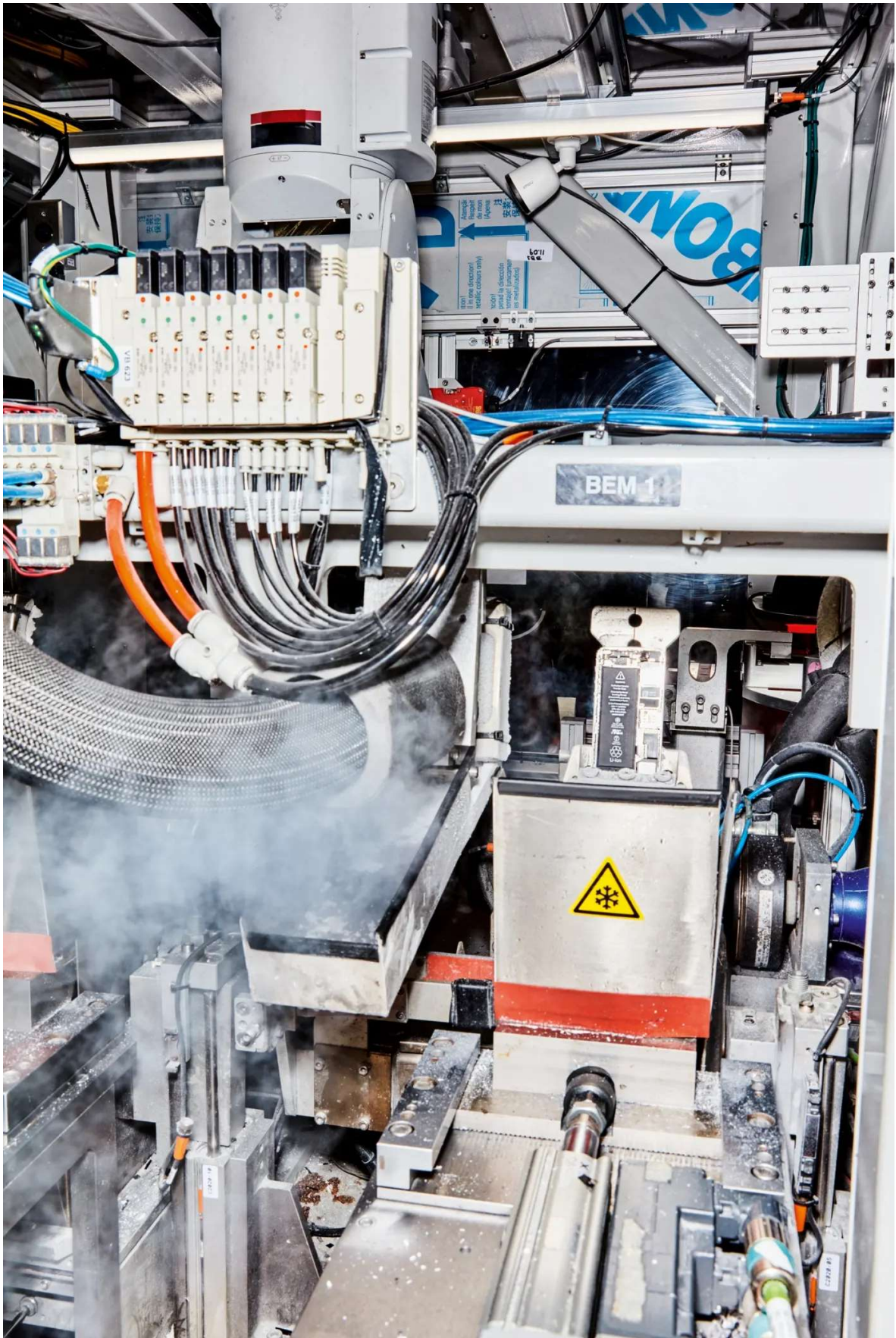
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For as long as there have been electronic goods, there's been electronic waste. The hazardous material it contains makes it difficult to process, and for decades the burden fell upon local authorities who struggled to cope. In 1990 an unlikely hero emerged, a Swedish professor named Thomas Lindhqvist who proposed that manufacturers of goods should be made responsible for the costs of dealing with them when they reach the end of their life, giving them an incentive to design products sustainably.

Over the next three decades, his idea slowly found its way onto some statute books, and some forward-looking electronics manufacturers embraced it. But even as the number of laws and recycling schemes expanded, our desire for gadgets outpaced them — particularly during the Covid pandemic: 21.2 million digital devices were bought in the UK in the first two months of 2020 lockdown alone. And for some reason, when we're finished with [gadgets](#) we tend to hoard them.



Daisy removes iPhone batteries using air cooled to -80°C © Valentina Vos



Disassembled iPhone Taptic engines containing rare earth metals, tungsten, copper, steel and gold © Valentina Vos

British e-waste scheme [Repic](#) estimates that 11.7 million laptops are sitting unused in UK households. They also found, in a 2019 survey, that when gadgets do finally leave our homes, older, wealthier consumers are more likely to recycle, while younger, smaller households are more likely to throw them away. This is a problem, according to Lisa Jackson, Apple's vice-president of environment, policy and social initiatives. "If people have devices in drawers, it's really important to tell them that they have a value to the planet," she says. "Apple can either resell, send to a reseller, or, if it's really end-of-life, we can recycle and get that material back into circulation. We're trying to show that you can have a successful thriving business that gives customers what they want, but is also mindful of the planet."

Smartphones contain a wealth of reusable material, including aluminium, cobalt and rare earth elements such as palladium and neodymium. Some are defined by the EU as critical raw materials — demand is rising, and there's high risk associated with their supply. According to Pascal Leroy, director-general of the [WEEE](#) (waste electrical and electronic equipment) Forum, an international association of e-waste compliance schemes, 42 per cent of palladium comes from Russia, China sits on 95 per cent of most rare earth elements, and we should be trying harder to recover this material from existing devices instead of mining for more. "Even in a 100 per cent circular economy we will still have to mine, because the population continues to grow," he says. "But the more we conduct urban mining, the more we alleviate the need for primary mining."



A small team packs material disassembled by Daisy before sending it to specialist recycling plants © Valentina Vos



Daisy can currently process 23 different models of iPhone © Valentina Vos

Not enough devices are being supplied for Daisy to operate 24/7

One of the most advanced examples of urban mining occurs in Breda in the Netherlands, where Apple's recycling robot, Daisy, automates the process of removing components from 23 different models of [iPhone](#). Designed to process 1.2 million units a year, it creates clean streams of waste from which useful materials can be liberated, either by other Apple robots (named Dave and Taz) or by recycling specialists. One tonne of printed circuit boards, flexible electronics and camera modules recovered by Daisy contains the same amount of gold and copper you'd find in 2,000 tonnes of rock. Daisy makes perfect sense — but it's currently running under capacity simply because not enough devices are being supplied for it to operate 24/7.

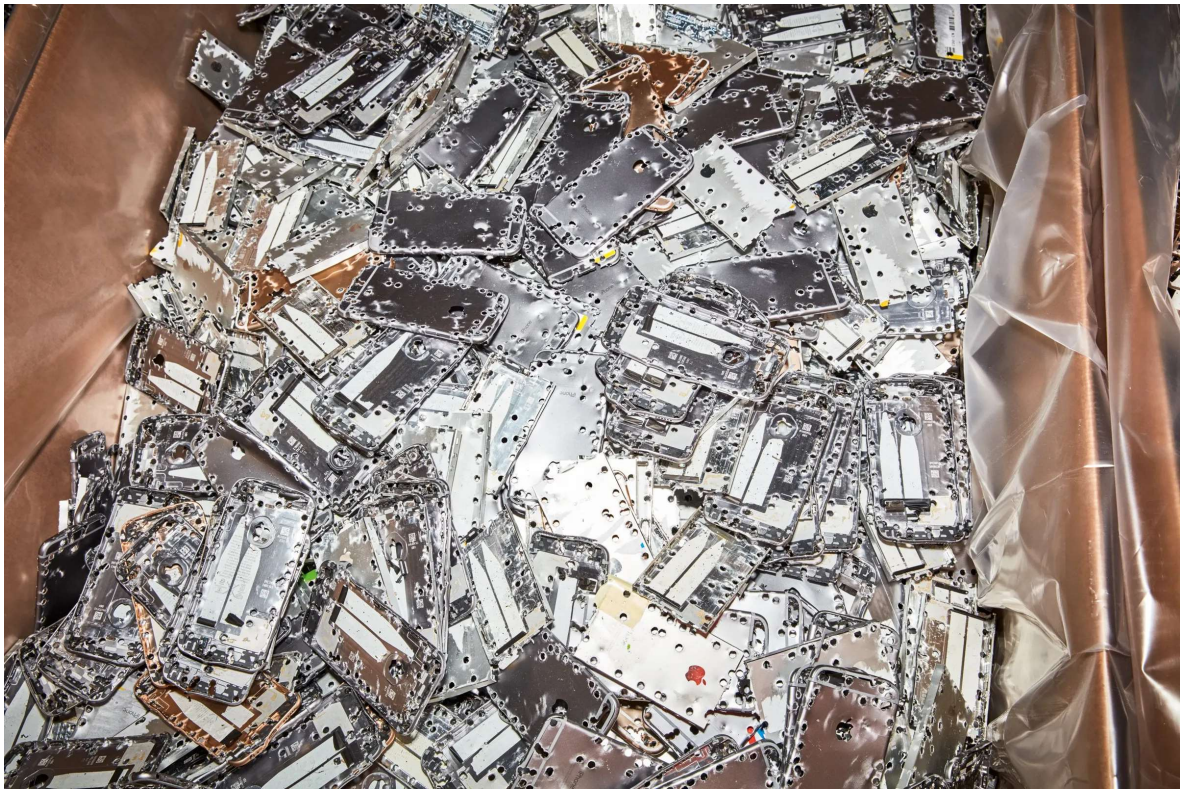
Apple's ultimate aim (with no current timeline) is to make its products only from recycled and renewable materials. Some of its commitments are more specific: by 2025 it plans to be using 100 per cent recycled cobalt in all Apple-designed batteries, and for all magnets in its devices to use recycled rare earth elements (beginning this year with the [new iPhone 15](#) and Apple Watch Series 9). Meanwhile, its drive towards decarbonisation continues apace, with its first carbon-neutral products appearing in the new Apple Watch Series 9 line: these watches have the same carbon footprint as a plain white T-shirt, with high-quality offsets coming in the form of grasslands, savannahs and mangroves.

Recycling can also help with decarbonisation, but consumers play a critical part. Apple's Trade In programme, available in 25 countries, simplifies the process of safely offloading unused devices, either in store or via post, and last year the company directed more than 40,000 tonnes of electronic scrap to recycling globally. The world's three other biggest smartphone vendors, by volume — [Samsung](#), Xiaomi and OPPO — also offer e-waste take-back schemes and recycling programmes via WEEE partners. Samsung boasts of collecting 5.69 million tonnes of e-waste between 2009 and 2022 while increasing the number of device components that incorporate at least 10 per cent recycled material. [OPPO](#)'s recycling centres in China collected 1.08 million phones last year, with 195 tonnes of products recycled. [Xiaomi](#), once criticised by Greenpeace for not reporting publicly on its use of recycled materials or take-back efforts, has now committed to recycling 38,000 tonnes of e-waste and using 5,000 tonnes of recycled material in products between 2022 and 2026.

Such promises look good on paper, but seem to trail behind Apple's vision of using 100 per cent recycled material across its product range. One of the main challenges of pushing towards complete circularity is the trace contaminants that can lower a material's grade, and according to John Ternus, Apple's senior vice-president of hardware engineering, the problem can only be overcome by imaginative innovation. "We have a very stringent specification for the aluminium we use to meet our [cosmetic and strength] requirements," he says. "But we've been able to design a completely new aluminium alloy that can handle those contaminants without affecting the material properties. So the MacBook Air now has a 100 per cent recycled aluminium enclosure. And I think most customers probably wouldn't know."



Material is ejected from Daisy after disassembly © Valentina Vos



Processed iPhone housings ready for the metal to be recycled © Valentina Vos

As Ternus suggests, much of this work goes uncelebrated. Machines punching out screws and engineers devising ways to retrieve small amounts of tungsten aren't sexy, and that's reflected in a general lack of innovation in the world of recycling — which is why Apple had to develop Daisy in-house. At its Material Recovery Lab in Austin, Texas, it is applying machine learning processes to help traditional recycling machines better deal with electronics: more yield, less waste. CEO Tim Cook talks about Apple's efforts being a "ripple in the pond", and to that end it has also made Daisy available for free licence — but as yet there have been no takers. "It puzzles me," says WEEE's Pascal Leroy. "I've discussed it with recyclers, and I didn't get a straightforward response. There doesn't seem to be a strategy, a long-term plan or vision, and I think that's deplorable."

One reason may be the huge amounts of capital expenditure needed to retrieve material that, in a few years time, may no longer even be required thanks to advances in materials science. Apple's deep pockets, however, put it in a prime position to do groundbreaking work. "As we go through this effort and work with suppliers to build up a flow of recycled material, we're almost always the first ones to have those conversations with them," says Ternus. "We're happy to go first," adds Jackson. "Then other companies can say, 'OK, now they've figured out perfectly acceptable ways to recycle and use tantalum or copper, we want it too.'"

Recycling is just one of the ways in which tech manufacturers are having to innovate to alleviate their environmental impact. Extending the durability and longevity of devices is one loudly trumpeted by Apple (“We think the best repair is the one you never have to make,” says Jackson). Expanding the use of renewable energy, eliminating single-use plastics and reducing the power consumption of their products all play a part, and tech firms will be keen to tell us about these things, because they want to assure us that technological progress and care for the environment are not mutually exclusive. But we have to play our part. Last Saturday was International E-Waste Day, promoted by the WEEE Forum. You probably missed it. But it’s never too late to recycle that iPhone that hasn’t been turned on for, what, a year? Daisy is ready and waiting.

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