to 1.25 watts of electricity that can power devices directly or charge a battery. Lead researcher Zhong Lin Wang has set up a company to commercialise the device, but he admits there are still technological hurdles to overcome, particularly regarding the durability of the plastic-based product. "We've done tests in our lab and after 10 million compressions the device still works," he says. "We need to extend that to billions."

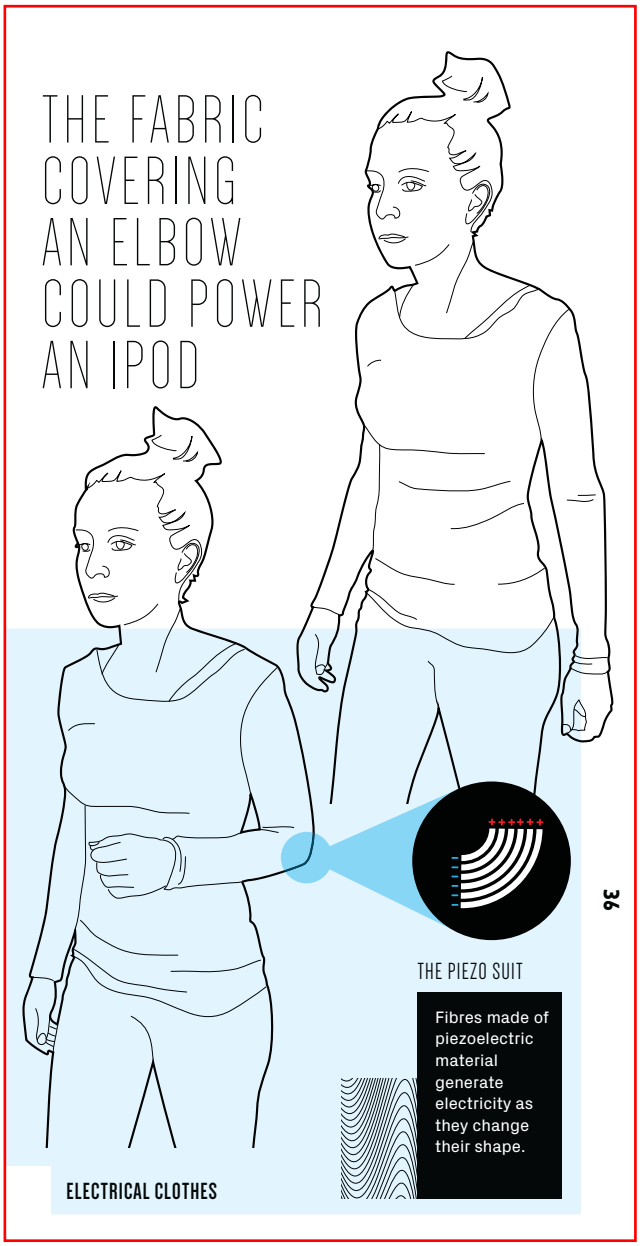
PIEZO CLOTHING

Another solution is smart clothes that generate energy through bodily movement. Liwei Lin's group at the University of California at Berkeley has produced tiny fibres from a polymer material known as PVDF that accumulates charge when it is mechanically deformed - a phenomenon known as the piezoelectric effect. The fibres, only 500 nanometres in diameter, can convert as much as 20% of applied kinetic energy into electricity, which means, says Lin, that 1 million of them packed into just 1 mm^2 of fabric covering a moving part of the body such as the elbow "would be able to power an iPod". But producing fibres in large quantities with a consistent performance remains a technological challenge.

Steve Beeby of the University of Southampton is leading a team that aims by 2015 to make films of piezoelectric and thermoelectric materials for printing onto fabrics. These films would provide electricity for portable devices through people's movement as well as the thermal gradients between them and their surroundings.

ENERGY FROM THE AIR

At the University of Washington in Seattle, a team is working to pluck energy from thin air. Shyam Gollakota and colleagues have built credit card-sized devices that use wireless signals from television and mobile-phone transmissions to communicate among themselves and to generate power. They say that their devices could be used inside autonomous smart sensors and potentially incorporated into battery-using devices such as smart phones, providing enough power after the battery has fully discharged to allow the user to send text messages.



DIANA BOSCH

"ENERGY IS THE MAIN CONSTRAINT FOR PORTABILITY"

EPFL's Ionescu predicts that energy harvesting will appear on the market gradually, supplementing rather than replacing rechargeable batteries over the next five to 10 years; better energy-management software will also be needed to prioritise the limited energy available to devices. Ionescu says that harvesting is limited because it is "opportunistic", scavenging whatever energy happens to be available locally. He notes that solar power is less efficient indoors and that technologies exploiting thermal gradients work better during the winter, when there is a higher temperature difference between people and their surroundings. Electromagnetic scavenging would work only when antennas are relatively close by and not at all in remote areas such as mountains. The technique might also potentially disrupt mobile communications, since it would consume some of the finite energy beamed by antennas.

Even so, Ionescu is convinced that such technology will eventually become commonplace. Until then, maybe, your smart glasses might just be the most expensive pair of eyewear you've kept in a drawer because recharging it proved too much of a hassle. ▮