Economist.com SCIENCE & TECHNOLOGY

Self-generated energy

Power from the people

Feb 7th 2008
From The Economist print edition

Now you can recharge things just by walking around

Illustration by David Simonds

IN THE early 1990s, an inventor called Trevor Baylis came up with an idea that provoked the sort of smirking disbelief journalists usually reserve for those who have spent too long in their garden sheds. But the smirkers were wrong. Mr Baylis's clockwork radio turned out to be a great success in places where batteries are expensive and mains electricity is non-existent. In the latest versions, the crank charges a battery directly, rather than winding up a spring which then turns a small dynamo. A few minutes' handle-turning can provide an hour's reception.

Wind-up radios have turned into consumer products in rich countries too, along with wind-up torches, wind-up mobile-phone chargers and wind-up music players. But all these gadgets rely on people having to do some specific work in return for their entertainment. Hence the appeal of finding a way of extracting power from everyday activities without the user noticing what was going on—rather like an old-fashioned self-winding watch, but on a grander scale. There have been several attempts to do this in the past, from trainers that absorb power from the pounding of a foot on a pavement to backpacks that generate it from the bobbing motion of the load while the wearer walks. None, though, has really taken off. But the latest idea might, as it is a human version of a popular idea in car design—regenerative braking.

The "energy harvester" that Max Donelan of Simon Fraser University and his colleagues describe in this week's *Science* looks like an orthopaedic knee-brace. It tucks behind its wearer's knee and has extensions that strap around the front of his calf and his thigh. When the wearer walks, the knee's motion drives a set of gears which turn a small generator.

On the face of it, that sounds like a recipe for making walking difficult. Surprisingly, it is not. Although the leg muscles perform "positive" work when they accelerate the leg forward to begin a step, when the leg straightens at the end of the step they perform "negative" work as they slow the leg down. If the generator in the harvester were connected during the accelerating phase the process would, indeed, be expected to increase the load on the muscles. But if it were connected only during the decelerating phase it would impose no load. It might even make things easier.

To test this idea, Dr Donelan recruited six volunteers, attached harvesters to their knees and put them on a treadmill. With the generators in the harvesters engaged all the time, walking produced seven watts of power. When the generators were engaged only during deceleration, however, they produced almost five watts (enough to power ten mobile phones simultaneously). Moreover, in that second case, the amount of extra energy used by walkers wearing the harvesters was insignificant, since the harvesters were absorbing energy that would otherwise be dissipated as heat—which is exactly the principle used by regenerative braking in a petrol-electric hybrid car.

One use for the harvesters, if they could be made cheaply (and people could be persuaded to wear them routinely), would be to charge up batteries. But Dr Donelan also has more sophisticated applications in mind. He thinks energy harvesters could be used to power robotic artificial joints and might even, one day, be implanted within muscles for that purpose.

A green light

Even the quotidian uses of an energy harvester like Dr Donelan's will, however, be enhanced by other advances in the field. Rechargeable batteries are getting smaller, lighter and more powerful. They may eventually be replaced in some applications by ultracapacitors that can charge up and discharge even faster than a battery. More efficient cranking systems and generators are also under development. And the miniaturisation of electronics continues to reduce power demands.

One of the biggest changes has been the use of light-emitting diodes (LEDs). This has transformed wind-up lighting products, says Rory Stear, chairman of Freeplay Energy, which specialises in such “self-powered” devices. The company's Indigo lantern, for instance, can provide up to two hours of light from just one minute of winding. LEDs also last for a long time: those in the Indigo are rated for 100,000 hours, whereas a filament bulb might burn out after 16 hours.

Such products can make a huge difference to power-starved people. Freeplay's charitable foundation reckons that the use of kerosene, candles and firewood for lighting absorbs 10-15% of monthly household incomes in sub-Saharan Africa. It is planning to test a range of wind-up LED lanterns in Kenya and South Africa this year. These, it hopes, will allow people to do things like studying at night, increasing their security and coping better with medical emergencies. Freeplay Energy is also developing self-powered medical equipment, including a fetal-heart monitor.

Mr Stear says people in poor countries are prepared to work hard for their energy, with wind-up lanterns often passed among family members to help power them. That bodes well for Dr Donelan's idea, if it can be mass-produced. But the ability of such devices to save on batteries and to serve as reliable standby devices could make them popular even in Western markets as their performance gets better. Save the planet by walking to work and powering up your iPod at the same time. What more could a Green want?