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Biodegradable Electronics: *toss away your old gadgets in the compost bin*

Printed Circuit Boards That Break Down in Compost Scientists are now making this a reality using biodegradable circuit boards, where they will break down organically instead of damaging the world.

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Introduction

E-waste, or electronic rubbish, is one of the environmental problems that is getting worse the fastest in the 21st century. Printed circuit boards (PCBs) are the fundamental part of all modern electronics, and they make this problem worse because they are made from materials that don't break down naturally. The traditional way to create PCBs is with fiberglass and epoxy resins. When these things end up in landfills, they can leach dangerous chemicals into the soil and water for generations.

Scientists across the world are now working on an interesting solution: PCBs that break down on their own and may be safely composted or destroyed when they are no longer needed. These new boards are made from materials that can be recycled and are good for the environment, like polylactic acid (PLA), cellulose, or biobased composites that break down more easily. They don't employ glass fiber or polymers that are hard to recycle.

Old PCBs are a big source of e-waste since the materials they are made of are hard and costly to recycle. This means that metals are often found, but the harmful non-metal parts are not. Biodegradable alternatives, on the other hand, are made to break down without leaving behind harmful chemicals. This is good for the circular economy and bad for pollution.

The technological ecosystem in Pakistan is growing swiftly, and more individuals are using and throwing away electronics. Biodegradable PCB technology might be good for the environment, inspire local artists, and support business owners who wish to build hardware that lasts. This adjustment is in line with global aims for sustainability and allows Pakistani engineers and businesses a chance to be leaders in eco-friendly technology.

> ***"Researchers have shown that almost 99% of some compostable circuit designs can safely dissolve in household chemicals or soil. This means that electronics won't have to stay in landfills forever."***

Technology Overview

Biodegradable printed circuit boards (PCBs) use renewable fibers and eco-friendly materials instead of hard fiberglass and epoxy. You may make these boards dissolve in hot water or break down in compost when you're done by mixing natural materials like cellulose, bamboo-derived lyocell, or lignocellulose with conductive tracks formed of metals like zinc. The UK company Jiva Materials, for instance, has put Soluboard up for sale. By soaking the board in hot water, this device lets

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companies separate and get back copper and other parts. Researchers at the University of Glasgow have shown that paper and bioplastic boards that are like each other work like ordinary PCBs when used, but they break down in a few weeks when put in compost.

These kinds of improvements are very helpful for things like smart sensors, medical test strips, and electronic packaging that are only used once or don't cost much. The circuit is thrown away after a short time. Pakistan doesn't have any institutional e-waste collection, although people are using more technology. Using biodegradable boards could be good for the environment and open new markets for electronics that are created locally and are good for the environment. Compostable PCBs might be used in cheap IoT modules for farming or smart meters. This would support the circular economy and bring in green investment.

Key Findings & Impact

Pakistan's tech scene is no longer just a bunch of numbers; it's a story of people's drive and strength. In the last few years, startups have popped up all over Pakistan, from Karachi to Peshawar. These companies are not only coming up with new ideas, but they are also helping communities, creating jobs, and inspiring a new generation of entrepreneurs who aren't afraid to dream big. There is a young founder staying up all night coding, a woman breaking preconceptions to run her startup, and many students learning skills that could change the future of the country behind every growth statistic. These changes are not just good for the economy; they also show hope, innovation, and real change. The message is obvious for governments, investors, and teachers: it is not an option to nurture talent and give people chances; it is necessary. These stories also remind us that development is most important when it affects real people and leads to action by many people.

What's Next?

Biodegradable PCBs are no longer just a dream. Lab prototypes now power touch sensors, LED counters, and temperature probes that break down almost completely when composted. Researchers in the EU determined that their zinc-based circuits might lower the potential for global warming by 79% and the depletion of resources by 90% compared to regular

boards. You may take apart Jiva Materials' Soluboard with hot water to get back copper and fibers. Big projects in Europe are also trying out boards made from wood pulp. These improvements show that circular electronics can be made, but there are still problems that need to be solved before they can be widely used. There are still problems to solve. Plant-based substrates soak up moisture easily, which can make boards bend or short-circuit in humid settings. Some prototypes changed shape by over one percent at 85% relative humidity. Natural fibers don't stop fires as well as glass-reinforced epoxy, and low-temperature solders might make it hard to utilize in high-power devices.

Start-ups realize that biodegradable boards cost 15–20% more than jute and are still a lot more expensive than regular FR-4 boards. Infrastructure is just as vital. Pakistan makes almost 500,000 tons of e-waste per year, but it doesn't have any baseline data or official collection methods. Informal recycling is the most common way to recycle, and only 60–70% of ordinary waste is picked up. Without strong laws, certified recyclers, and public awareness, even compostable boards could end up being burned or thrown away with regular electronics. There are chances to come up. The government is paying attention. In July 2025, the Ministry of Climate Change brought together a high-level working group to write Pakistan's first national e-waste management framework. They said that safe recycling and laws were needed right away. Biodegradable circuits are great for sensors that are only used once, agricultural monitors, and medical tests. These are areas where Pakistani start-ups can compete without necessitating expensive fabrication operations. Local colleges might work with international groups like Hyperlignum or CircEl-Paper to make wood-fiber boards that are more suited to South Asian conditions and use fibers from crops grown in the area. Because e-waste contains valuable metals, such copper, lithium, and gold, a professional recycling industry can create jobs, recover resources, and pay for the more expensive compostable PCBs. For example, one ton of obsolete cellphones can yield 70 kg of copper, 15 kg of lithium, and 235 g of gold. A call to action. Pakistan's future inventors and decision-makers have a rare chance to jump forward to circular electronics. A national e-waste policy, more research into green materials, and safe recycling infrastructure will make the country's expanding electronics consumption into a long-lasting business. Compostable PCBs give entrepreneurs an edge in export markets that want low-impact technology. For readers, asking for things that may safely return to the planet is a strong market signal. Researchers say that 99% of the materials in their circuit can be safely composted or decomposed. If Pakistan accepts that vision, the gadgets of the future might not only light up our homes and farms, but they might even help our soils when they are done working.

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References

Radio Pakistan (2025): The Climate Change Ministry is working harder to deal with the problem of e-waste. 8 July: National broadcast.

Javaid, A. (2025) "Recycling in Pakistan: turning waste into opportunity for a sustainable future," The Friday Times (Citizens' Voice), 22 October.

Raza, M. (2026) "Pakistan's growing waste problem and why it needs long-term solutions right away," The Friday Times (Citizens' Voice), January 17.

King, A. (2026) 'Sustainable technology: creating greener circuit boards', Chemistry & Industry (C&I), Issue 1, pp. —. CIVIS Newsroom (2026) 'Compostable circuits might halve environmental effect of electronics', CIVIS Highlights, 22 January.

Sun, Y., Driver, S., and Wagih, M. (2026) "Additively manufacturing printed circuit boards with low waste footprint by transferring electroplated zinc tracks," Communications Materials, 7(1).