OPPORTUNITY 48

SCOPE TRANSITIONAL

UNCERTAINTIES

Technology, Nature

MEGATRENDS

Materials Revolution

TRENDS

Artificial intelligence
Biomaterials
Immersive technologies & wearables
New Materials
Sustainable Waste Management

SECTORS IMPACTED

Agriculture & Food
Automotive, Aerospace & Aviation
Chemicals & Petrochemicals
Communication Technologies & Systems
Consumer Goods, Services & Retail
Digital Goods & Services
Energy, Oil, Gas & Renewables
Financial Services & Investment
Government Services
Health & Healthcare
Immersive Technologies
Logistics, Shipping & Freight
Manufacturing
Materials & Biotechnology
Metals & Mining
Professional Services
Sports

What if food waste was the key to sustainable flexible electronics?

GREEN PLASTICS

Advanced machine intelligence with sustainable agriculture bioengineer starch from food waste transforming it into fully biodegradable plastics for electronics, wearables, and packaging, supporting a fully circular bioeconomy.

WHY IT MATTERS TODAY

The equivalent of 2,000 trucks full of plastic enter the world's oceans, rivers, and lakes daily,[972] taking hundreds of years to degrade, with negative impacts on land and marine ecosystems.[973] Recent studies indicate that some 77% of people have plastic particles in their blood.[974] E-waste, which includes plastic, is expected to increase from 50 million to 110 million tons by 2050.[975] Only some 20% of e-waste is recycled.[976] Soft, flexible and stretchable electronic devices are particularly difficult to recycle.[977]

With rising plastic waste and plastic bans, researchers are developing biodegradable, starch-based, plastic substitutes with low toxicity for humans and ecosystems as they degrade.[978] Starch is inexpensive and less environmentally harmful than conventional plastics.[979] Researchers are working to improve on current starch-based plastics, which have poor flexibility and high water vapor permeability.[980]

Flexible electronics (also known as flexible circuits) are capable of bending, folding, and stretching without losing their functionality. They are thin, lightweight, and can be designed for recyclability.[981] Manufacturing processes for flexible electronics are more material- and energy-efficient, generating less waste.[982] By 2030, it is estimated that the flexible electronics market will surpass $61 billion.[983]

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Even though starch, as a biopolymer, has been an area of high potential for at least 20 years, it is brittle, sensitive to moisture, and has poor thermal properties and mechanical resistance.[984] Advanced machine intelligence enables the bioengineering of starch into 100% biodegradable plastics that can subsequently be used as external and internal components for all types of electronics, wearables, and consumer packaging. Avoiding the need to blend with other polymers to enhance performance[985] and derived from organic waste – such as pineapple stems[986] – starch-based plastics can boost sustainable agriculture as production for green plastics expands into a growing market supporting agricultural livelihoods and moves towards a circular bioeconomy.

BENEFITS

Using starch as a biodegradable form of plastics reduces the harmful effects of plastic e-waste on people and nature, while also opening up new possibilities with stretchable electronics and soft robotics.

RISKS

Starch-based biodegradable plastics may not be as durable as expected, leading to higher maintenance and repair costs. Using food waste for bioplastic production could inadvertently result in more food waste and less sustainable agriculture to meet increased demand.