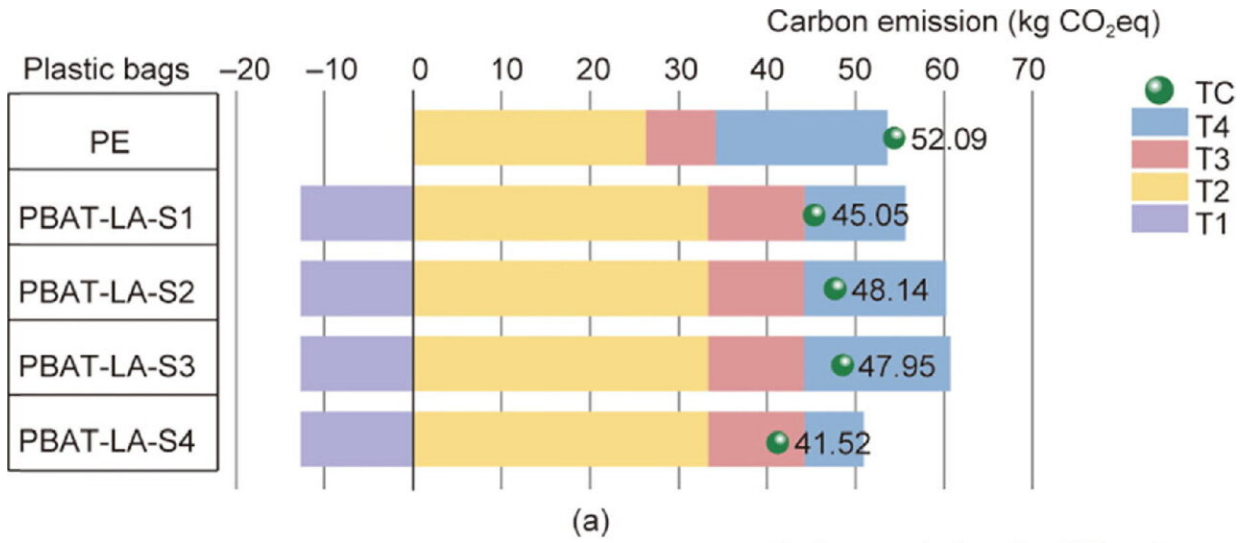
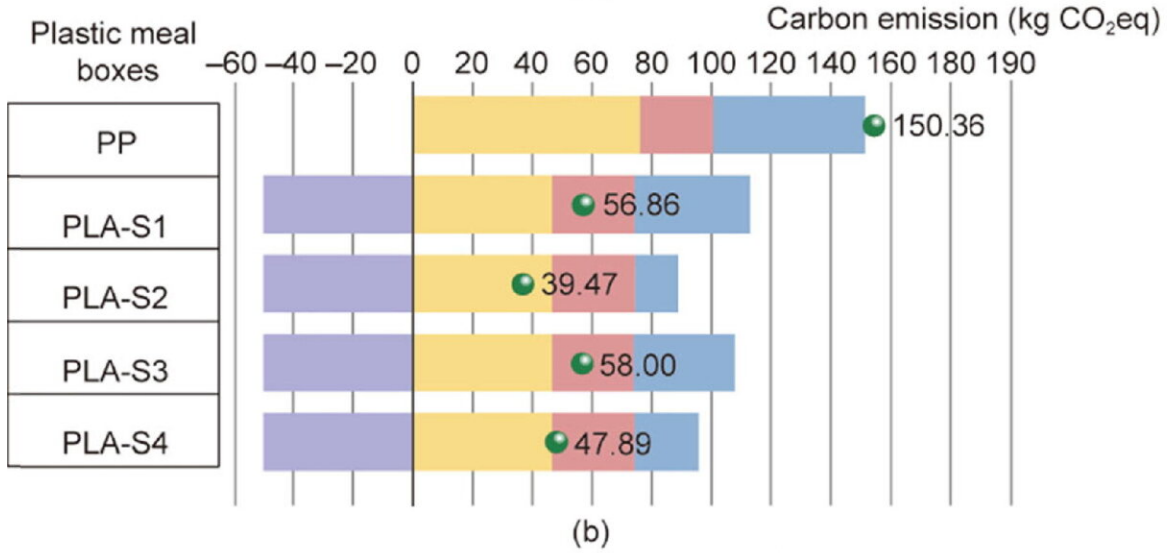
Study: Replacing plastics with biodegradable alternatives would lead to significant carbon emissions reduction

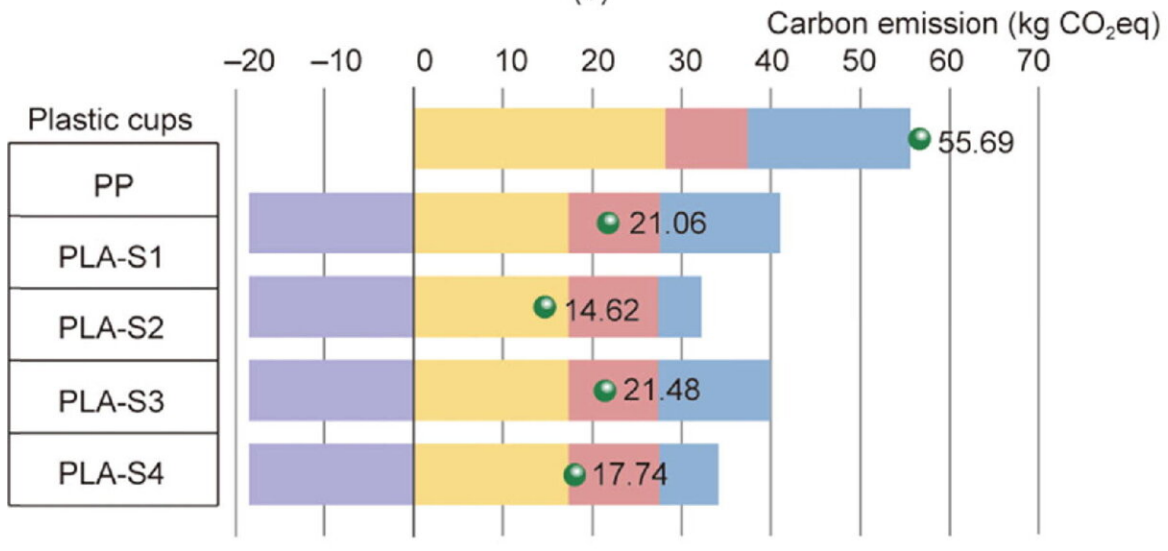
February 21 2024


Carbon emission (kg CO_2eq)
Plastic bags
–20 –10 0 10 20 30 40 50 60 70
PE
PBAT-LA-S1
PBAT-LA-S2
PBAT-LA-S3
PBAT-LA-S4
52.09
45.05
48.14
47.95
41.52
TC
T4
T3
T2
T1

(a)


Carbon emission (kg CO_2eq)
Plastic meal boxes
–60 –40 –20 0 20 40 60 80 100 120 140 160 180 190
PP
PLA-S1
PLA-S2
PLA-S3
PLA-S4
150.36
56.86
39.47
58.00
47.89

(b)


Carbon emission (kg CO_2eq)
–20 –10 0 10 20 30 40 50 60 70
Plastic cups
PP
PLA-S1
PLA-S2
PLA-S3
PLA-S4
55.69
21.06
14.62
21.48
17.74

(c)

(a) 1000 single-use polyethylene (PE) and polybutylene adipate terephthalate (PBAT)-lactic acid (LA) plastic bags; (b) 1000 single-use polypropylene (PP) and Polylactic acid (PLA) plastic meal boxes; (c) 1000 single-use PP and PLA plastic cups. The labels PBAT/PLA-S1, PBAT/PLA-S2, PBAT/PLA-S3, and PBAT/PLA-S4 indicate that the T4 stage uses S1, S2, S3, or S4. Credit: Guanyi Chen et al.

Plastic pollution and its impact on the environment have become critical global issues in recent years. In response, the research teams have conducted a study to evaluate the carbon emissions associated with both traditional plastic products and biodegradable plastic products (BPPs). Their findings demonstrate a substantial reduction in carbon emissions by replacing traditional plastics with biodegradable alternatives, highlighting the potential for a more sustainable future.

The study, published in *Engineering*, compared four stages of the life cycle of traditional plastics and BPPs to determine their respective carbon emissions. These stages include raw materials acquisition, plastic production, product manufacturing, and waste disposal.

The research teams analyzed 1000 traditional plastic products, such as plastic bags, lunch boxes, and cups, and found that their carbon emissions ranged from 52.09 to 150.36 kg CO_2eq. In contrast, 1000 similar BPPs emitted only 21.06 to 56.86 kg CO_2eq, representing a remarkable reduction of 13.53% to 62.19%.

The study also revealed that the plastic production and waste disposal stages had the most significant impact on carbon emissions for both traditional plastics and BPPs. Notably, BPPs showed substantial carbon reduction potential at the raw material acquisition stage. When

considering waste disposal methods for BPPs, composting and anaerobic digestion emerged as the preferable options due to their positive environmental impact.

However, the high cost of biodegradable plastics poses a challenge for their widespread adoption. While the study highlights the environmental benefits of BPPs, it emphasizes the need for more economical production technologies and waste disposal methods to enhance the sustainability of biodegradable plastics.

According to the research team's calculations, the adoption of BPPs in China, replacing traditional plastic products like bags, meal boxes, and straws, could lead to a reduction of 1.03×10^6 to 1.10×10^8 kg CO_2eq of carbon emissions annually. This significant reduction highlights the potential positive impact on the environment and the urgent need to prioritize the development and implementation of BPPs.

This study serves as a valuable reference for the sustainable development of the biodegradable plastics industry. Quantifying the environmental benefits of BPPs and identifying optimal waste disposal methods provides critical insights for policymakers, industry leaders, and researchers striving for a greener and more sustainable future.

More information: Guanyi Chen et al, Replacing Traditional Plastics with Biodegradable Plastics: Impact on Carbon Emissions, *Engineering* (2023). DOI: 10.1016/j.eng.2023.10.002

Provided by Engineering

https://phys.org/news/2024-02-plastics-biodegradable-alternatives-significant-carbon.html