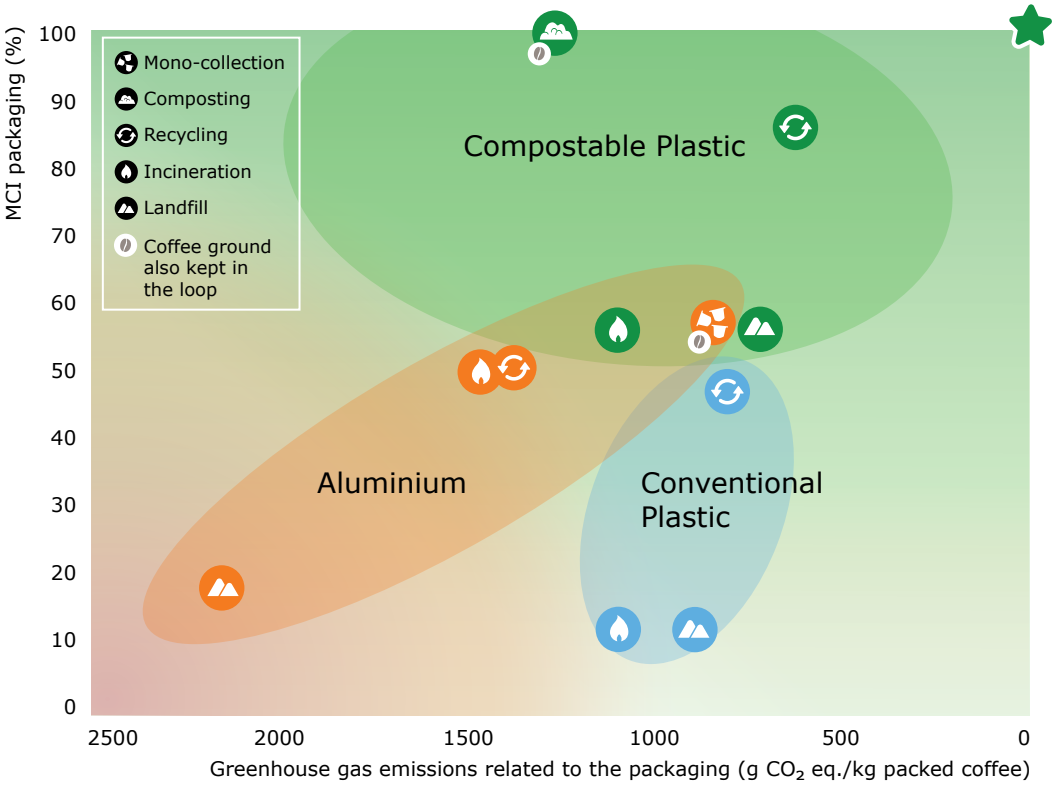
WAGENINGEN
UNIVERSITY & RESEARCH

Compostable capsules the most sustainable option for single serve coffee units

Wageningen University & Research has assessed the environmental impacts and circularity of different materials for single serve coffee capsules, when subjected to various end-of-life scenarios. When both material circularity and greenhouse gas emissions are taken into account, compostable capsules are the most sustainable option.



About coffee use
In Europe approximately 53 billion capsules were purchased by consumers in 2023.

AMI Consulting, Single Serve Capsules, Global Market overview 2020, September 2020 (confidential)

Conclusions

1 When taking into account both greenhouse gas emissions and circularity, the main conclusion is that compostable plastic capsules are the most sustainable option. Their MCI is 100% (fully circular) when the capsules are composted: materials are both biobased (non-fossil based) and biodegradable. Both coffee grounds and capsule material can be kept in the loop as they are "organically recycled" via the biosphere into compost. Compostable options remain sustainable even when consumers dispose of the capsules in the 'wrong' container. Currently in the Netherlands, the main hurdle is getting compostable coffee capsules accepted in the separately collected municipal organic waste.

2 Aluminium capsules are a second-best choice if they are collected separately through systems designed exclusively for returning these capsules (mono-collection): the aluminium is then recycled and the coffee composted. However, the MCI is lower (around 60%) compared to compostable capsules, even when recycled aluminium is used to produce the capsules. A closed recycling loop is not feasible because untargeted trace elements will accumulate in the aluminium, making it less pliable over time. Another main challenge is to achieve a high participation rate in a voluntary mono-collection system.

3 Conventional fossil-based plastics do not fit in a circular economy as neither the plastic capsules nor the spent coffee grounds are recycled. The MCI is below 50%.

Scope and method

Types of coffee capsules researched, all for the Nespresso machines:

- Compostable and bio-based plastic capsules (PLA, PHA)
- Conventional plastic capsules (PP, HDPE)
- Aluminium capsules, with and without recycled content

Sustainability factors assessed:

- Global warming potential over a period of 100 years (GWP-100) in terms of carbon dioxide equivalents;
- Material Circularity Indicator (MCI)[1], which includes recycling rates, recycled content, recycling process yield, biobased content, reusability and average lifespan.

End-of-life scenarios:

- Industrial composting (only for compostable capsules)
- Recycling via light weight packaging (LWP) waste collection
- Incineration with energy recovery
- Landfill with energy recovery
- Mono-collection (only for aluminium capsules)

Project and funding

This research is part of the project "Increase circularity by the use of biobased and/or industrially compostable materials". This study was carried out by Wageningen Food & Biobased Research, subsidised by TKI BBE[2] and funded by Advanced Technology Innovations, De Koffiejongens, Natureworks, Novamont, TotalEnergies Corbion and the Dutch Ministry of Infrastructure and Water.

Full report can be downloaded at: https://doi.org/10.18174/641509

1 www.ellenmacarthurfoundation.org/material-circularity-indicator
2 www.biobasedeconomy.nl/tki-bbe