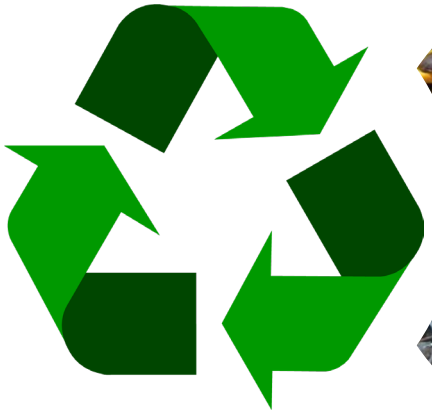
Issues in the recycling of different waste streams

Prepared within the TKI BBE Project Circularity of Bioplastics

Karin Molenveld, June 16th 2022



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Introduction

- Aim is to create a more realistic picture of current and future opportunities of collection, recycling and circular use of different waste streams with a focus on single use products and specifically for food packaging
- Show connections and similarities of different waste streams (system approach)
- Focus on organic waste and plastic waste and include glass, metal and paper and board as common alternatives

Main issue of waste is probably that it is waste:
- ✓ *Waste management is costly*
- ✓ *Waste streams are often heterogenous and polluted*
- ✓ *Can have issues with pests and smell*
- ✓ *Recycling ambitions are high*

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Background; increasing circularity

To meet climate goals collection and recycling of plastics and organic waste needs to improve:

Plastics

- Increase collection rate and quality
- Improve sorting and recycling towards higher quality products
- Recycling target EU is 55%% in 2030
- Plastic recycling in NL in 2017: 35-39%, estimation for 2020: 48%.

Organic waste

- Increase collection of organic waste
- Reduce pollution of organic waste and improve quality of compost
- End 2023 collection of organic waste including food waste compulsory in EU
- Collection of food waste in EU ~16% (2017) and in NL ~25% (2019)

The Dutch waste management system

- Starting point is the "Waste Hierarchy" (reduce, reuse, recycling, recovery...)
- Ban on land-filling ofmost types of waste
- Organized by municipalities with mandatory collection of:

Packaging glass

Metals

Packaging plastic

Paper and board

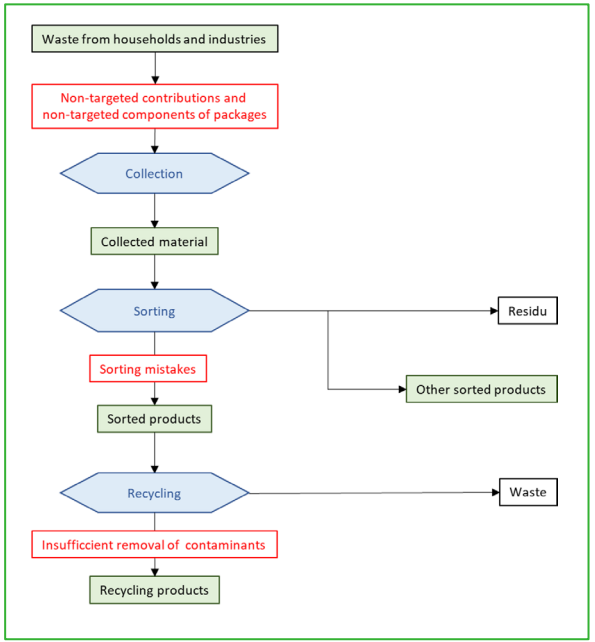
Organic waste

Residual waste

Hazardous waste

Textile

Electronics waste



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Quantity and quality of municipal waste in NL

Parameters	Residual waste	Organic waste	Paper and board	Packaging glass	Plastic packaging
Collected 2019 [kton/a]	2830	1553	838	357	333
Collected 2019 [kg/pp.]	**163**	90	48	21	19
Share in residual waste[%]	n.a.	**31%**	5.9%	4.6%	8.4% (Plastic) 2.4% (Metal) 1.7% (Drink cartons)
Pollution [%]	n.a.	3.9%	2.1%	0.5%	**~15%**
Collection rate [%]	n.a.	**63%**	83%	73%	**44%**
Quality limit[%]	n.a.	(2%)	1.5%	?	15%

Recycling figures and targets (all waste)

	Estimated recycling rate in 2017	Recycling target 2019
Packaging glass	71-76% (82% including glass-rejects)	90%
Paper & Board	87%	75%
Plastic packaging	**35-39%**	50% in 2025 and 55% in 2030
Metal	90-94%	85%

Organic waste

- Low consumer participation, and not all municipalities support separate collection, still a lot of food leftovers in residual waste.
- It is unclear which green waste is accepted (varies per municipality).
- Increased pollution (including plastic and glass) that is difficult to remove.
- Processing focuses on throughput of organic waste and not specifically on the production of compost.
- In compost, only visual pollution (2-20 mm) is considered and not micro- and nano-plastics (such as PP fibers from tea bags).

For pollution issues see also:

Fate of compostable plastics

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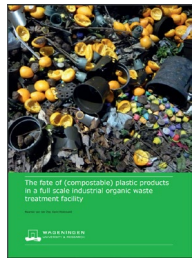

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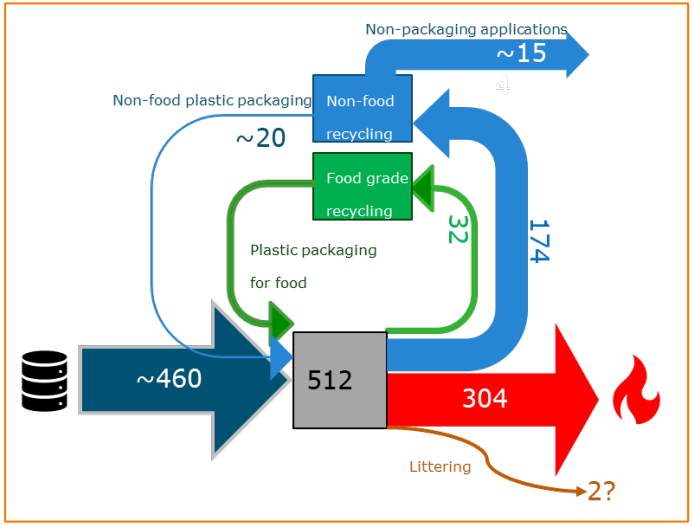
Plastic packaging

- Low consumer participation in cities, lot of plastics in residual waste.
- Significant losses during sorting and recycling (due to e.g. agglomerates and interfering substances).
- Product residues and packaging components (caps, labels), glues, additives, inks etc. contaminate plastic flows
- Quality aspects of recyclate (purity) limited application in (food) packaging
- Not all packaging fits in the system (too small, laminate, black, other type of plastic).

Recycling of plastic packaging

- The recycling system has so far, unfortunately, not:
  - decoupled the plastic system from fossil feedstock (limiting overall CO_2 emissions)
  - solved the littering / plastic pollution problem
- Although the plastic recycling system can reduce current issues, it can not solve them
- Ultimately we have to move to plastics that are biobased, recyclable and do not accumulate in nature



Brouwer et al. 2020, doi:10.3390/su122310021

Paper and board

- Officially not a waste stream and only clean and dry material is accepted (no food scraps).
- Making paper water-resistant (plastic replacement) can result in materials that are not recyclable and/or contain chemicals (silicone, PFAS, ..). Plastic coatings are accepted to a limited extent (<1.5-5 wt%).
- Recycled paper and cardboard contains (most different types of) residues of chemicals (e,g. MOSH, MOAH, PFAS, phthalates) and is not suitable for food applications.
- There is no standard measurement method to determine recyclability.

Glass

- Usually easily recyclable.
- Very high recycling targets, which are often not achievable in cities.
- Presence of exotic bottles (stone, painted bottles, labels, etc.) induces contamination.
- Heavy and fragile (and a problem if it ends up in organic waste)

Metal

- Sorting via magnets beneficial but often multi-materials and packaging contents hinder sorting and recycling (too heavy for magnets).
- High oxidation losses in small aluminum products (coffee capsules, animal feed sachets).
- Not circularly recyclable, aluminum packaging becomes cast aluminum products, packaging steel becomes construction steel.

Concluding on recycling issues

- Accept the limitations of waste management and recycling
- Identify packaging products that do not fit into the current waste management system
- Determine whether the existing and alternative packaging products have a possible negative effect on other waste streams (integral approach)
- Support choices with data and facts
- Provide honest and clear communication; NB losses in the recycling chain originate from collection, sorting and recycling and are cumulative!!!

Teabags & coffeepads – **Current situation**

Residual waste

- **38%** of consumers throw the tea bags and coffee pads in the residual waste.

Post-Separation

Tea bags and coffee pads are too small to be sorted for recycling

Incineration

- Incineration of wet material costs a lot of energy
- Organic material is lost for organic recycling

Organic waste

- **60%** of consumers throw tea bags and coffee pads in the organic waste (55%) or compost heap (5%).
- Throwing away at the GFT waste is a habit

Sorting

Tea bags and coffee pads are small and not easily removed, therefore there is a high chance that they will be included in the composting process.

Composting

- The traditional tea bags and coffee pads containing PP will partially compost and the plastic fibers from the packaging (size <30 microns diameter and a length of a few millimeters) will end up in the compost.
- **Plastics from tea bags and coffee pads leak into the ground via compost**

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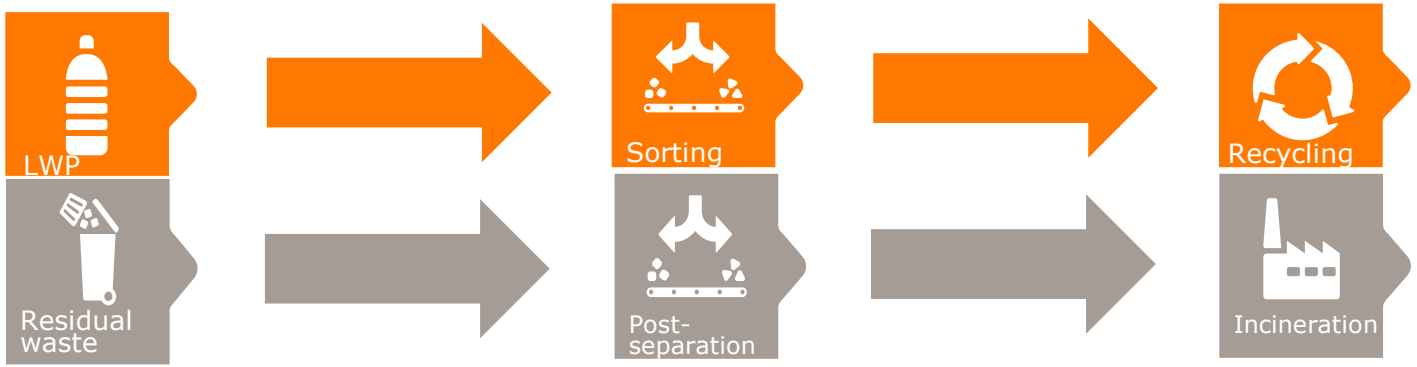
Green deal Compostable Teabags & coffeepads

- **Compostable tea bags and coffee pads can be thrown away with organic waste**

Tea bags and coffee pads are small and not easily removed, therefore there is a high chance that they will be included in the composting process.

- **No more microplastics in compost (provided 100% compostable)**
- **Increase in organic waste collectional**



- **What if they end up in LWP or residual waste**

Tea bags and coffee pads are too small to be sorted for recycling, and do not diststurb other recycling routes.

- **Tea bags and coffee pads are usually disposed of wet and therefore have a negative calorific value.**
- **Compared to current situation: Less energy for incinerating wet waste**

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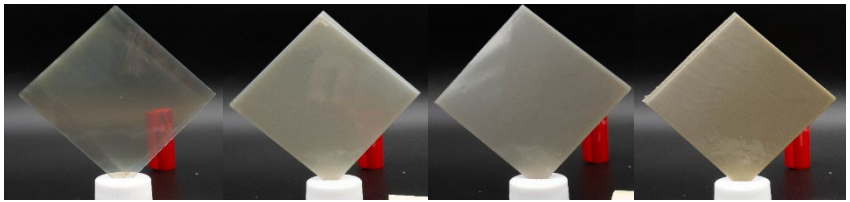
What about PET trays?

- PET trays have issues in recycling
- Even with implementation of design for recycling measures

Tray 0 Pure | **Tray 1** + Seal | **Tray 2** PET-PE | **Tray 3** Seal & Top



Tray 0 Pure | **Tray 1** + Seal | **Tray 2** PET-PE | **Tray 3** Seal & Top

The presence of seal-medium and top-film causes blend formation. Hence, the rPET is hazy, for which there is limited market.

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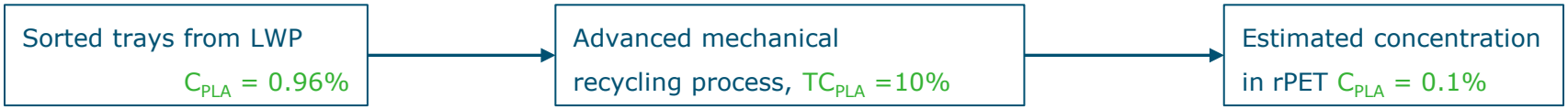
PLA trays as an alternative

- Can be efficiently produced from biomass
- Can be efficiently chemically recycled
- Can be mechanically recycled
- Will not cause pollution in compost
- Does PLA cause issues in PET recycling?

Effect of PLA in PET recycling



- In well-managed recycling chains the concentration of PLA in rPET will not exceed 0.1%
- At this concentration the optical and thermal properties of rPET are not affected
- Even at concentrations of 8% PLA in sorted PET trays, using modern sorting techniques no negative effects are expected on the quality of recycled PET.
- PVC, however, has pronounced effect on colour, IV and crystallinity

Thoden van Velzen et al (2021)
DOI: 10.1002/pts.2633

Concluding remarks

- To improve waste management systems and increase recycling we should:
  - Use an integral approach
  - Be open to discuss current issues
  - Be open for new solutions (avoid lock-in)
  - Set achievable goals (instead of the current unrealistic goals)
  - Generate data and evidence

Thank you for your attention

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Issue paper recycling of different waste streams

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