

Kann unser heutiges Plastik-Recycling tatsächlich Neuware-Herstellung vermeiden?

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21 Juni 23, OST Coffee Lectures

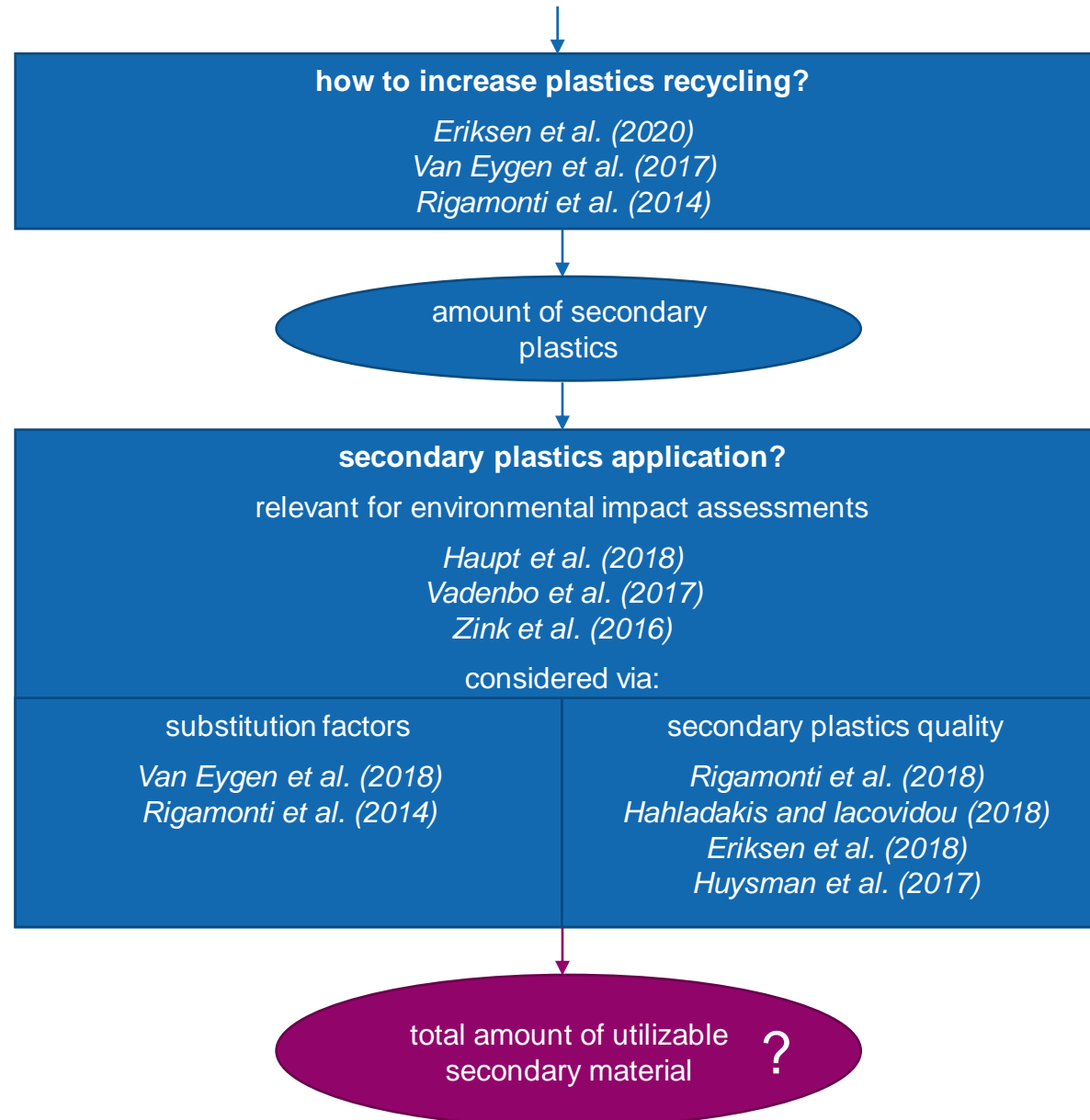


50%

recycling rate

by 2025*

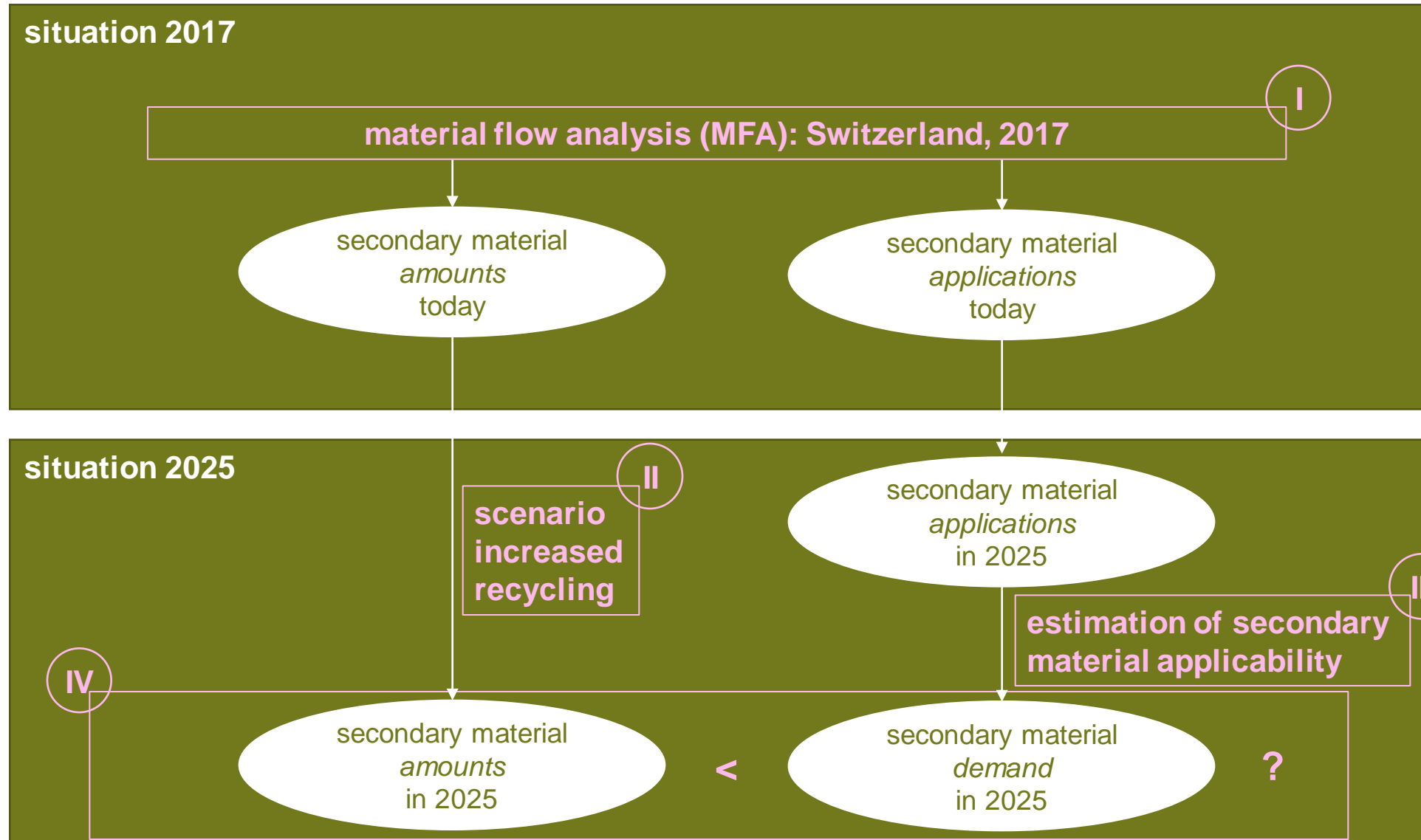
50% recycling rate by 2025



Research Question

Does the usability of secondary plastics constitute a limitation for the plastic recycling rate achievable by mechanical recycling?

Methodology



I MFA: Switzerland, 2017



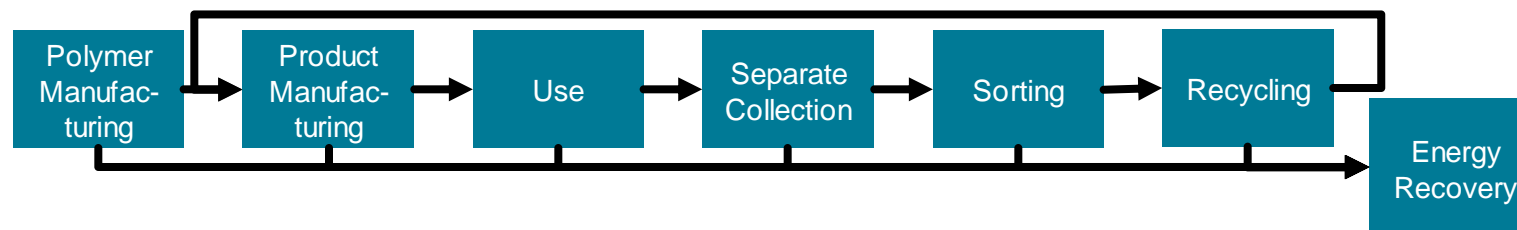
11 plastic types

	Commodity plastics						Technical plastics				PUR	considered share of total plastics in segment
	LDPE	HDPE	PP	PS	PVC	PET	ABS	HIPS	PC	PA		
Packaging	■											97%
B&C	■										■	86%
Automotive	■						■					94%
EEE	■						■				■	97%
Agriculture	■											77%
Textiles			■			■				■	97%	
Other	■						■				■	76%

54 product subsegments

Application segment	Subsegments
Packaging	Food films
	Food bags
	Food bottles
	Food pots, trays and tubs
	Food other
	Consumer non-food films
	Consumer non-food bags
	Consumer non-food bottles
	Consumer non-food pots, trays and tubs
	Consumer non-food other
	Non-consumer – manufacturing
	Non-consumer – retail
	Non-consumer – hospitality
	Non-consumer B&C
Non-consumer agriculture	
...	...

all life cycle stages



II 2025 scenario: increased recycling



consumption amounts:

scaled 2017 consumption amounts with expected population in 2025

waste amounts:

product lifetime-based calculation

collection rate:

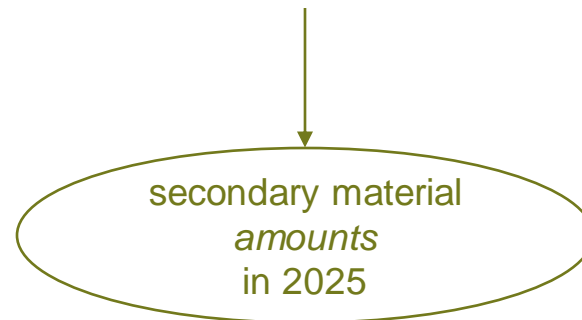
80% collection rate for all product groups that were collected in 2017

sorting processes:

same as 2017

recycling processes:

same as 2017



III secondary material applicability



secondary material from

Food pots, trays and tubs, NIR sorting abroad, recycling abroad
Consumer non-food bottles, density sorting CH, recycling CH
Non-consumer - manufacturing – films, density sorting abroad, recycling abroad
Window profiles, window profile sorting abroad, recycling abroad
Bumpers, dismantling in Switzerland, recycling abroad
...

uptaken by

Consumer non-food bags	25-63%
Consumer non-food pots, trays and tubs	38-81%
Non-consumer - manufacturing - rigids	18-51%
...	
Pipes	17-50%
Window profiles	40-80%
Automotive total	9-50%
Household products	13-44%
...	...

maximum secondary material share

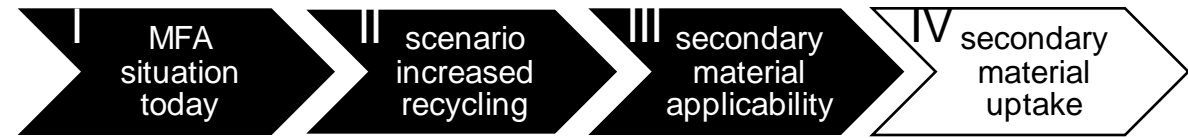
secondary material applicability restrictions related to:

- **safety**
- **esthetics**
- **odor**
- **stability**
- **technical performance**

estimation of share based on available examples for secondary material application

3 scenarios:
high/moderate/low secondary material applicability

IV secondary material uptake



secondary material from

Food pots, trays and tubs, NIR sorting abroad, recycling abroad
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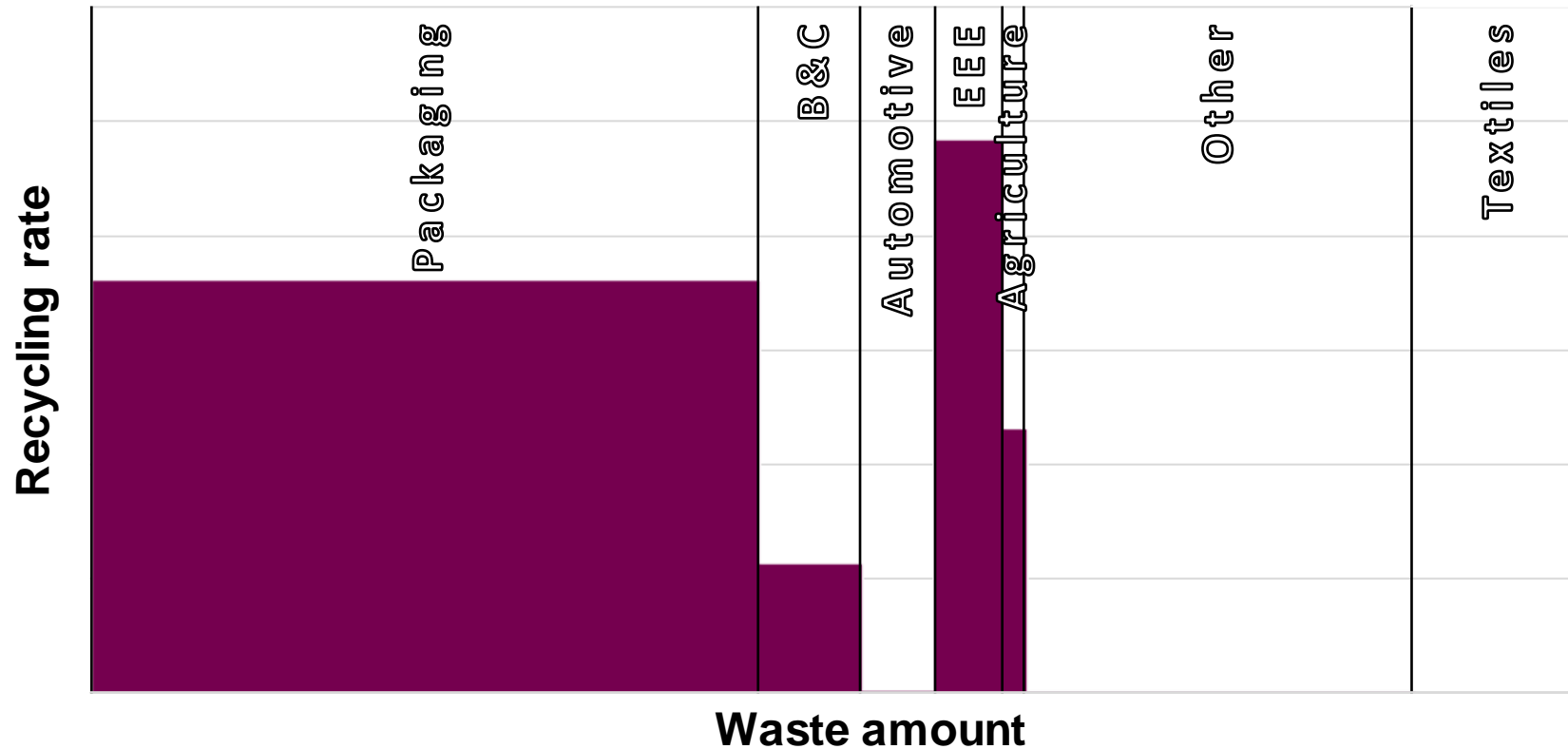
3 scenarios:
high/moderate/low secondary material applicability

linear optimization for each plastic type to maximize secondary material uptake



overall recycling rate
9%

Individual recycling rates



Klotz & Haupt (2022),
Data Br. DOI:
10.1016/J.DIB.2022.
108001

Results



recycling rate 2025

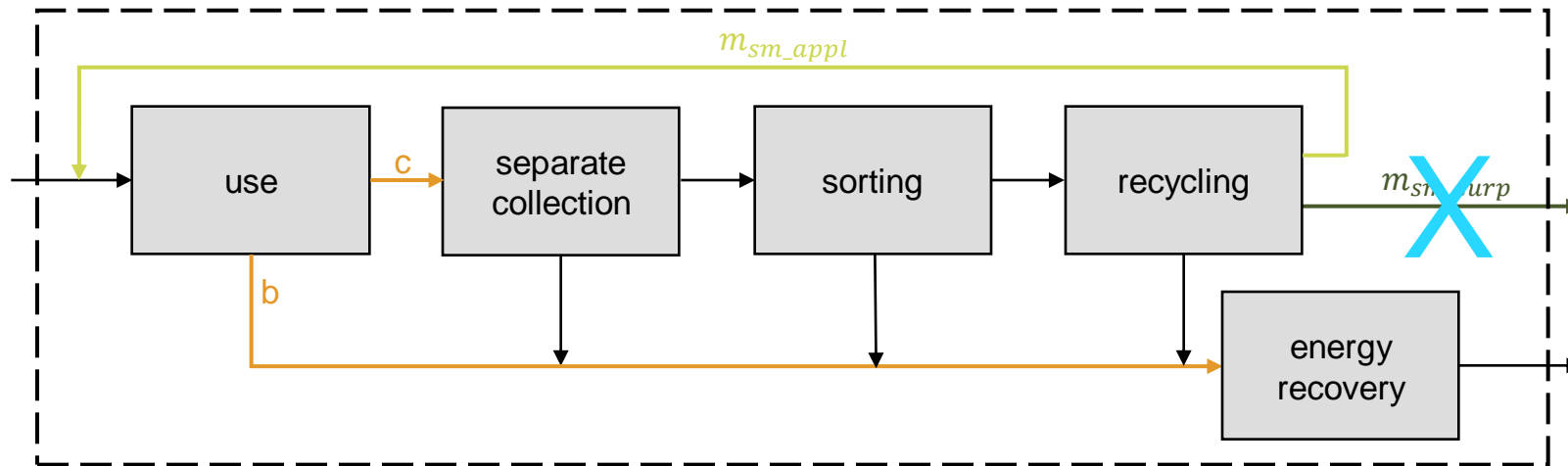
based on total secondary material

$$RR = \frac{m_{sm_appl} + m_{sm_surp}}{b + c} = 23\%$$

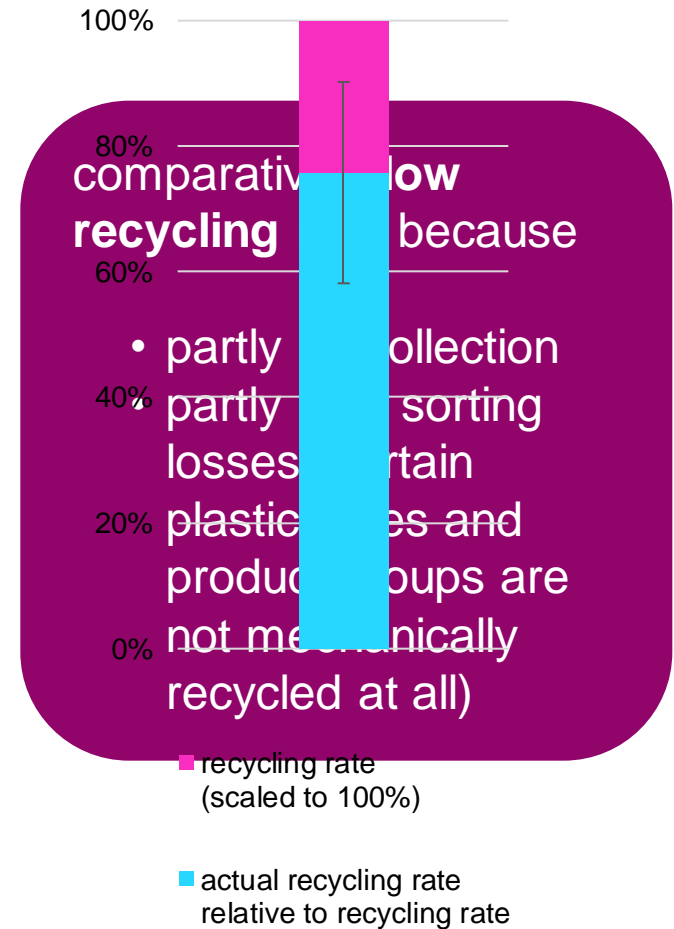
true recycling rate 2025

based on utilizable secondary material

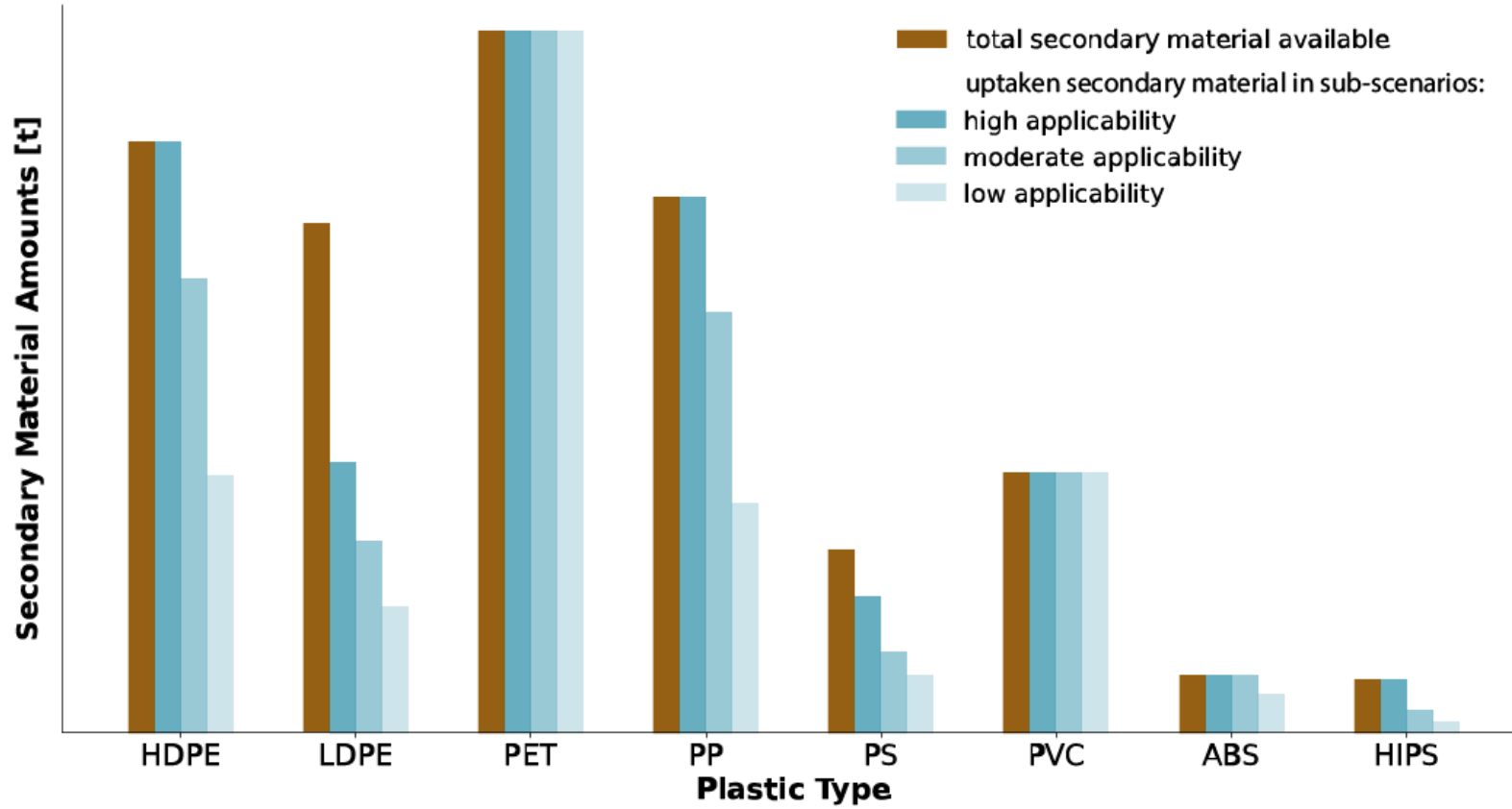
$$TRR = \frac{m_{sm_appl}}{b + c} = 13-20\%$$



adapted from Haupt et al. (2017)



Results



Klotz et al. (2022),
Waste. Manag. DOI:
10.1016/j.wasman.20
22.01.002

Discussion



increasing recycling by merely **increasing collection without other alternations** of the recycling system might lead to an **excessive amount of secondary material**

excessive: increases total consumption, no substitution of primary material



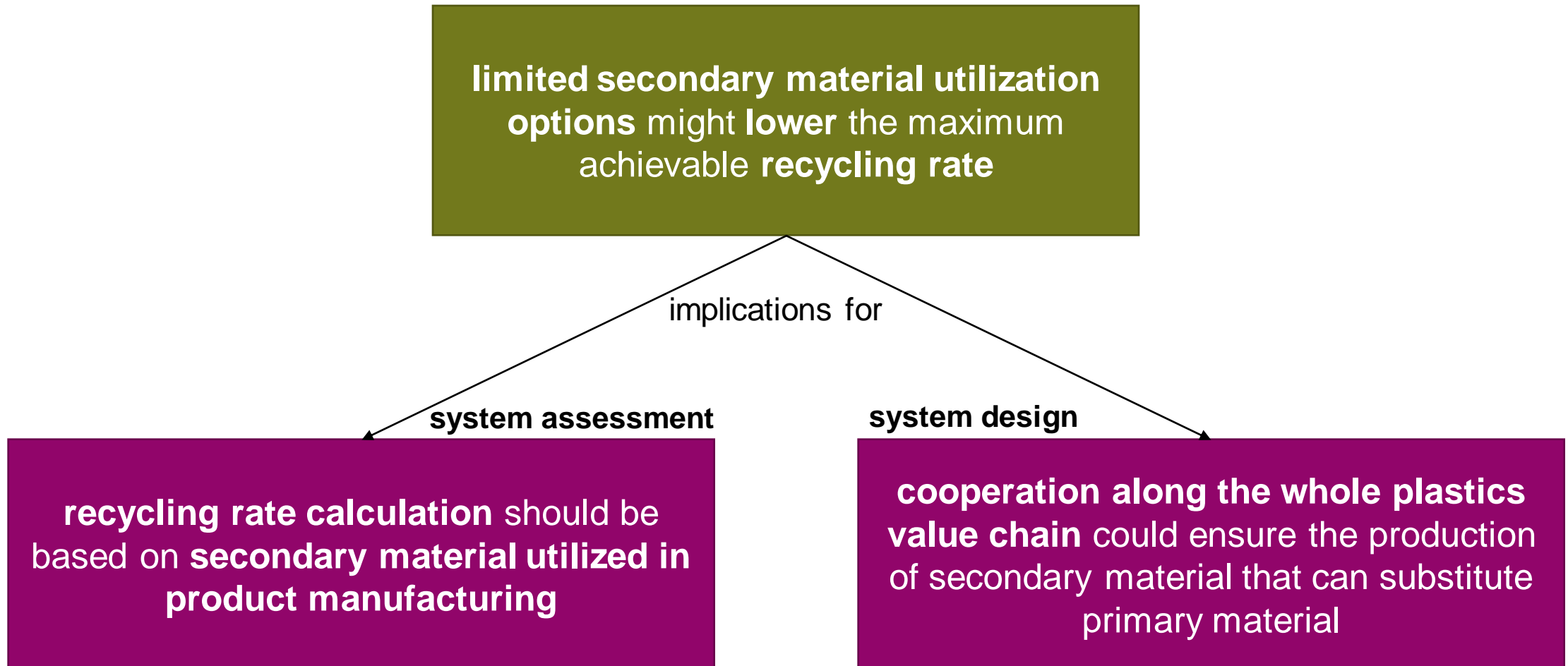
increase secondary material usability



- more specific sorting ► secondary material suitable for more applications
- new applications for secondary material with current quality
- alterations of the boundary conditions: consumer behavior, financial situation
- change in product design

→ **see new paper out: maximum mechanical recycling**
Klotz et al. (2023). *J. Ind. Ecol.* DOI: 10.1111/jiec.13393

Conclusions



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Picture sources

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Thank you for your attention!

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Clean Cycle project
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