



Industrial microplastics and pellets loss: Status quo and possible reduction measures

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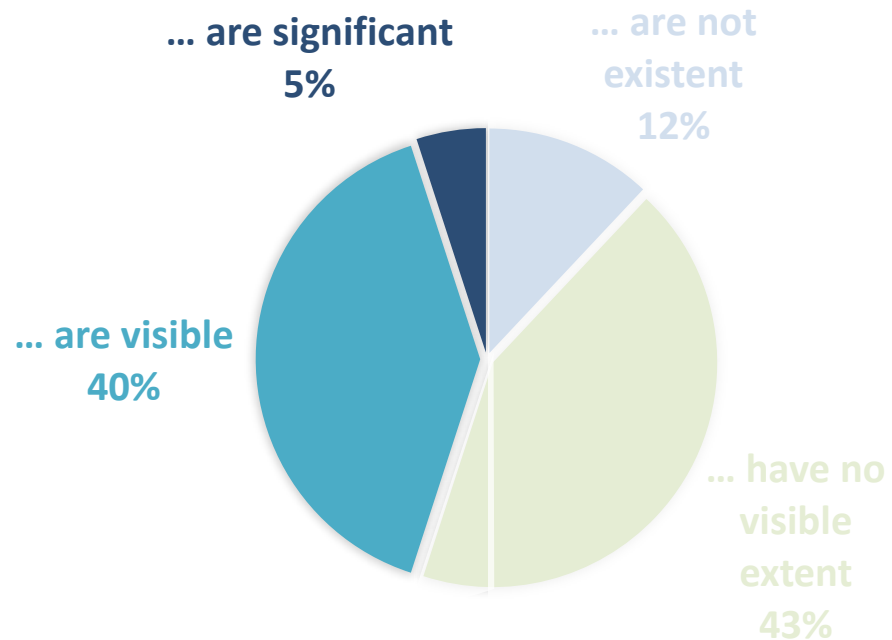
Status quo: Industrial microplastic emissions



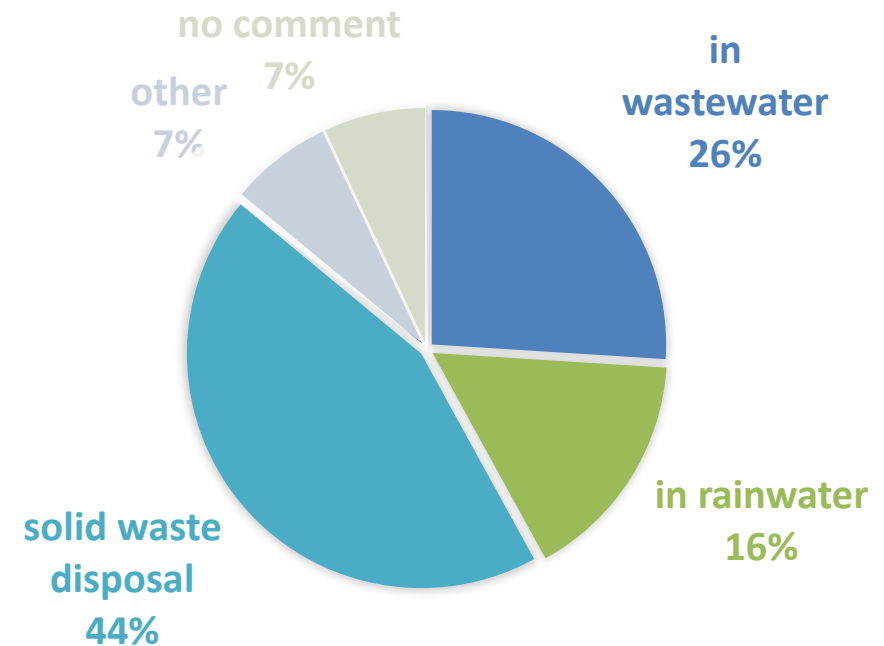
Occurrence of microplastics at industrial sites?



Microplastic losses...



Fate of microplastics at industrial sites



Mod. Barkmann et al. 2021: EmiStop final report (<https://bmbf-plastik.de/de/publikation/emistop-schlussbericht>)

Occurrence of microplastics at industrial sites?



Outdoor Storages



Waste management



Traffic areas



(un)loading zones



Occurrence of microplastics at industrial sites?

Delphy survey (n=43)

Site inspections

Sampling

Indoor processes

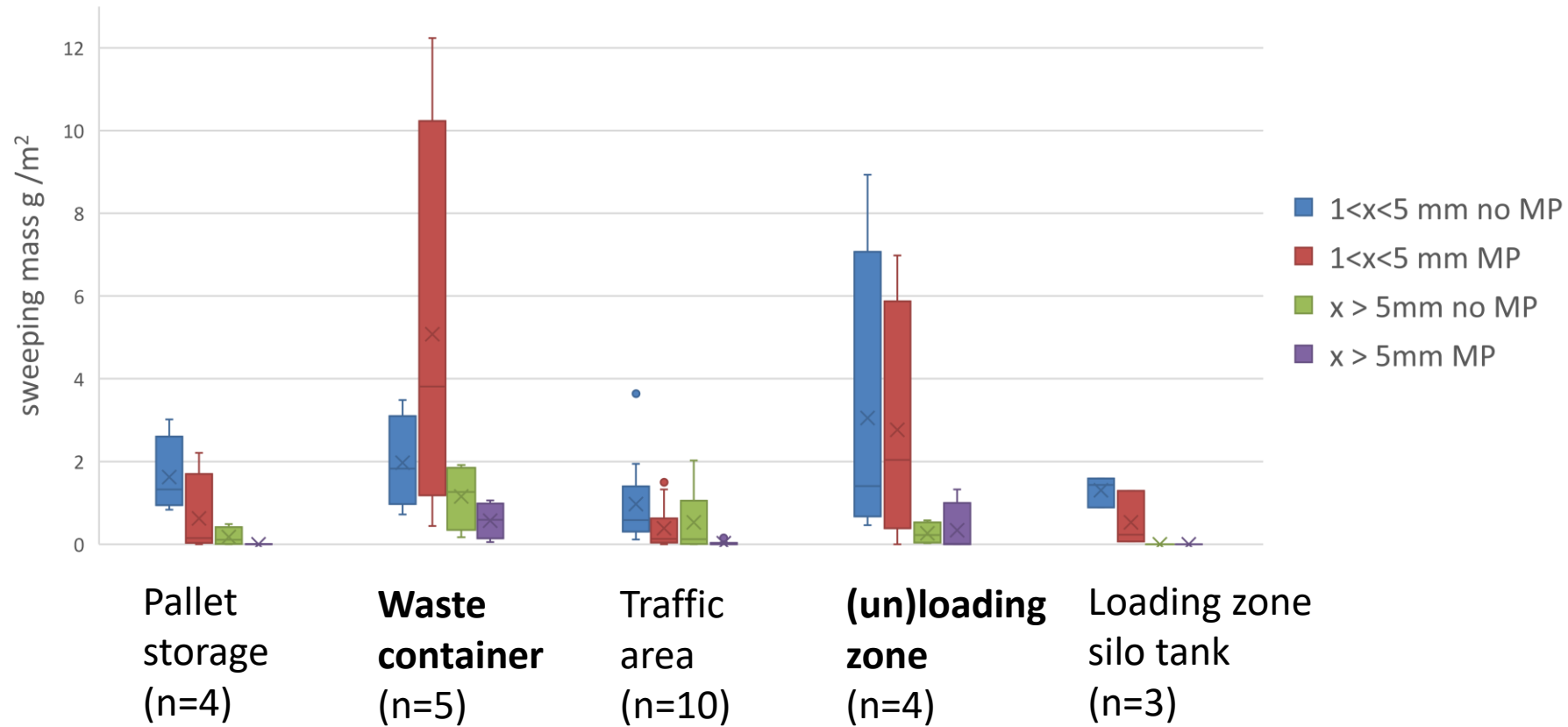
- Controlled environment
- Wastewater system
- Waste management
- Air cleaning

Outdoor processes

- Possible uncontrolled release
- Hotspots

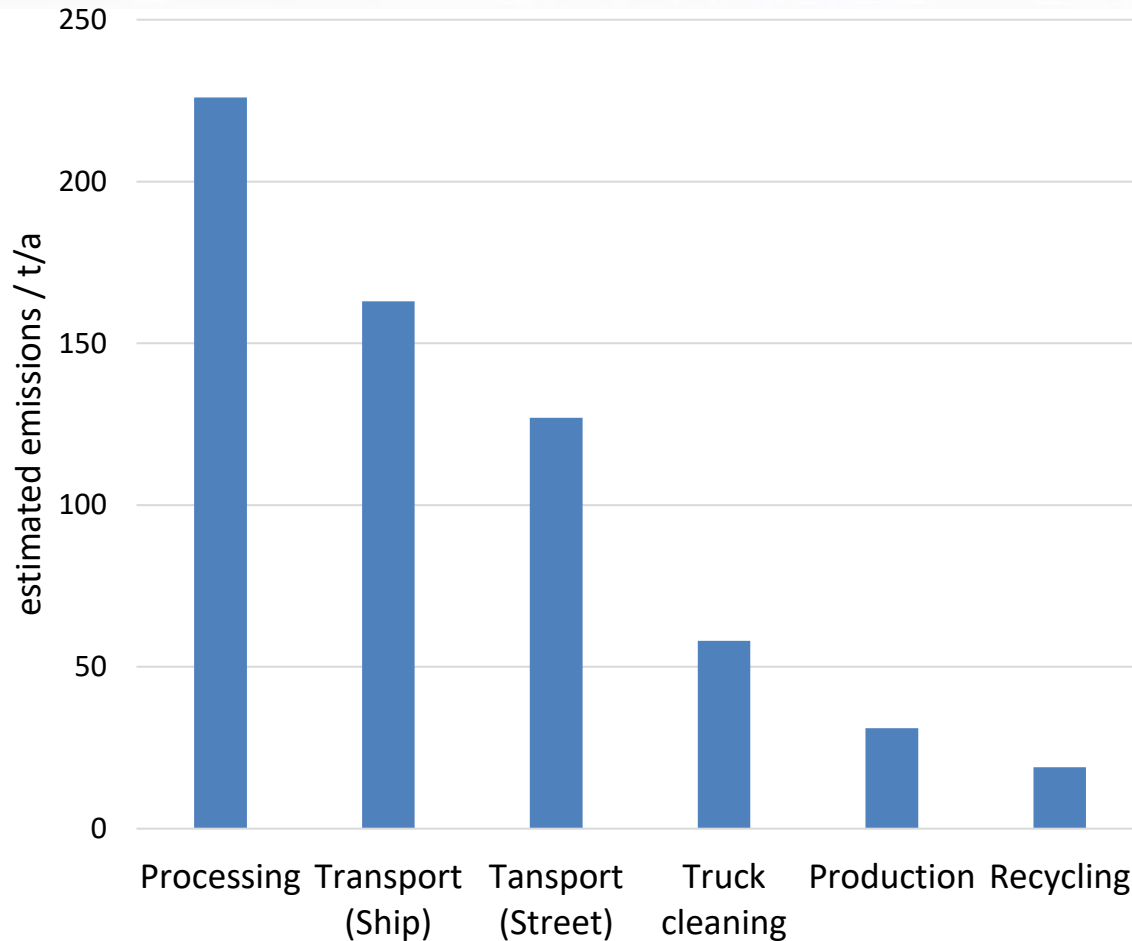


Occurrence of microplastics at industrial sites?



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Status quo: Industrial microplastic emissions

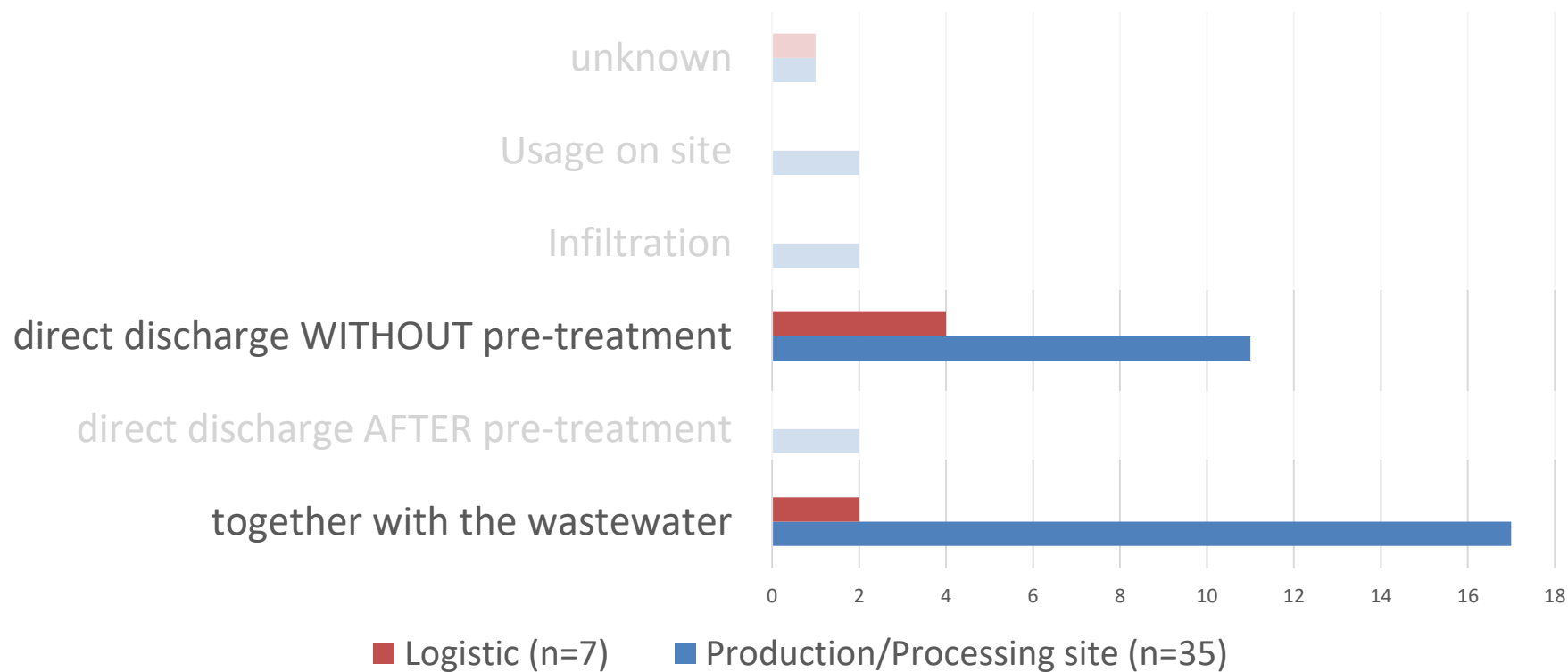


Data from: *Conversio Sonderbetrachtung Pelletverluste. Endbericht. 2022*

- **Estimation for Germany: 624 t/a**
 - 265 t/a (aquatic environment)
 - 359 t/a (terrestrial environment)
 - **0.001 % total loss.**
- **Transportation** has the highest emission potential.
- Most processing emissions occur during **loading activities.**
- **Drainage systems** for stormwater are the major emission pathways!

Pathways into the environment

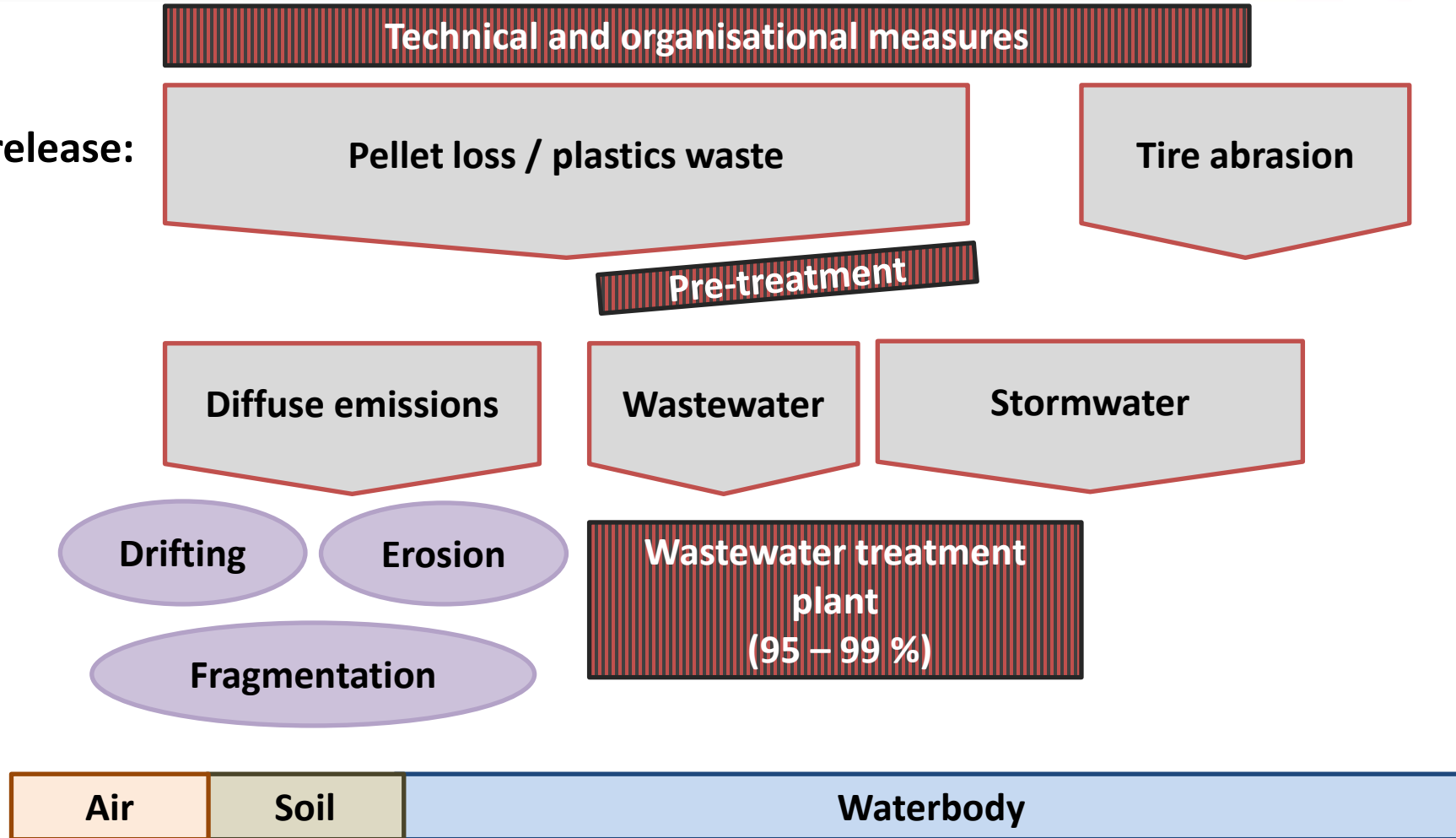
Representatives of industrial sites in the plastics industry on the type of stormwater disposal:



Mod. Barkmann et al. 2021: EmiStop final report (<https://bmbf-plastik.de/de/publikation/emistop-schlussbericht>)

Pathways into the environment

Unintentional release:



Reduction measures

Technical measures:

- **Approved and available technologies**
- Likely most effective
- Can be combined with wastewater treatment

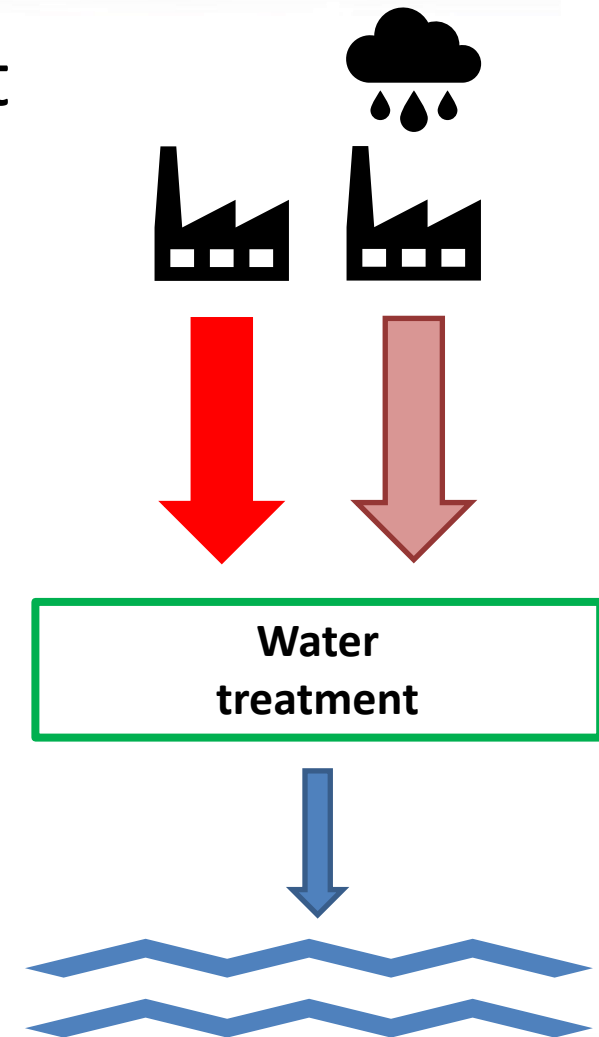
Organisational measures:

- Dependend on employee acceptance
- Monitoring
- Likely less effective
- Often single purpose solution

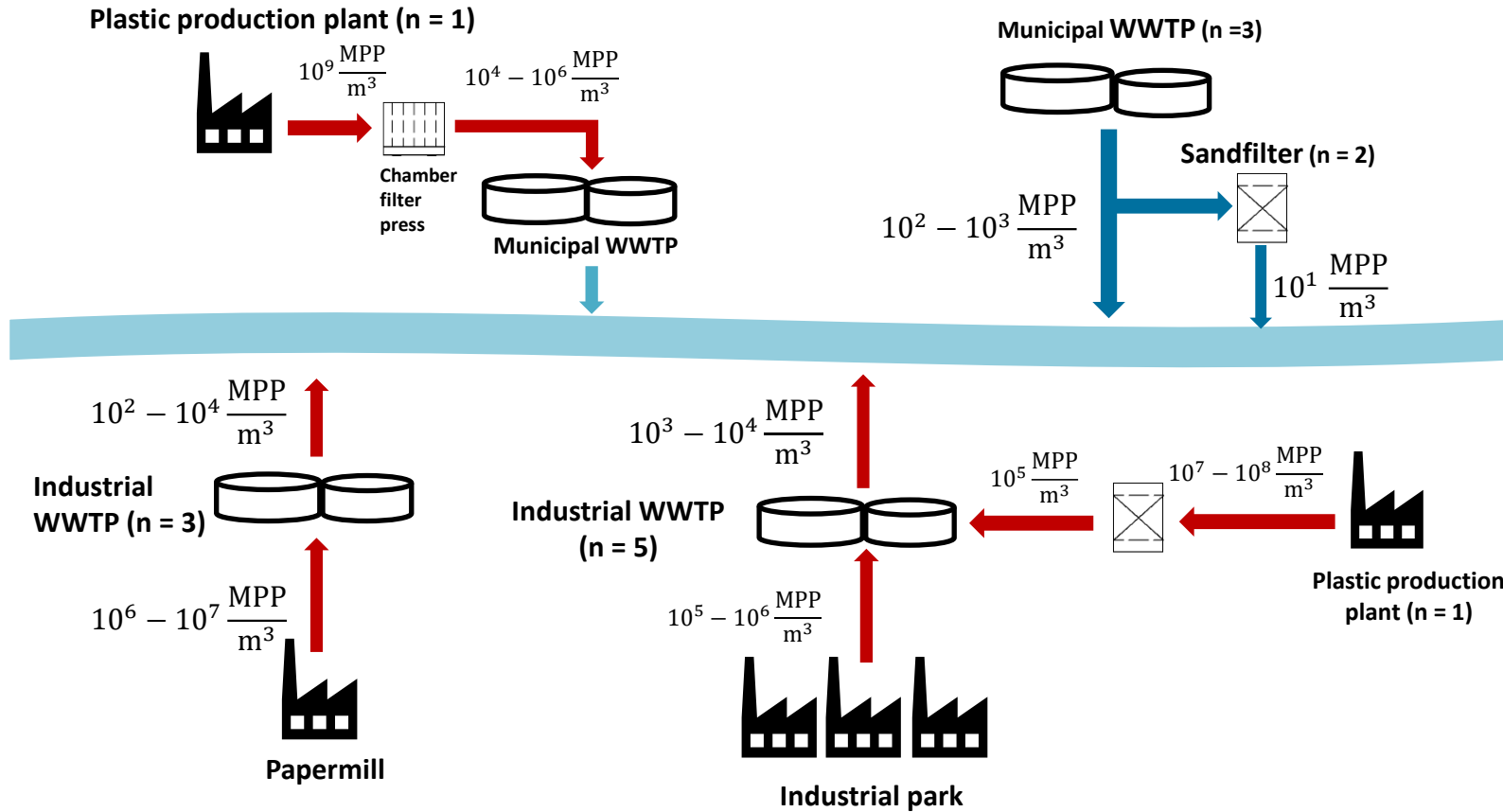
Best: combination of both

Reduction measures – examples

- Technical measures for wastewater treatment
 - Waste water pre-treatment (indirect discharge)
 - Sandfilter
 - Flotation
 - Chamber filter press
 - **Stormwater treatment**
 - **Stormwater discharge in industrial or municipal WWTPs**
 - Drain filters
 - Etc.



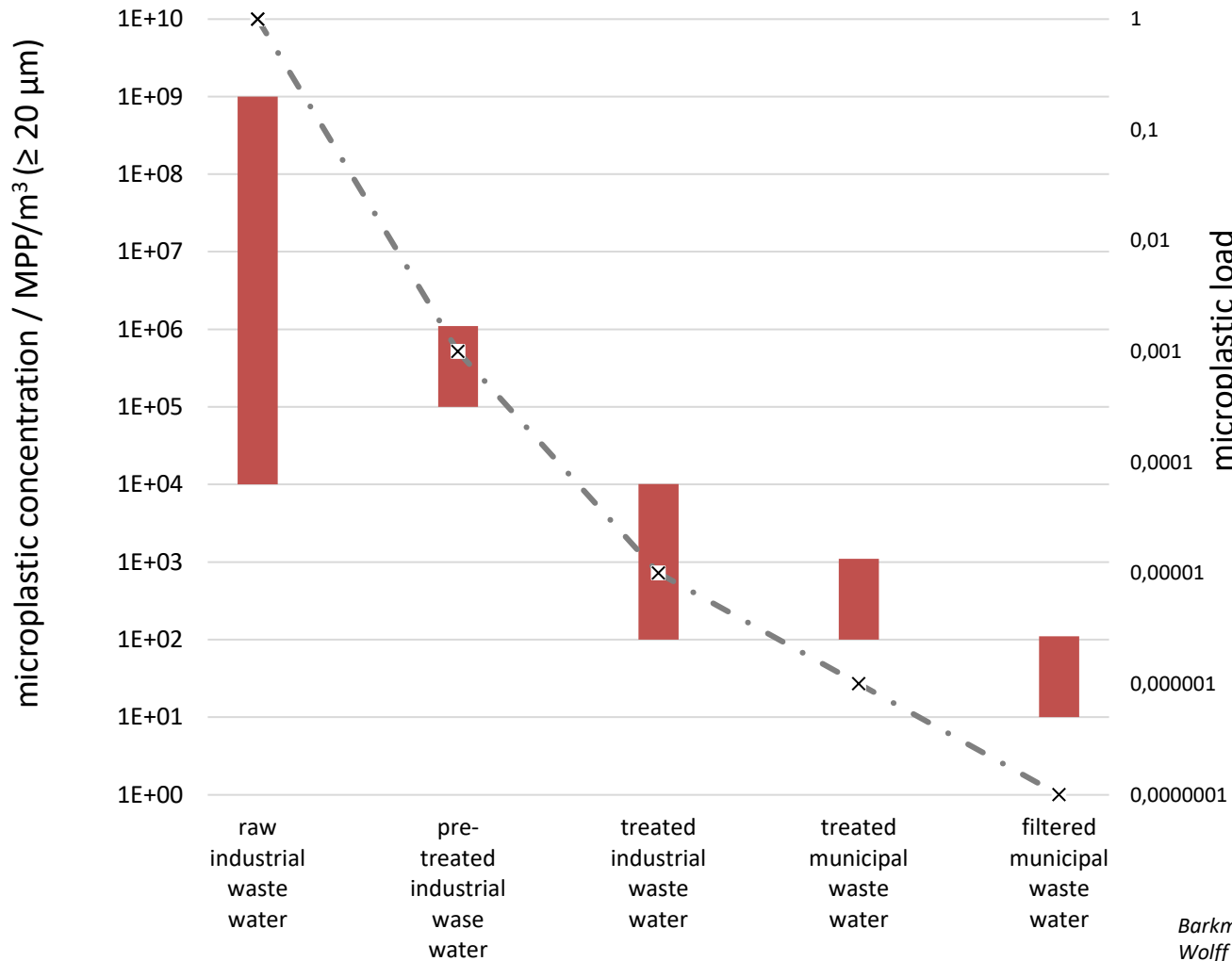
Status quo: Industrial microplastic emissions



The only input pathway for industrial microplastic emissions that has been studied is via wastewater.

Barkmann et al. 2023 (Preprint DOI: 10.2139/ssrn.4348375)
 Wolff et al. 2021 (DOI: 10.3390/w13010033)
 Wolff et al. 2018 (10.1016/j.wroa.2018.100014)

Status quo: Industrial microplastic emissions



- Effluent concentration from industrial WWTP are **slightly higher** than from municipal WWTP.
 - Industrial WWTP eliminate up to **99.9 %**.
 - Industrial WWTP are **not** assumed to be „hot spots“ for microplastic emissions.
 - ~ 90 % of the microplastic particles in effluents are **< 50 µm**.
- **Industrial WWTP effluents do not contain pellets.**

(small data base, further research is necessary)

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Reduction measures – examples

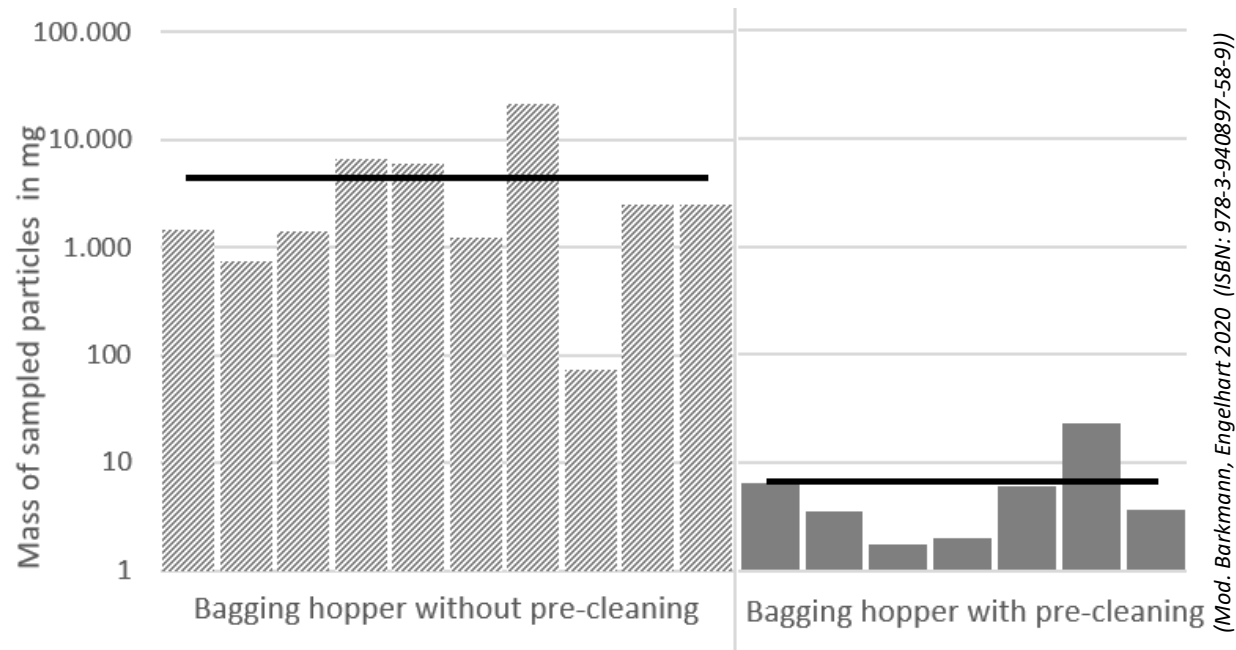
- Technical measures for emission reduction
 - Roofing of loading areas
 - Housing of storage areas
 - Improvement of packaging and storage



(Mod. Barkmann et al. 2021 (URN: urn:nbn:de:tuda-tuprints-202304))

Reduction measures

- Organisational measures
 - Employee training
 - Change of SOPs
 - Cleaning of vehicles (e.g. truck tires) and production equipment
 - Cleaning of production, storage and filling stations
 - Etc.



(Mod. Barkmann et al. 2021 (URN: urn:nbn:de:tuda-tuprints-202304))

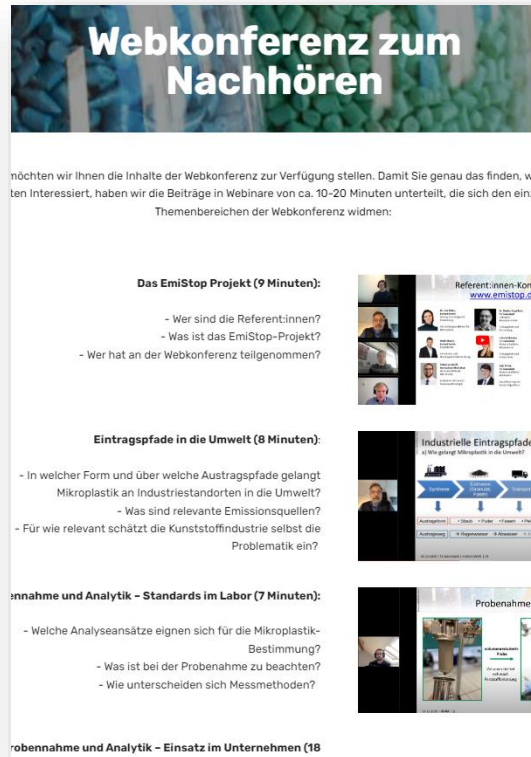
Conclusion

- **Stormwater** must be considered as the main emission pathway.
- In addition to **organisational** measures, **technical** measures should be implemented.
→ Especially wastewater treatment and **rainwater treatment**.
- There is a need for **further research** to obtain more reliable data on industrial microplastic emissions and pellet losses.

Further Literature



DOI: [10.26083/tuprints-00020230](https://nbn-resolving.org/urn:nbn:de:hbz:5:1-65882-p0020-2)



<https://emistop.de/conf/encercereview.html>



<https://bmbf-plastik.de/de/publikation/emistop-schlussbericht>



DOI: [10.3390/w13010033](https://doi.org/10.3390/w13010033)

- 1 Quantification of Microplastics in Wastewater Systems of
- 2 German Industrial Parks
- 3
- 4 Luisa Barkmann-Metaj¹⁾; Felix Weber²⁾; Hajo Bitter³⁾; Sebastian Wolff²⁾; Susanne
- 5 Lackner³⁾; Jutta Kerpen²⁾; Markus Engelhart¹⁾

DOI: [10.2139/ssrn.4348375](https://nbn-resolving.org/urn:nbn:de:hbz:5:1-65882-p0020-2) (Pre-Print)