Methodology to measure microplastics in drinking water

Claudia Cella, Susanne Belz, Guillaume Bucher, Hind El Hadri, Francesco Fumagalli, Otmar Geiss, Douglas Gilliland, Rita La Spina, Dora Mehn, Birgit Sokull-Kluettgen

Joint Research Centre – European Commission

Conference on Microplastics in drinking water – from source to tap
EUSDR PA4 (DRP-PAC-PA4)

JRC: Science for policy

ANTICIPATE

INTEGRATE

IMPACT

Our purpose

The **Joint Research Centre** provides independent, evidence-based knowledge and science, supporting EU policies to positively impact society.

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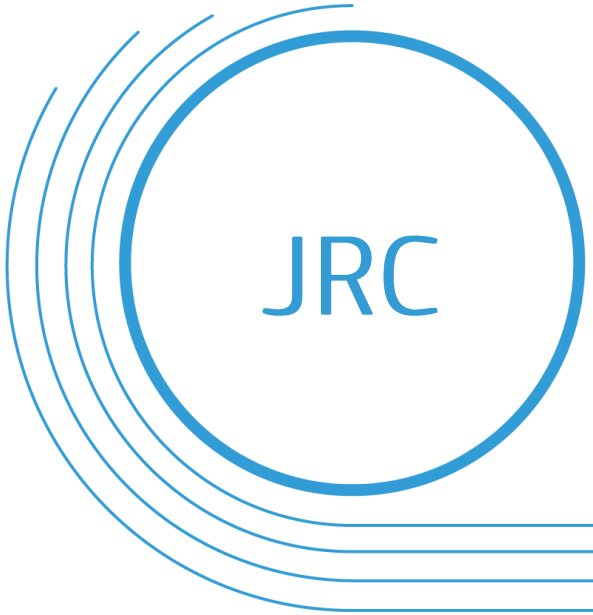
JRC – Facts and figures



Over **1400** scientific publications per year

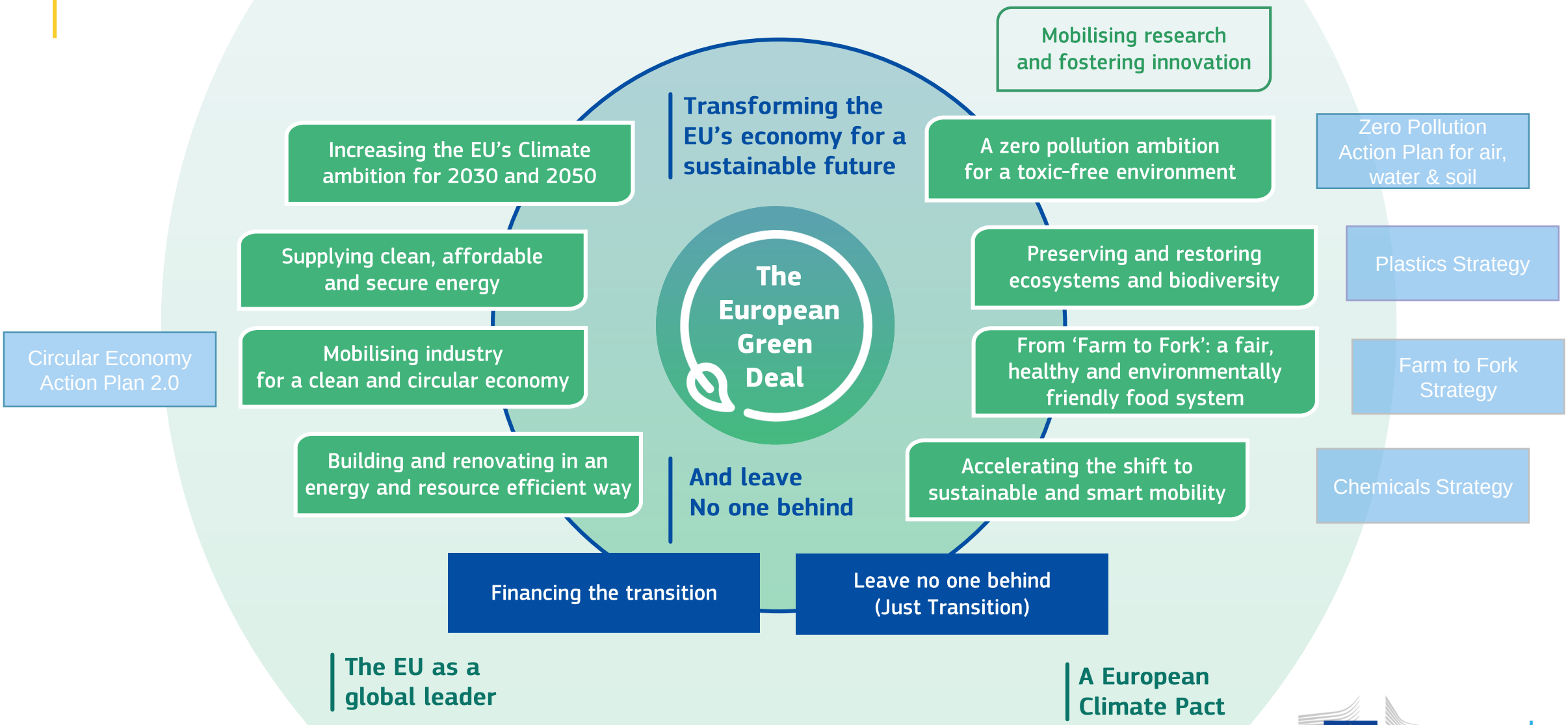
2.800 staff

50 large scale research facilities
Headquarters in **Brussels** and research facilities located in **5 EU Countries**

110 on line databases
> 100 economic, bio-physical and nuclear models

European Commission

The European Green Deal



https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en

European Commission

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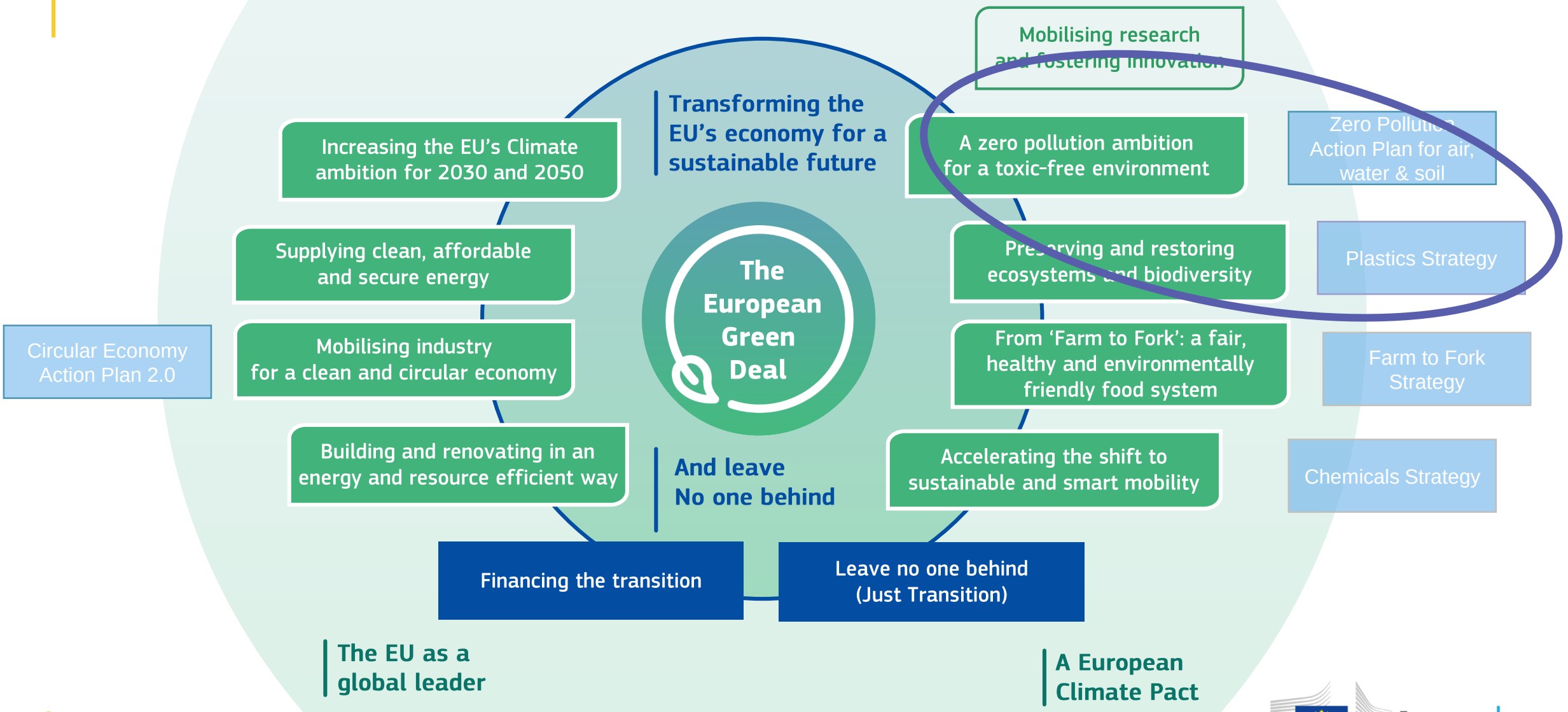

https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en

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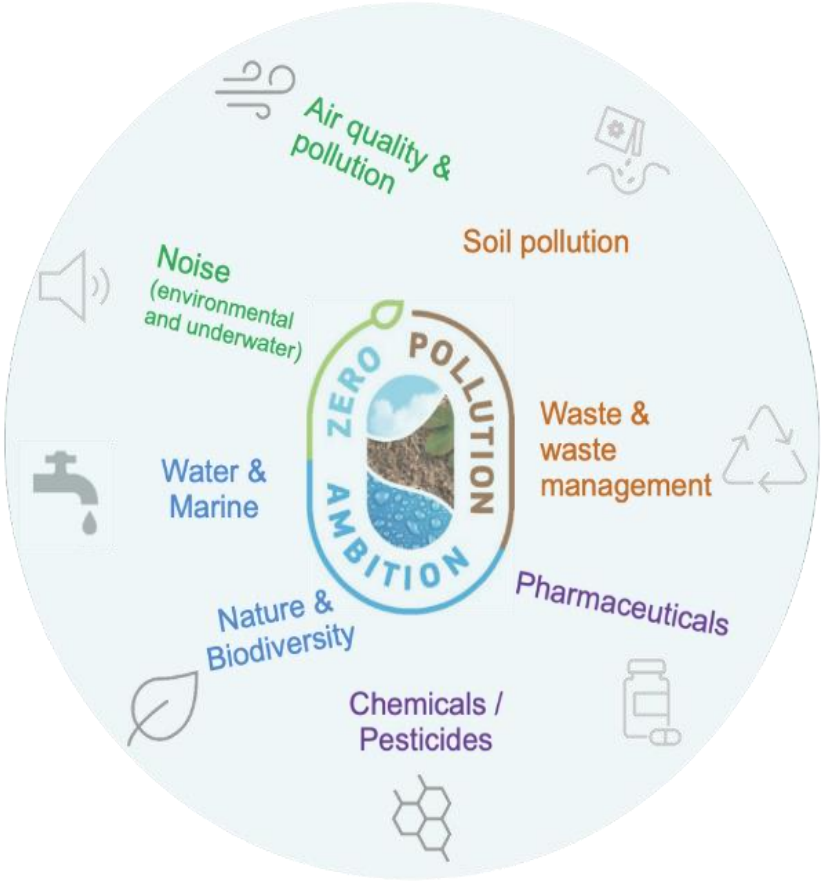
Zero Pollution Action Plan

2030 targets to speed up reducing pollution at source include:

- Improving water quality by reducing:
  - **plastic litter** at sea by **50%**
  - **microplastics** released into the environment by **30%**



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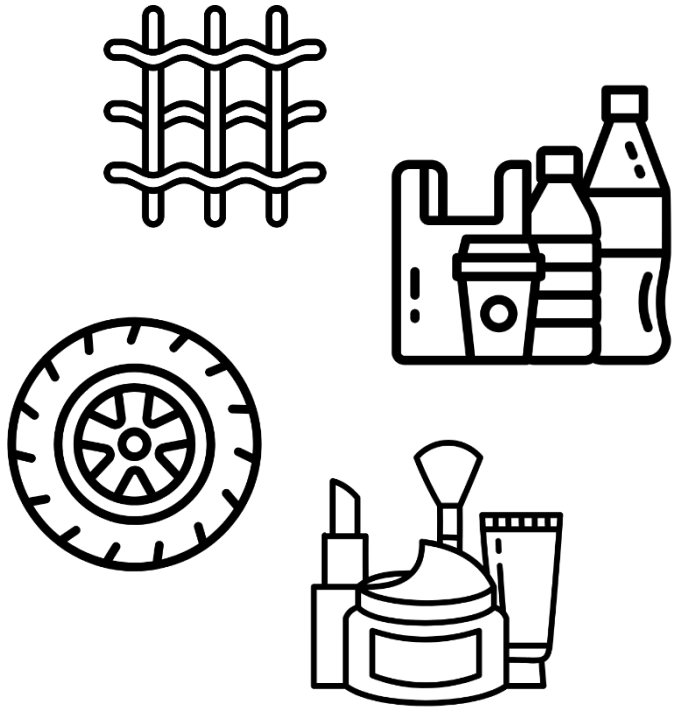
EU actions on microplastics

Mitigation measures

- **Intentionally added microplastic particles**
  (primary microplastics)
  deliberately manufactured particles,
  added to products such as cosmetics,
  detergents, paints…
  → REACH Restriction

- **Unintentionally released microplastics**
  (secondary microplastics)
  from mechanical, chemical and light induced
  breakdown of bulk plastic litter as well as tyre wear
  debris and fibres from textiles, paints, geotextiles…



Close knowledge gaps

- **Monitoring** of microplastics in drinking water, surface water, groundwater, costal water, wastewater, sewage sludge, soil…
  Harmonised/standardised methods
  (Sampling / Identification / Quantification)

Close knowledge gaps

- **Monitoring** of microplastics in drinking water, surface water, groundwater, costal water, wastewater, sewage sludge, soil…
  Harmonised/standardised methods
  (Sampling / Identification / Quantification)
- **Research and Innovation** (H2020 and HE Research projects)
  Sources, breakdown mechanisms / pathways / fate
  Effects of microplastics on environment and human health, thresholds
  Economic impact assessment
  Innovative technologies (tracking, recycling, removal)
  Alternatives
  How to prevent release?
  Best practices….

JRC activities in the area of microplastics

Quality in measurements

- Inter-laboratory studies
- Test & reference materials

Standardisation

- ISO, CEN, VAMAS
- National bodies

Extending boundaries towards nanoplastics

- Analytical methods
- Realistic test materials

Support to design & implementation of policies

Methodologies for monitoring

- drinking water,
- Groundwater & surface water,
- wastewater & sludge

Collaboration

- Thematic events
- Access to JRC facilities

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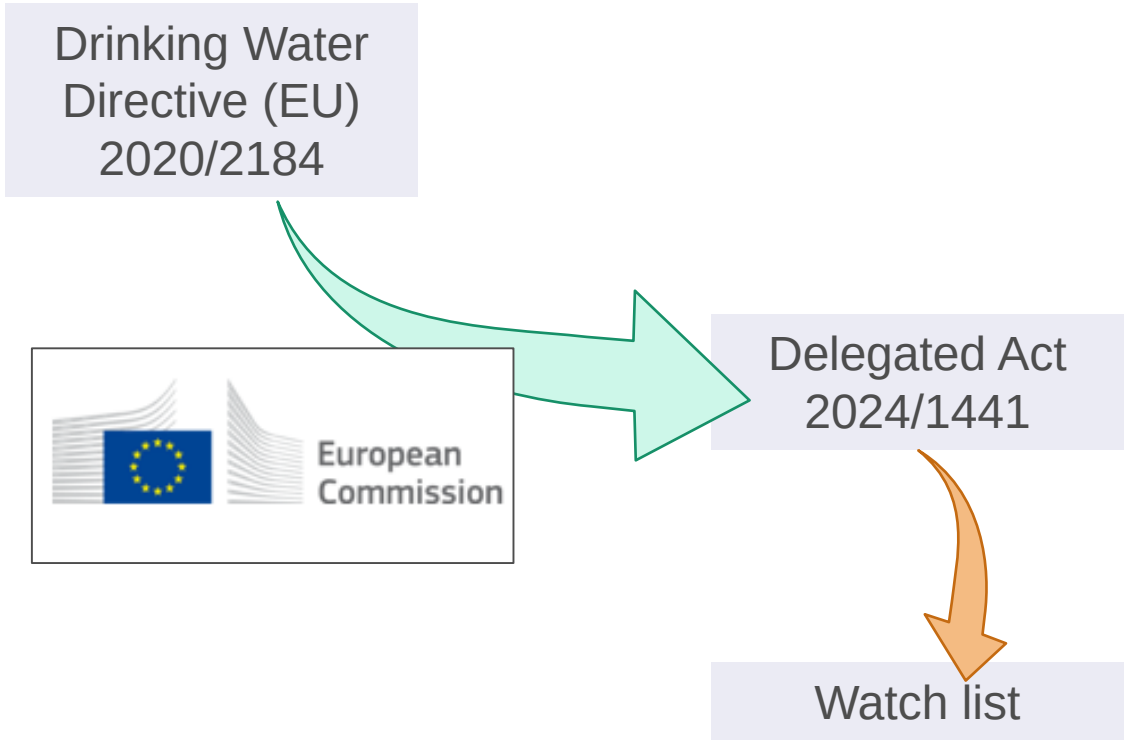
Policy context



The recast **Drinking Water Directive (EU) 2020/2184** empowers the European Commission to adopt a **methodology** to measure microplastics in water for human consumption with a view to including them on the **watch list** of substances or compounds which the public or the scientific community consider to be of concern for human health

- Directive (EU) 2020/2184 of the European Parliament and of the Council of 16 December 2020 on the quality of water intended for human consumption (recast) http://data.europa.eu/eli/dir/2020/2184/oj
- Commission Delegated Decision (EU) 2024/1441 of 11 March 2024 supplementing Directive (EU) 2020/2184 of the European Parliament and of the Council by laying down a methodology to measure microplastics in water intended for human consumption (notified under document C(2024) 1459) http://data.europa.eu/eli/dec_del/2024/1441/oj
- Commission Implementing Decision (EU) 2022/1307 of 22 July 2022 establishing a watch list of substances for Union-wide monitoring in the field of water policy pursuant to Directive 2008/105/EC of the European Parliament and of the Council (notified under document C(2022) 5098) http://data.europa.eu/eli/dec_impl/2022/1307/oj

European Commission

Major challenge

Micro(nano)plastics

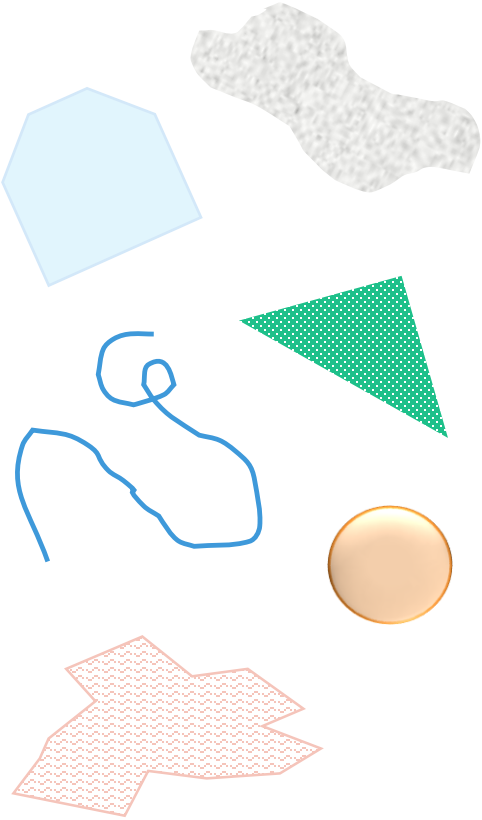
Primary sources

Secondary sources

NOT a single chemical entity

Heterogeneity in:

- Dimensions (from mm to nm)
- compositions
- shape
- presence of additives
- physicochemical characteristics
- degradation history
- …



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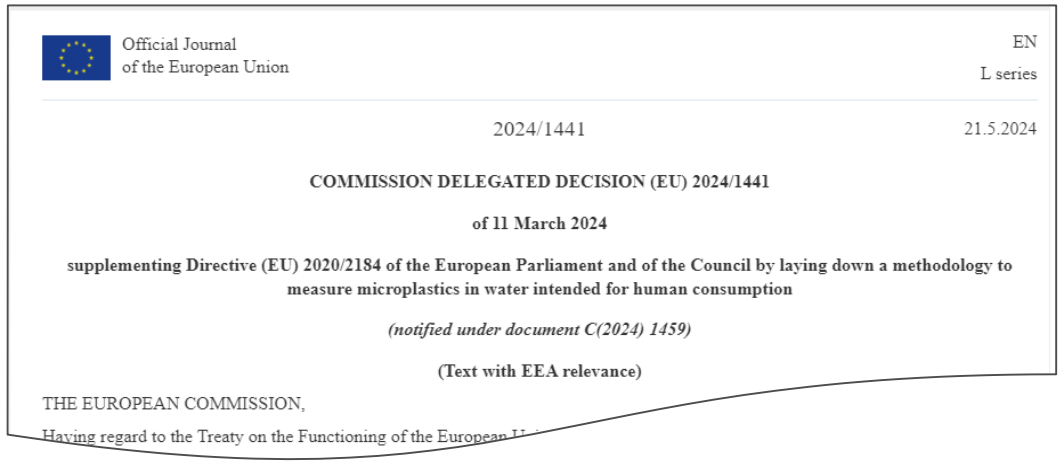
JRC role

Supporting DG Environment with:

- Evaluation of the state-of-the-art in literature, interlaboratory comparison, validation exercises, standardization bodies
- Expert consultations
- Member state feedbacks
- Drafting and revising of Delegated act and technical annexes
- Laboratory tests



Official Journal
of the European Union

EN
L series

2024/1441

21.5.2024

COMMISSION DELEGATED DECISION (EU) 2024/1441

of 11 March 2024

supplementing Directive (EU) 2020/2184 of the European Parliament and of the Council by laying down a methodology to measure microplastics in water intended for human consumption

(notified under document C(2024) 1459)

(Text with EEA relevance)

THE EUROPEAN COMMISSION,

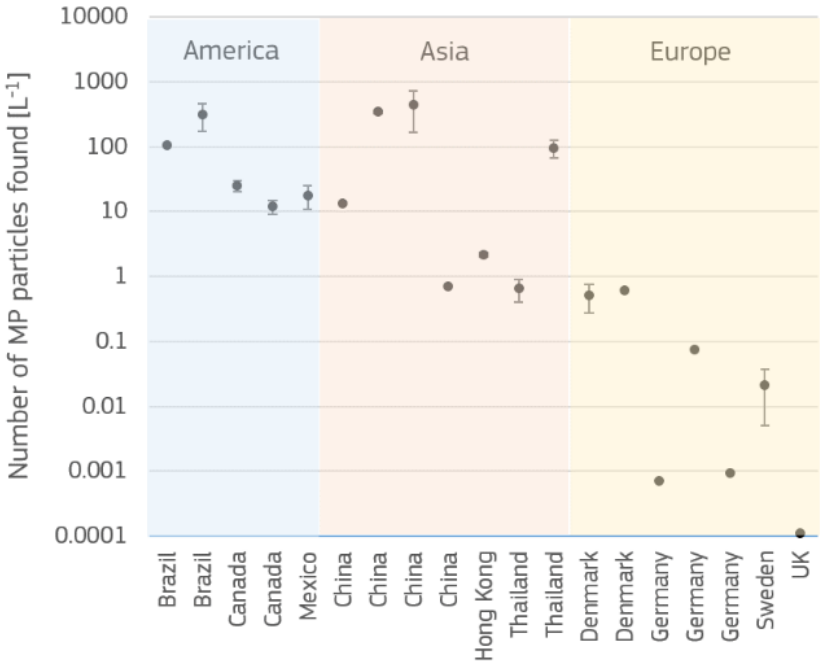
Having regard to the Treaty on the Functioning of the European

- Commission Delegated Decision (EU) 2024/1441 of 11 March 2024 supplementing Directive (EU) 2020/2184 of the European Parliament and of the Council by laying down a methodology to measure microplastics in water intended for human consumption (notified under document C(2024) 1459) http://data.europa.eu/eli/dec_del/2024/1441/oj
- Analytical methods to measure microplastics in drinking water https://publications.jrc.ec.europa.eu/repository/handle/JRC136859 https://dx.doi.org/10.2760/109944

European Commission

Literature background

Quantity (mass or number) of microplastics reported in drinking water, worldwide and in European continent



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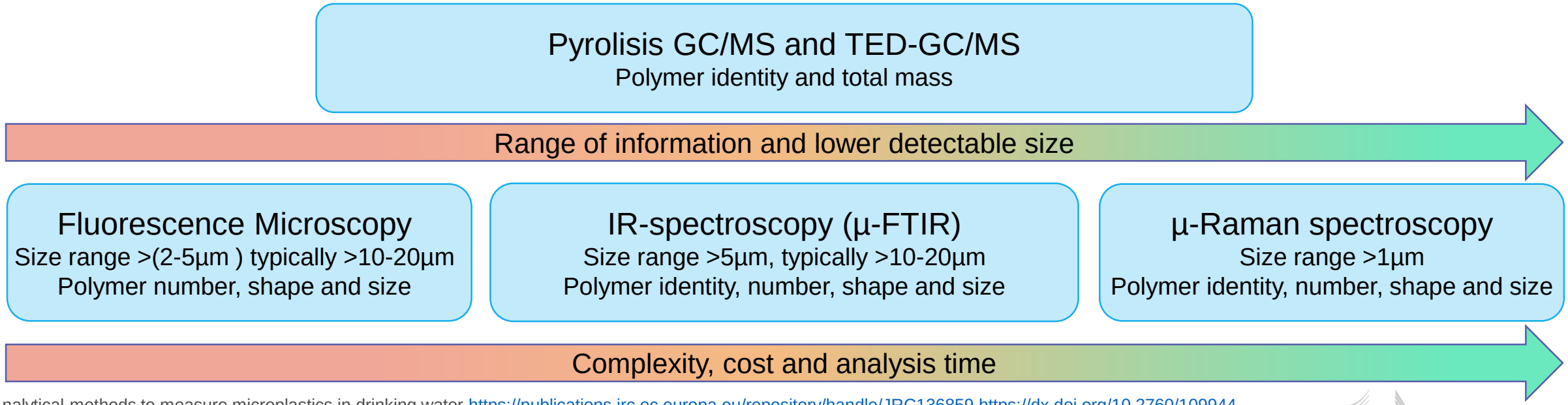

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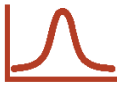


Size distribution

- Analytical methods to measure microplastics in drinking water https://publications.jrc.ec.europa.eu/repository/handle/JRC136859 https://dx.doi.org/10.2760/109944

Pragmatic approach

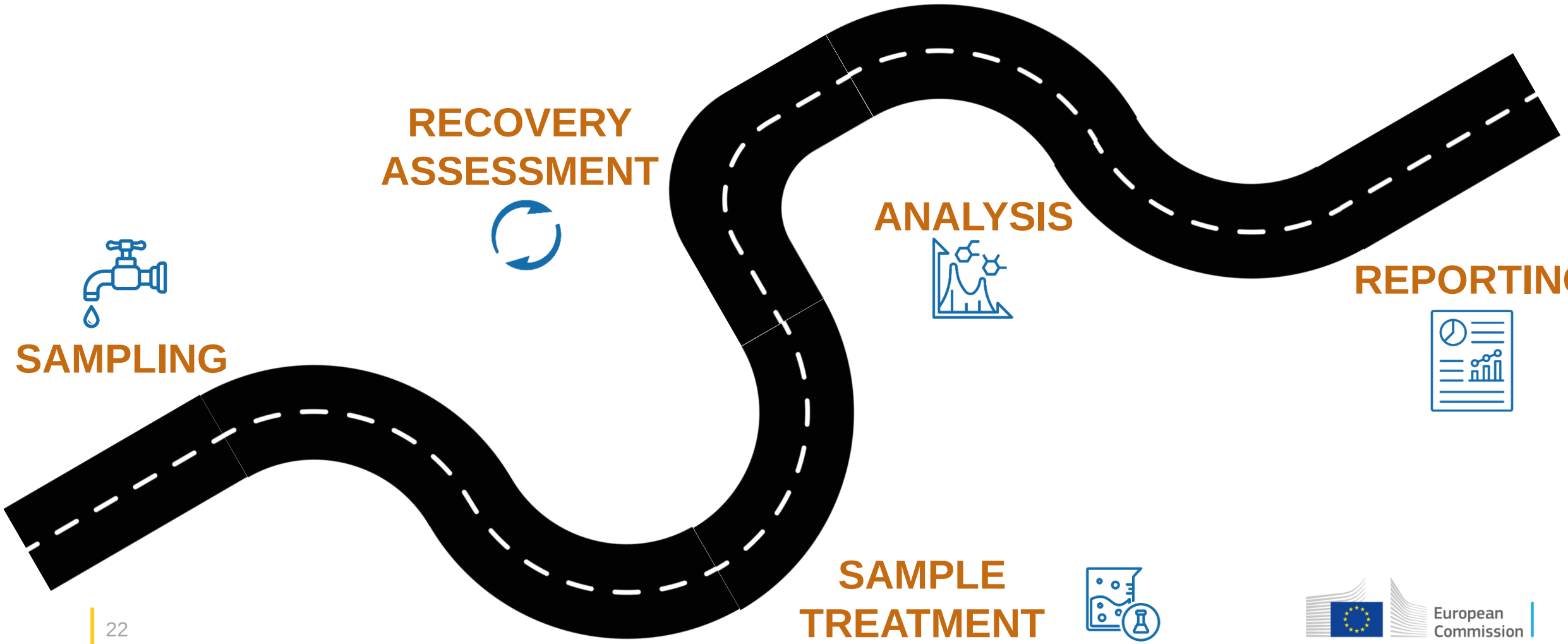
- Final goal: detailed methodology which could best **harmonize** the collection, analysis and reporting BUT analytical techniques are still under development

  - **Pragmatic** approach is necessary

- Microplastics identification: vibrational spectro-microscopy methods vs. thermo-analytical methods

- **Classifying** microplastics on the basis of predefined size bins, shape categories (particle/fragment or fibre) and composition categories (priority polymers), with an eye to **quality control**.

The methodology



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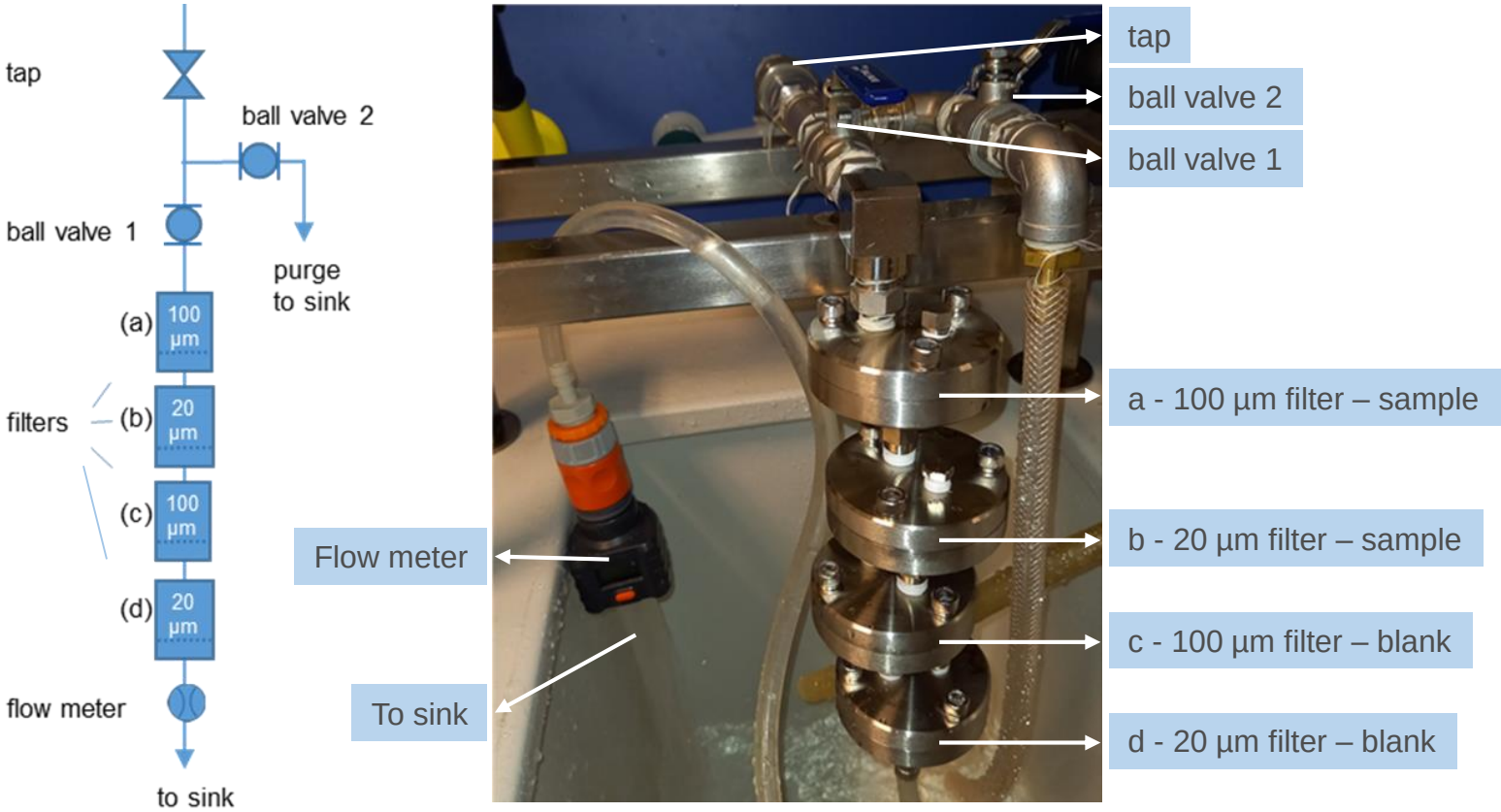
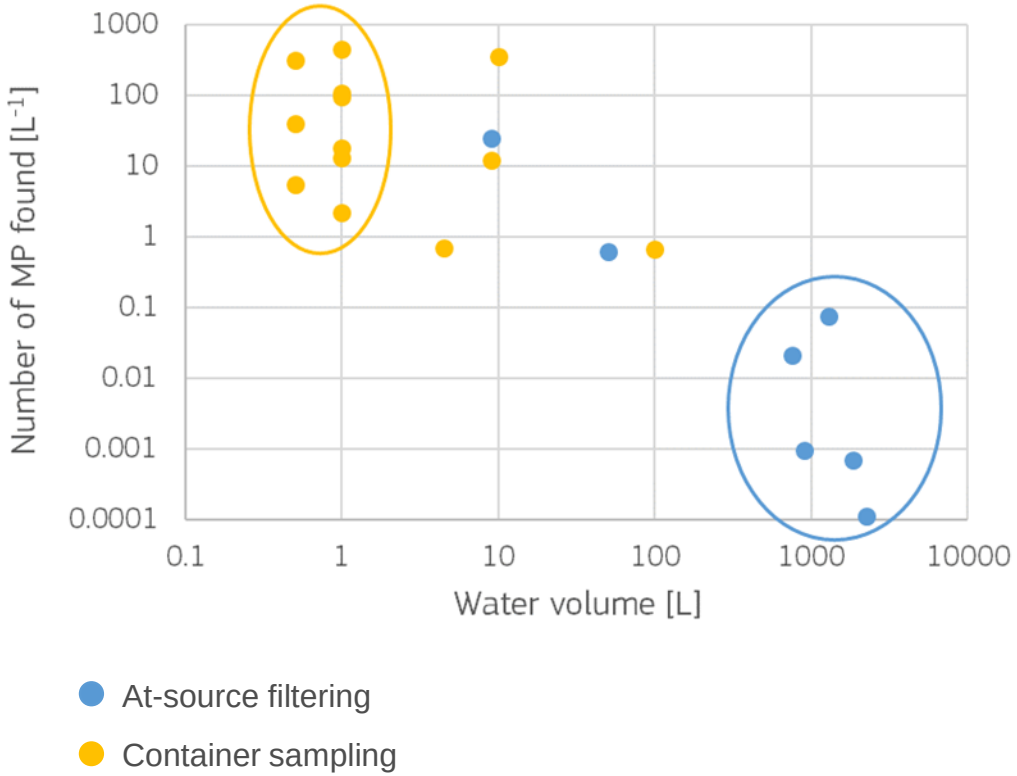
Sampling



- Directly at-source filtering
- Cascade of 4 filters:
  - 100 µm and 20 µm
  - Samples and blanks
- Minimum volume: 1000 L

Sampling

Why?



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Sampling

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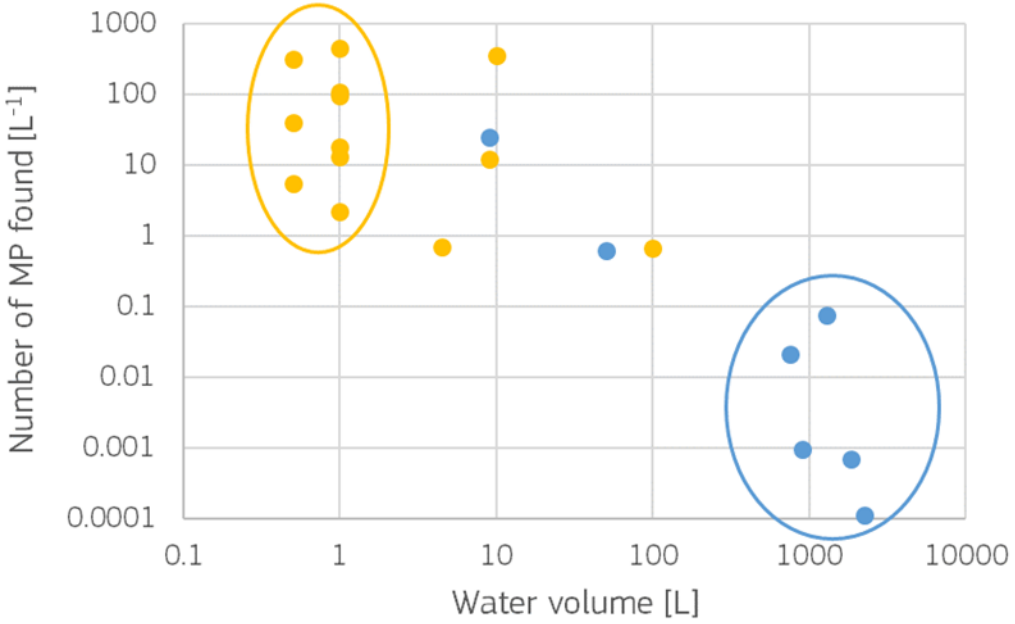
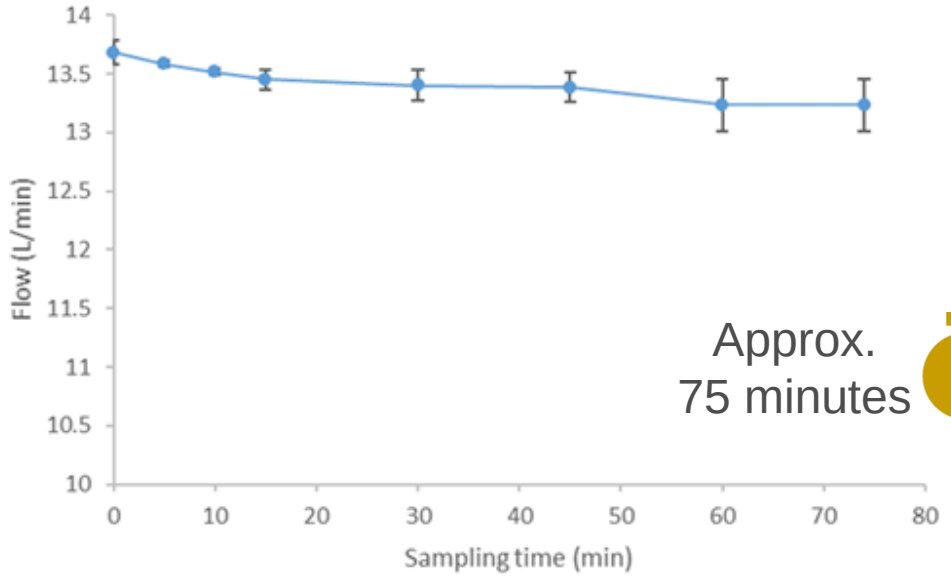


- At-source filtering
- Container sampling

Feasibility



Approx.
75 minutes

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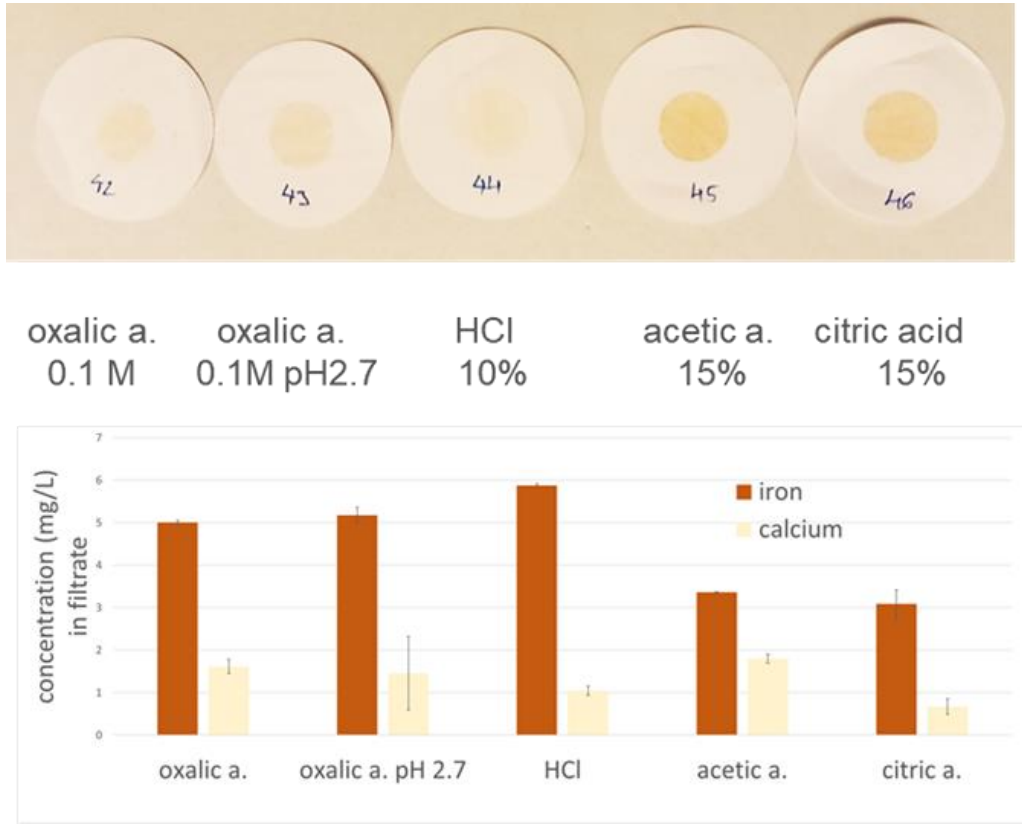
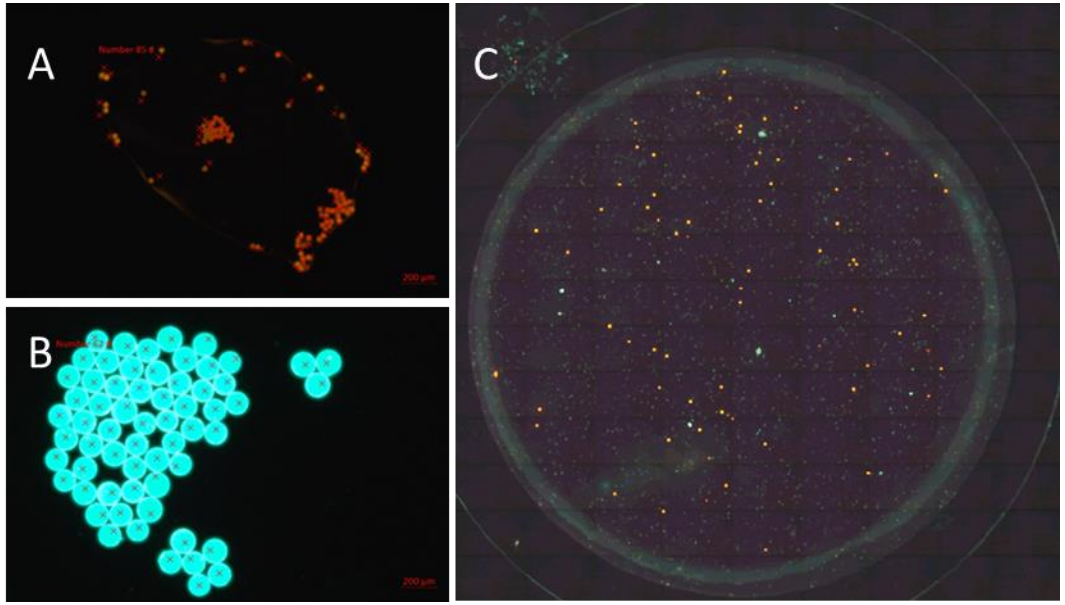
Sample treatment

- <u>Only if necessary</u>
- To reduce the presence of non-plastic materials such as minerals, metal oxides and natural organic matters
- Shall include a second filtration step



Example of acidic digestion to remove metal oxides

Recovery assessment



A) In-house labelled, Nile Red tagged 30 µm polymethylmethacrylate spheres
B) commercial 120 µm polystyrene fluorescent particles on a potassium bromide tablet
C) spike particles collected on a 25 mm aluminium oxide filter together with other particles from drinking water

Example recovery assessment using fluorescent spheres

- Spiked particles in the range:
  - 120-200 µm
  - 30-70 µm
- Two polymers with different density
- Particle number: 50-150
- Acceptable: 100 ± 40%

Analysis

Vibrational spectroscopy to determine the microplastics concentration as **number** of microplastics per cubic metre of water, **classified** according to size ranges, shape and composition categories

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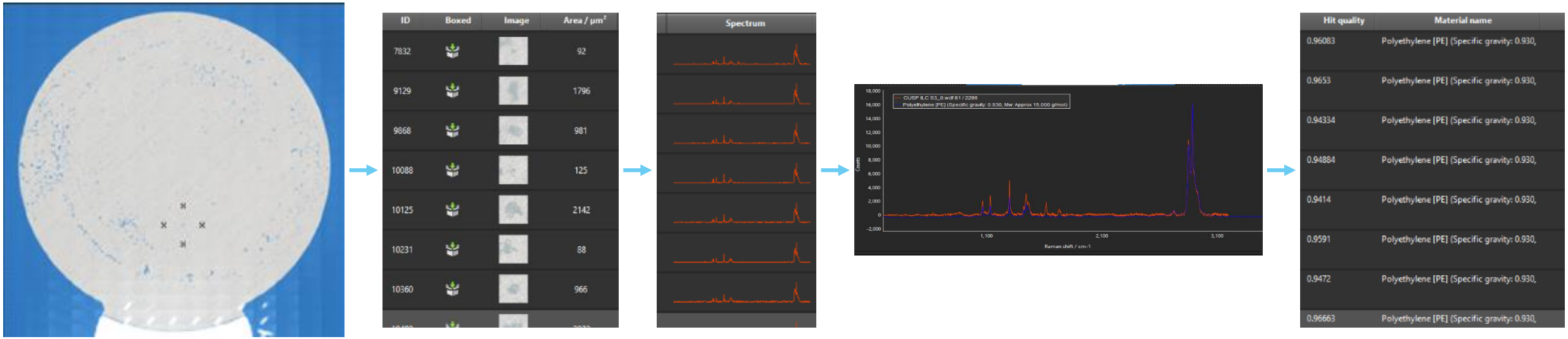


Image

Particle characteristic: shape, number, size

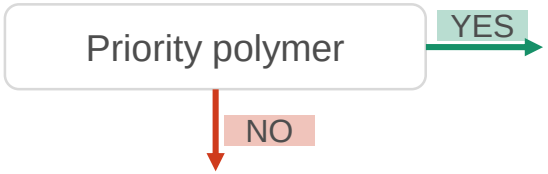
Chemical identity

Library comparison

Polymer identification

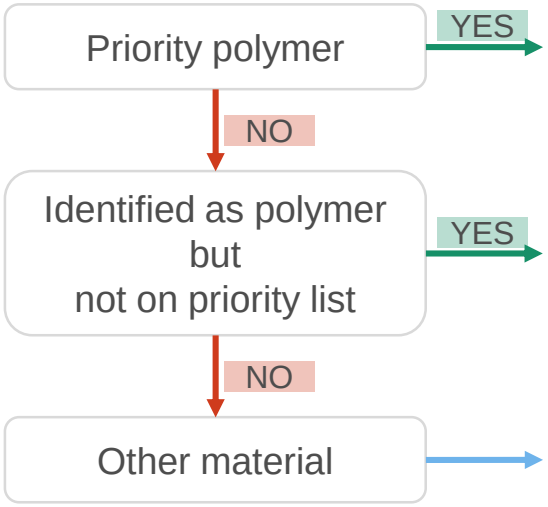
Print screen of a Raman microscope software, as an example of analysis results

Reporting



Polymer	Acronym
Polyethylene	PE
Polypropylene	PP
Polyethylene Terephthalate	PET
Polystyrene	PS
Polyvinylchloride	PVC
Polyamide	PA
Polyurethane	PU
Polymethylmethacrylate	PMMA
Polytetrafluoroethylene	PTFE
Polycarbonate	PC

Reporting



PE
PP
PET
PS
PVC
PA
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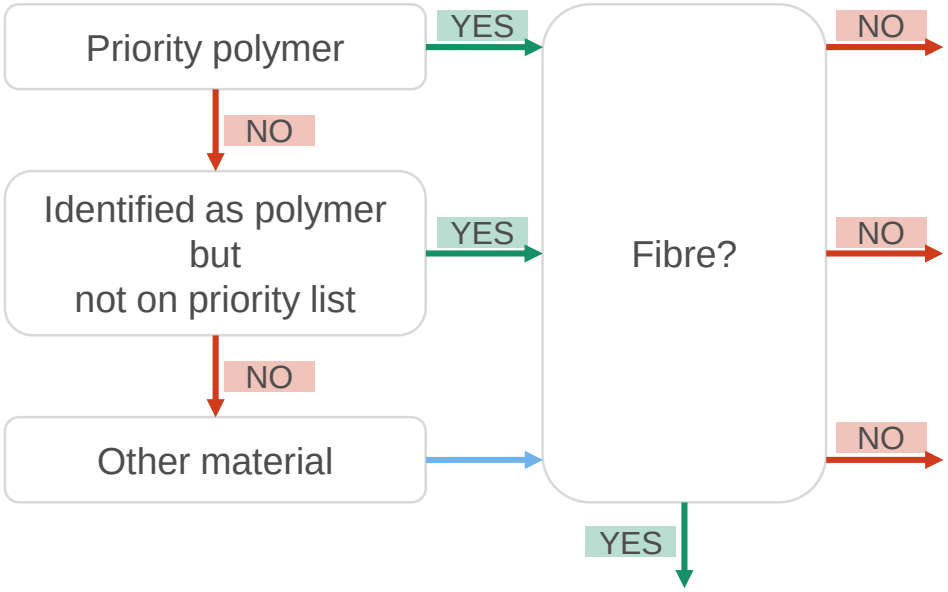
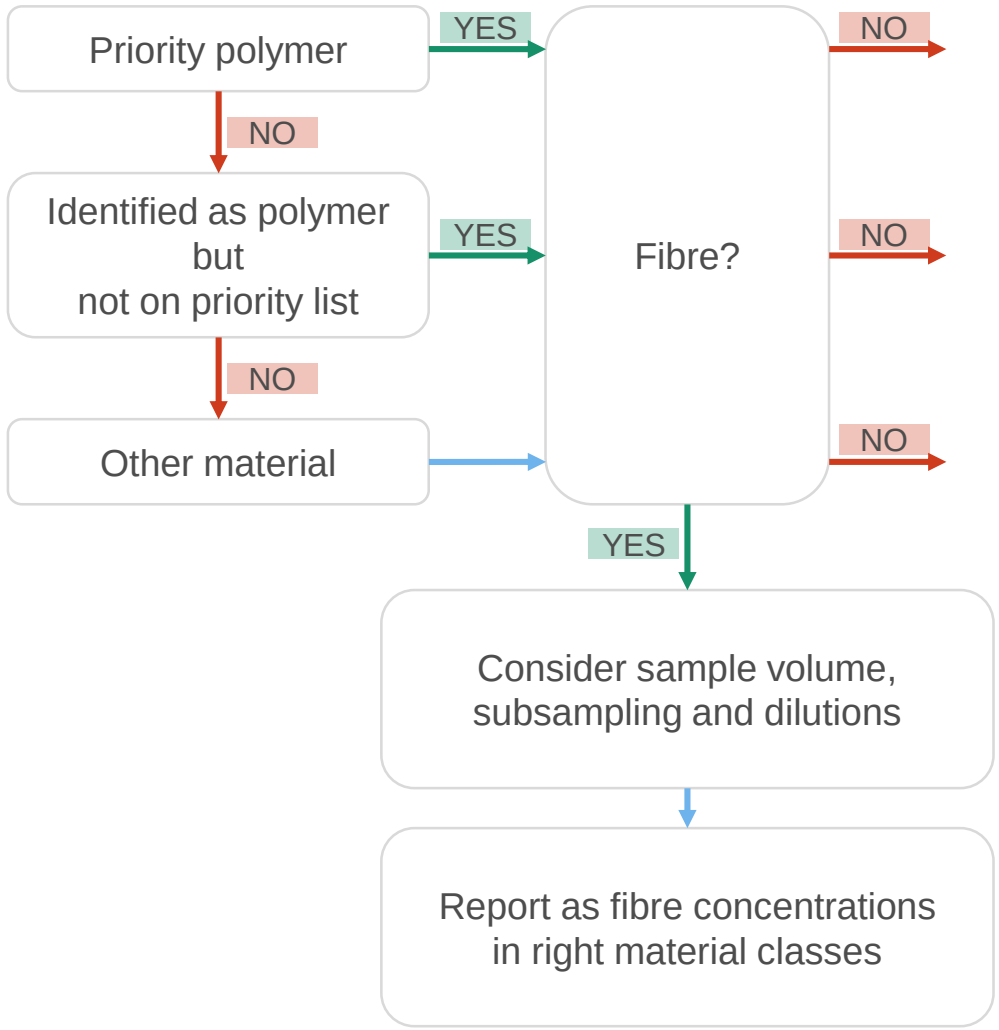
PMMA
PTFE
PC

Reporting


Priority polymer
YES
NO
Identified as polymer but not on priority list
YES
NO
Other material
Fibre?
NO
NO
NO
YES

Reporting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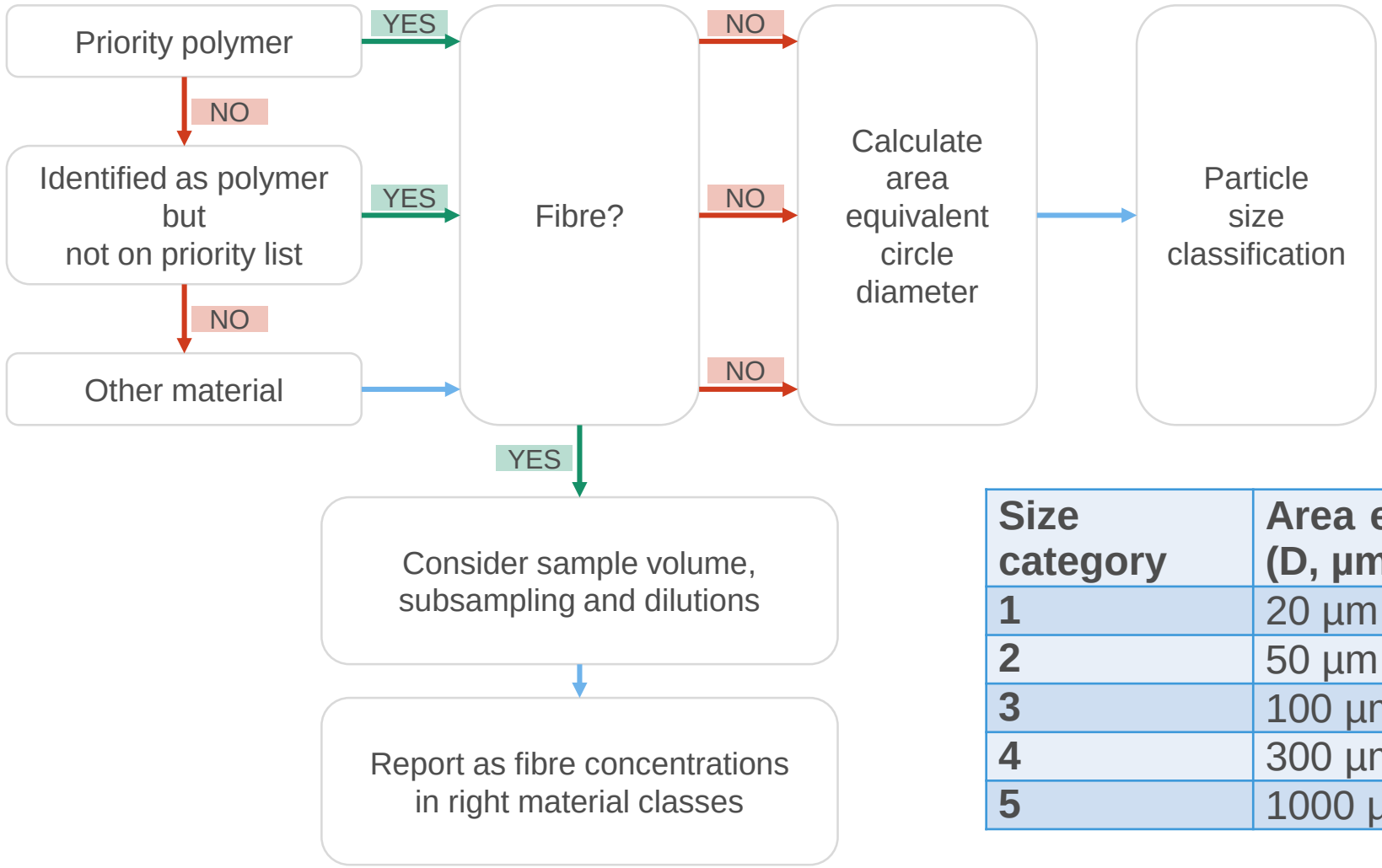
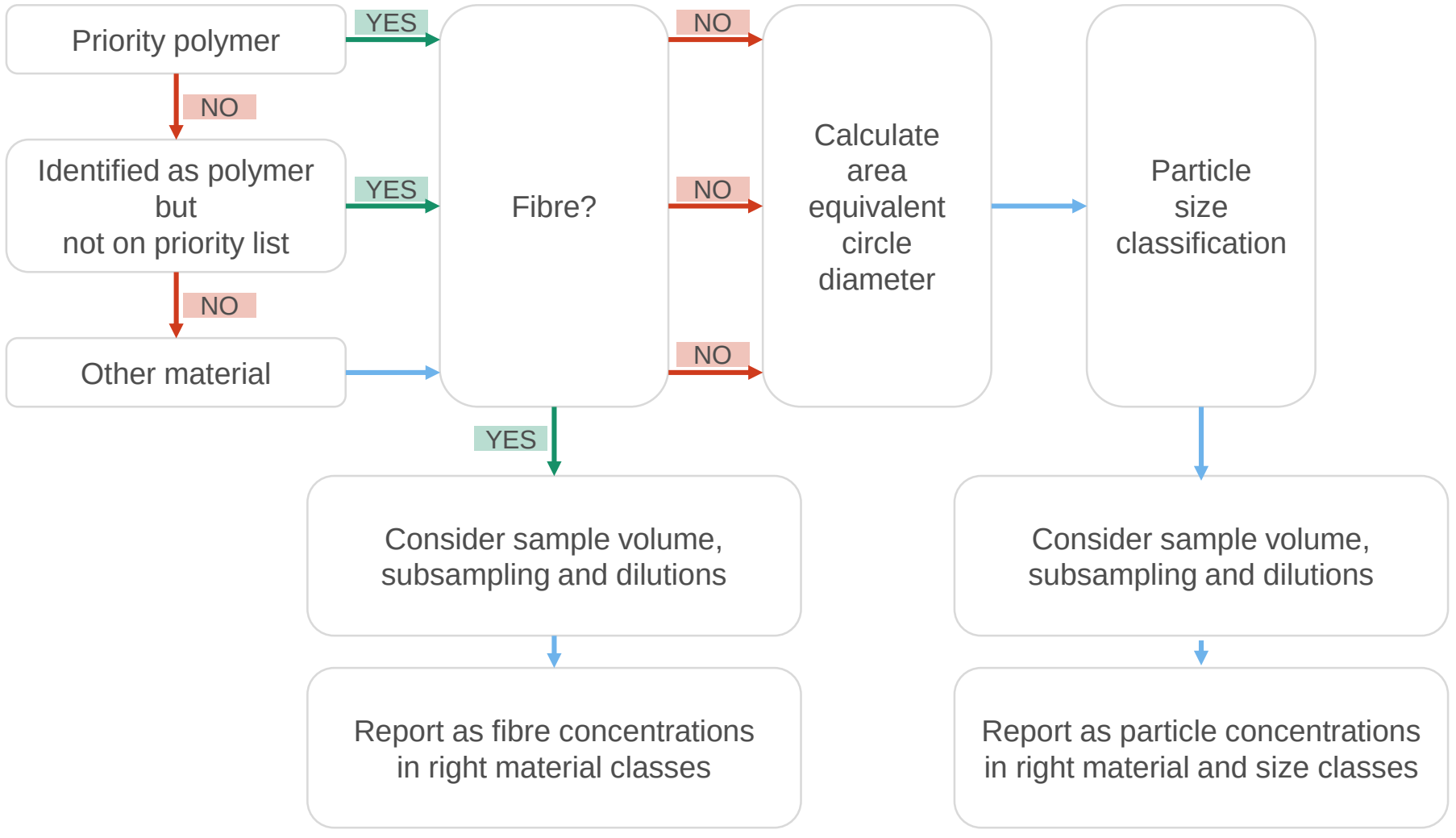
Other material
Fibre?
NO
NO
NO
YES
Consider sample volume, subsampling and dilutions
Report as fibre concentrations in right material classes

Reporting

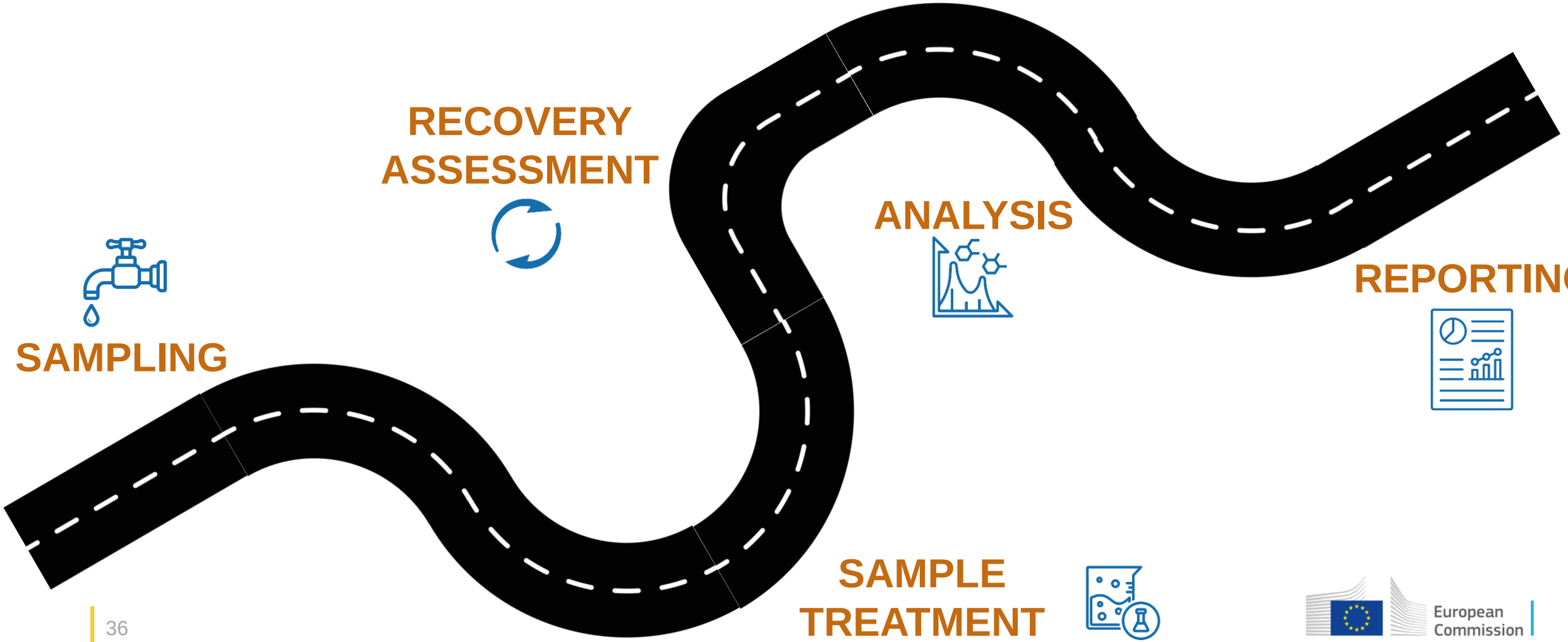


Size category	Area equivalent diameter (D, µm)
1	20 µm ≤ D <50 µm
2	50 µm ≤ D <100 µm
3	100 µm ≤ D <300 µm
4	300 µm ≤ D <1000 µm
5	1000 µm ≤ D <5000 µm

Reporting


Priority polymer
YES
NO
Identified as polymer but not on priority list
YES
NO
Other material
Fibre?
NO
NO
NO
YES
Calculate area equivalent circle diameter
Particle size classification
Consider sample volume, subsampling and dilutions
Report as fibre concentrations in right material classes
Consider sample volume, subsampling and dilutions
Report as particle concentrations in right material and size classes

Summary



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Thank you

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