Brigid: Progress and Horizons

- Clementina Vitali, Plastics Europe
- Erik Rushton, LyondellBasell

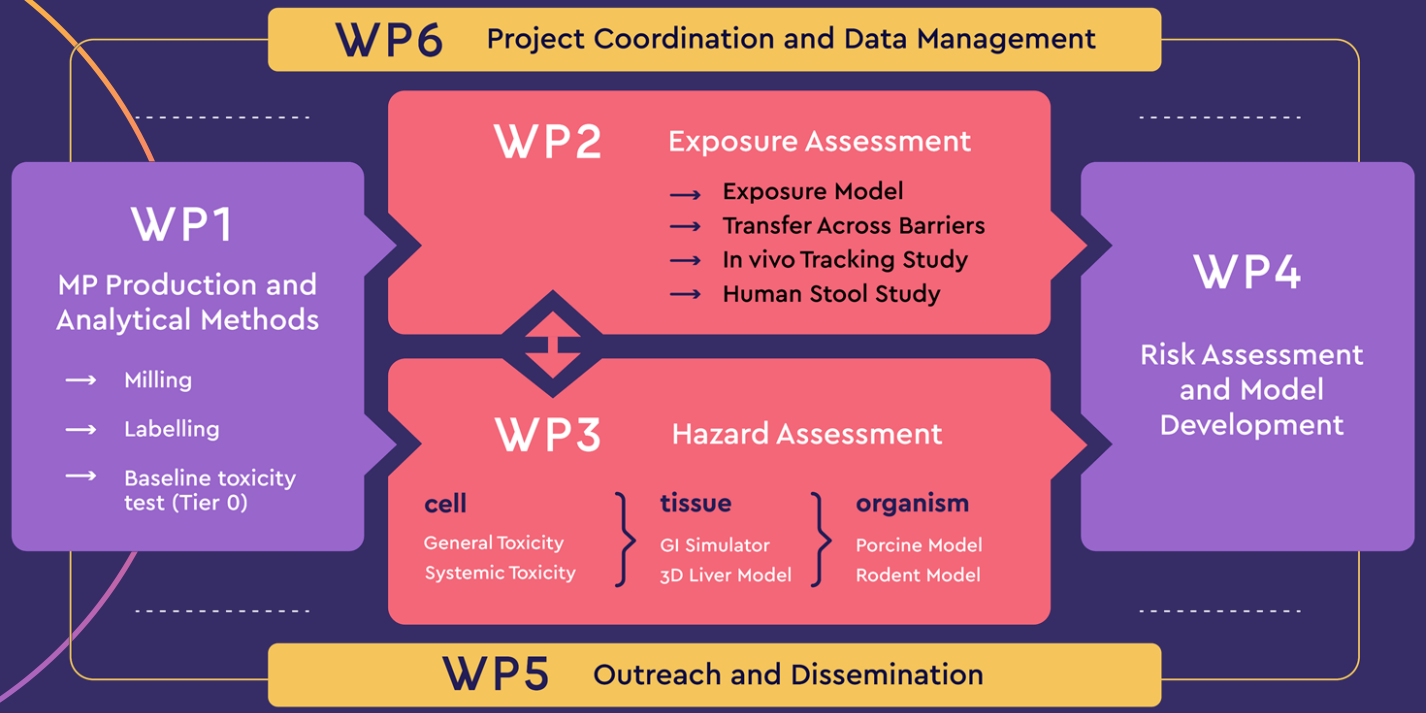
MARII Meeting | Madrid, Spain | 14th October 2025

Executive summary

- In 2022, Plastics Europe kicked off a research project on microplastic human health risk assessment – called **Brigid**
- Focus on the **potential health effects** of microplastics via **oral exposure**
- Testing materials employed in the project are generated from **micronising commercial grades**
- The project is overseen by the Plastics Europe Microplastics Science Task Force with members from the following plastic manufacturing companies represented:

  BASF, Borealis, Chevron-Phillips, DOW, ExxonMobil, INEOS Styrolution, LyondellBasell, Orlen Unipetrol, Shell, TotalEnergies, Trinseo

Brigid: structure and aims



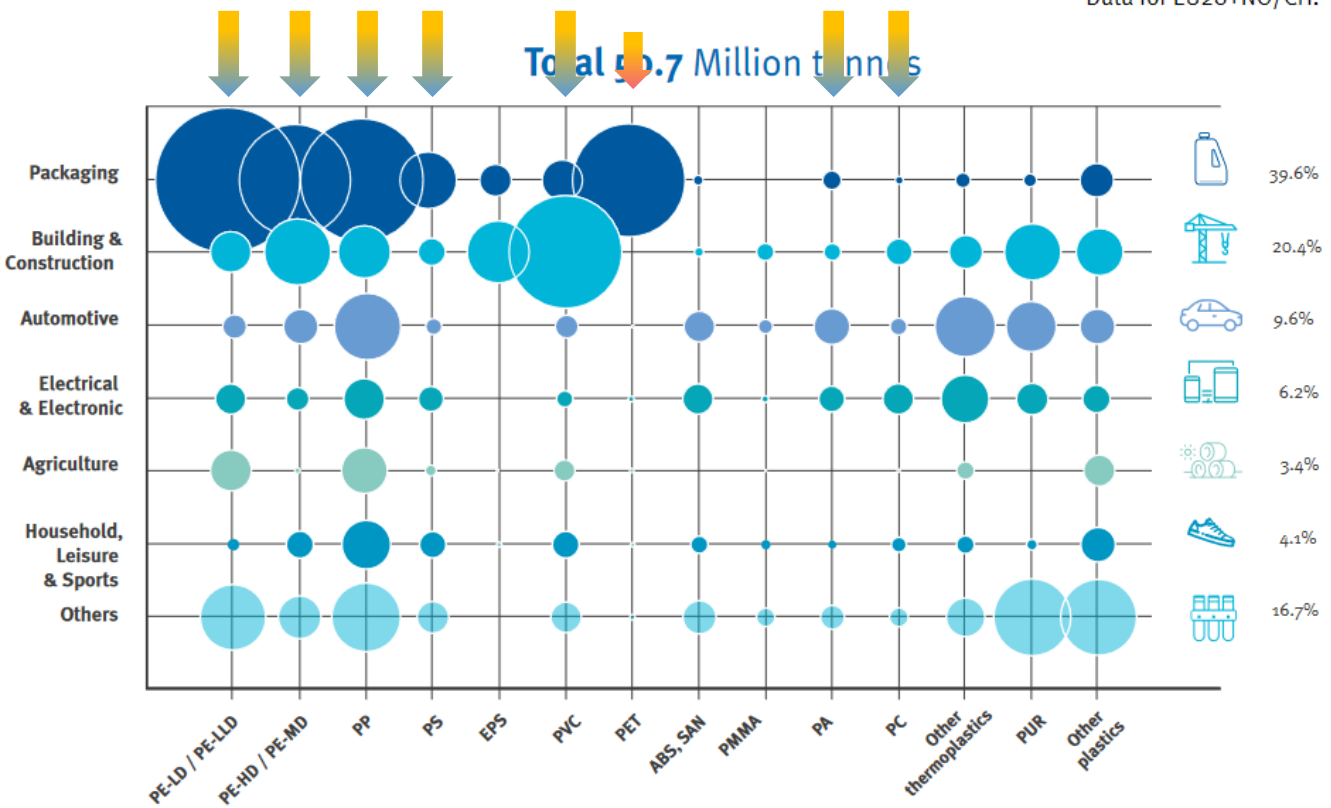
- **Six years** duration (2022-2027)
- Multimillion euro budget
- Consortium of **scientific partners** from public and private institutes
- **Open** and **transparent** communication of results
- Objective: human health risk assessment of microplastics ingestion

Polymer selection

SOURCE: PlasticsEurope Market Research Group (PEMRG) and Conversio Market & Strategy GmbH

PLASTICS DEMAND BY SEGMENT AND POLYMER TYPE IN 2019

Data for EU28+NO/CH.



Brigid testing materials: how are they different?

Brigid focuses on ***real world polymers*** → we generate microplastics from commercial polymer grades in a top-down approach

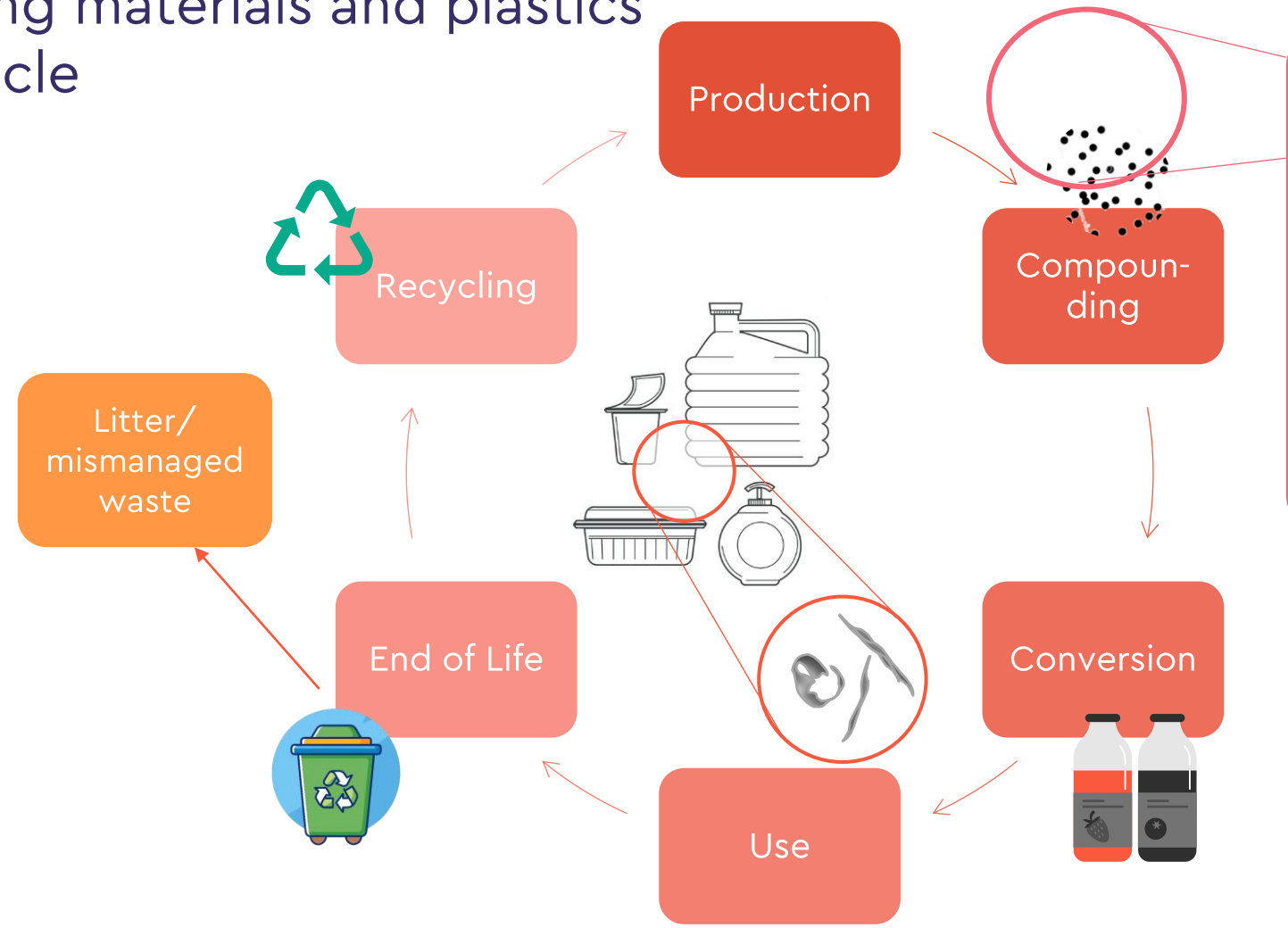
Challenges:

- Milling
  - Melting
  - Contamination
- Wide size distributions
- Targeting lower fractions

Limitations:

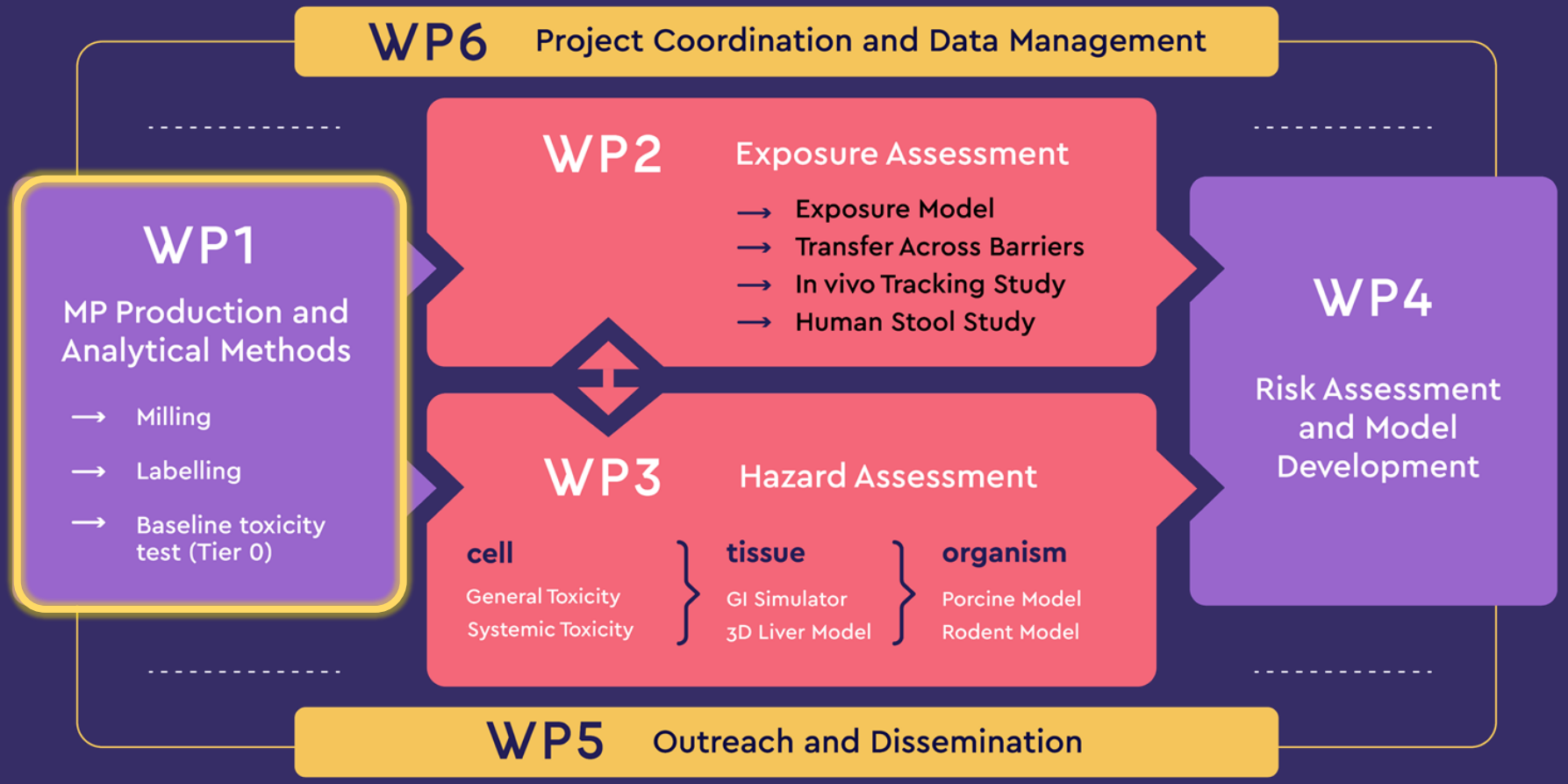
- The particles have not undergone environmental aging and are a model for emissions during the **use phase.**
- In some cases, commercial-grade materials cannot be employed, leading to the use of **research-grade polymer models** for studies (e.g., toxicokinetics).

Testing materials and plastics lifecycle



Testing material generation for Brigid is focusing on the early stages of the plastic value chain, starting from **pre-production pellets**

Where are we?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WP5 Outreach and Dissemination

Testing material characteristics

LLDPE/LDPE, HDPE, PP, PS, sPVC, PA-6, PC, PET*

Three size classes: ≤1, 10, 100 µm

Micronisation:

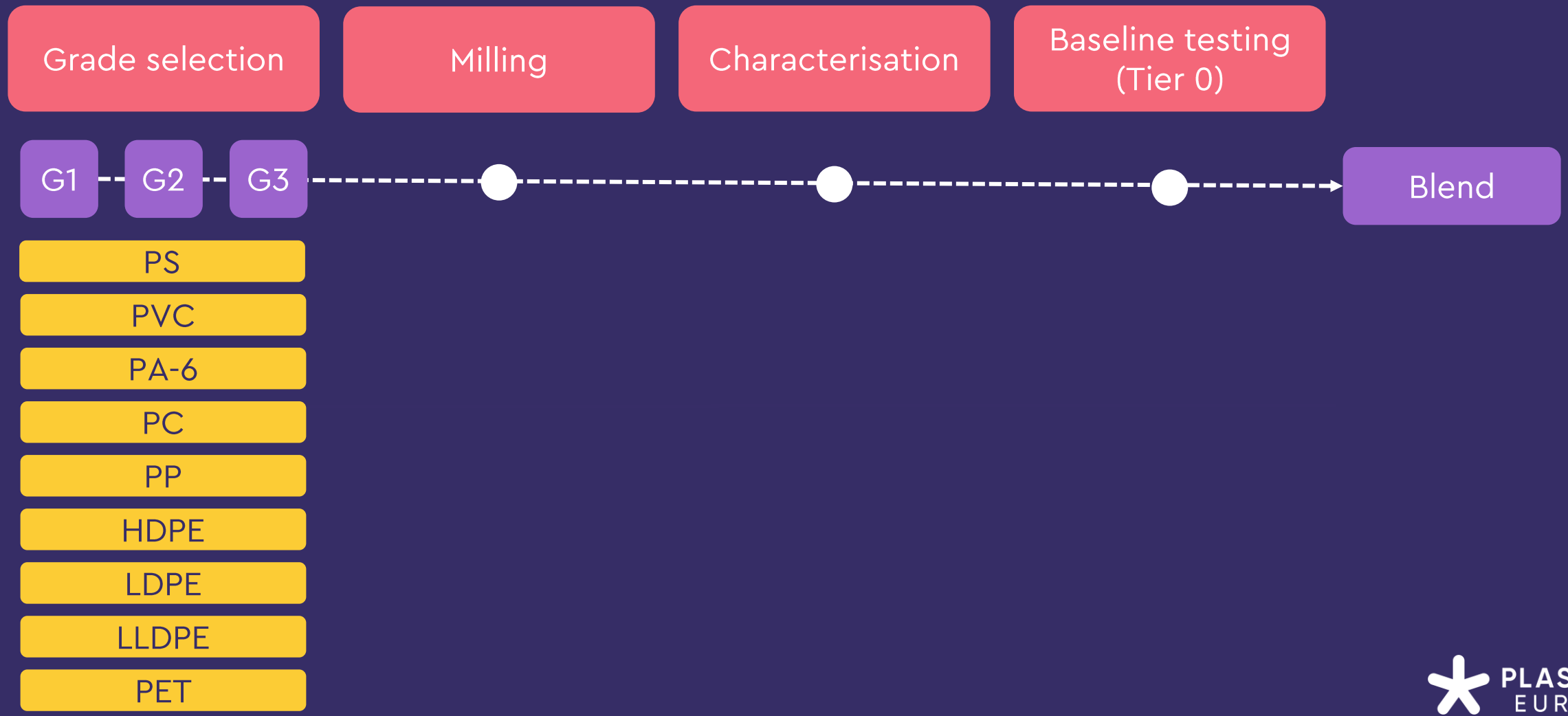
- Jet milling
- Cryogenic milling
- Ball milling
- Melt emulsion

Labelling:

- C^{14}
- Fluorescent probe

In collaboration with Petcore Europe

Focus on WP1: microplastic production



WP1: Literature Review on Microplastic Suspensions

- Toxicity testing requires stable, realistic test materials to be delivered to the testing system
- This review evaluates suspension methods for relevance and potential toxicity to biological systems

Environmental Pollution
Volume 356, 1 September 2024, 124306

Review

Suspension of micro- and nanoplastic test materials: Liquid compatibility, (bio)surfactants, toxicity and environmental relevance ☆

Dónal van Uunen [a 1], Maria Kloukinioti [a b 1], Ingeborg M. Kooter [a b], Elena M. Höppener [a], Laurine E.A. Yoe [a], Andrea M. Brunner [a], Arjen Boersma [c], Luke A. Parker [a]

Methods

- Evaluated **nine polymer types** in various liquid solutions (e.g., PS, PET, PP)
- Assessed **chemical compatibility** using Hansen Solubility Parameters
- Assessed **agglomeration** risk via **zeta potential** measurements
- Reviewed **dispersants** (synthetic & bio) for toxicity and environmental fit

Conclusions

- **Water and glycerol** show good chemical compatibility
- A zeta potential ≥ ±30 mV suggests good dispersion stability
- Surfactants can affect toxicity outcomes
- Biosurfactants are promising but variable
- **Eco-coronas** may enhance real-world relevance of tests

Van Uunen et al., 2024. doi.org/10.1016/j.envpol.2024.124306

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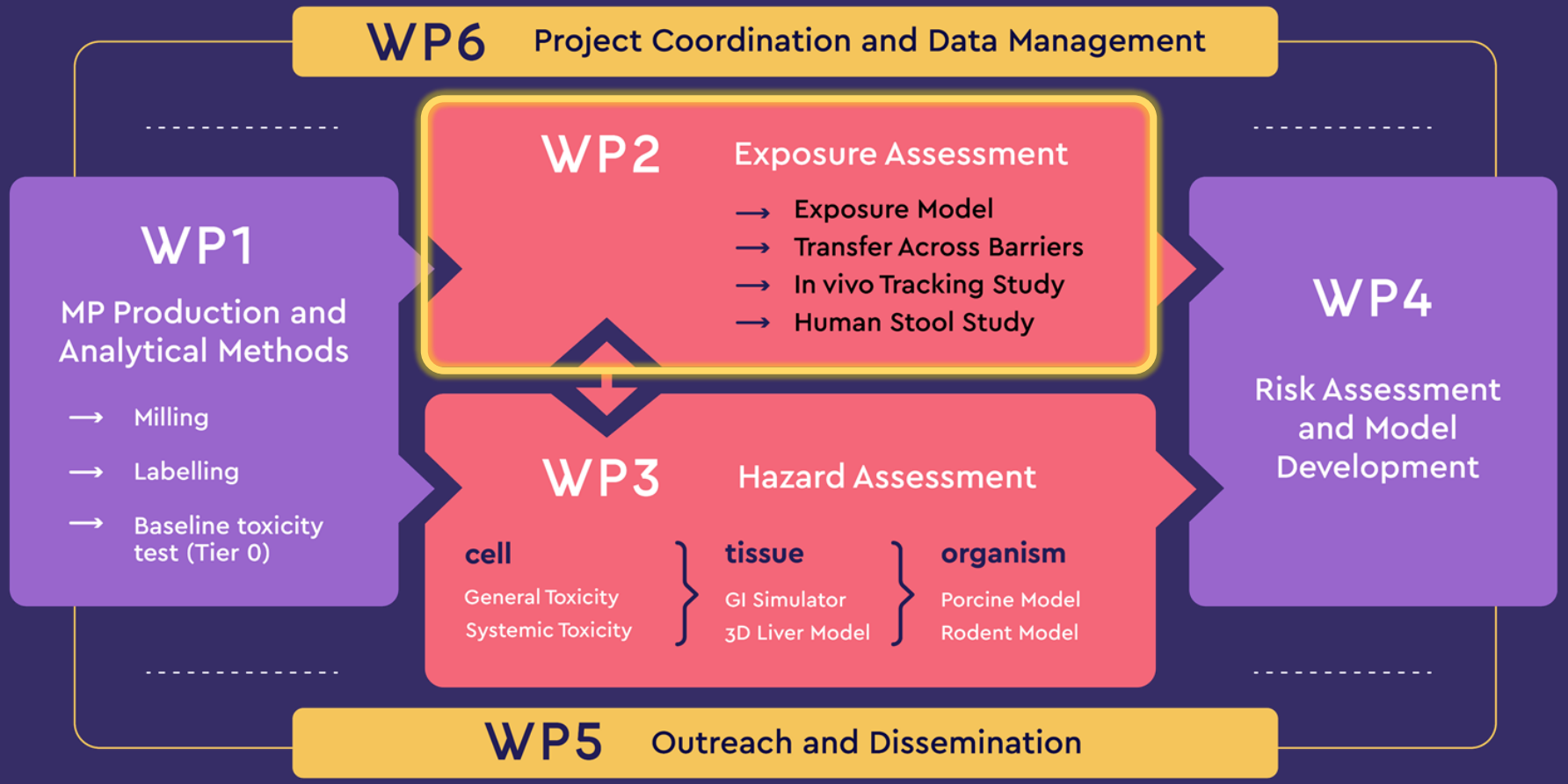
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Focus on WP2

WP2
Exposure assessment

In silico exposure model
(Cefic LRI B24)

Inhalation project
(Cefic LRI C10)

In vitro
Model of transfer across biological membranes (barrier model)

In vivo
- MP tracking study (MP uptake through oral route)
- Human stool study (influence of diet on MP presence in stool)

Human Stool Study

Pilot study aiming to quantify the microplastics in the stool of 15 human volunteers, following the initial study of Schwabl *et al.* (2019). The study will analyse the variation in quantity of microplastics detected in the stool samples after the volunteers follow three different types of plastic use scenarios:

High plastic use scenario

- processed and plastic-packaged foods
- plastic utensils and cutlery

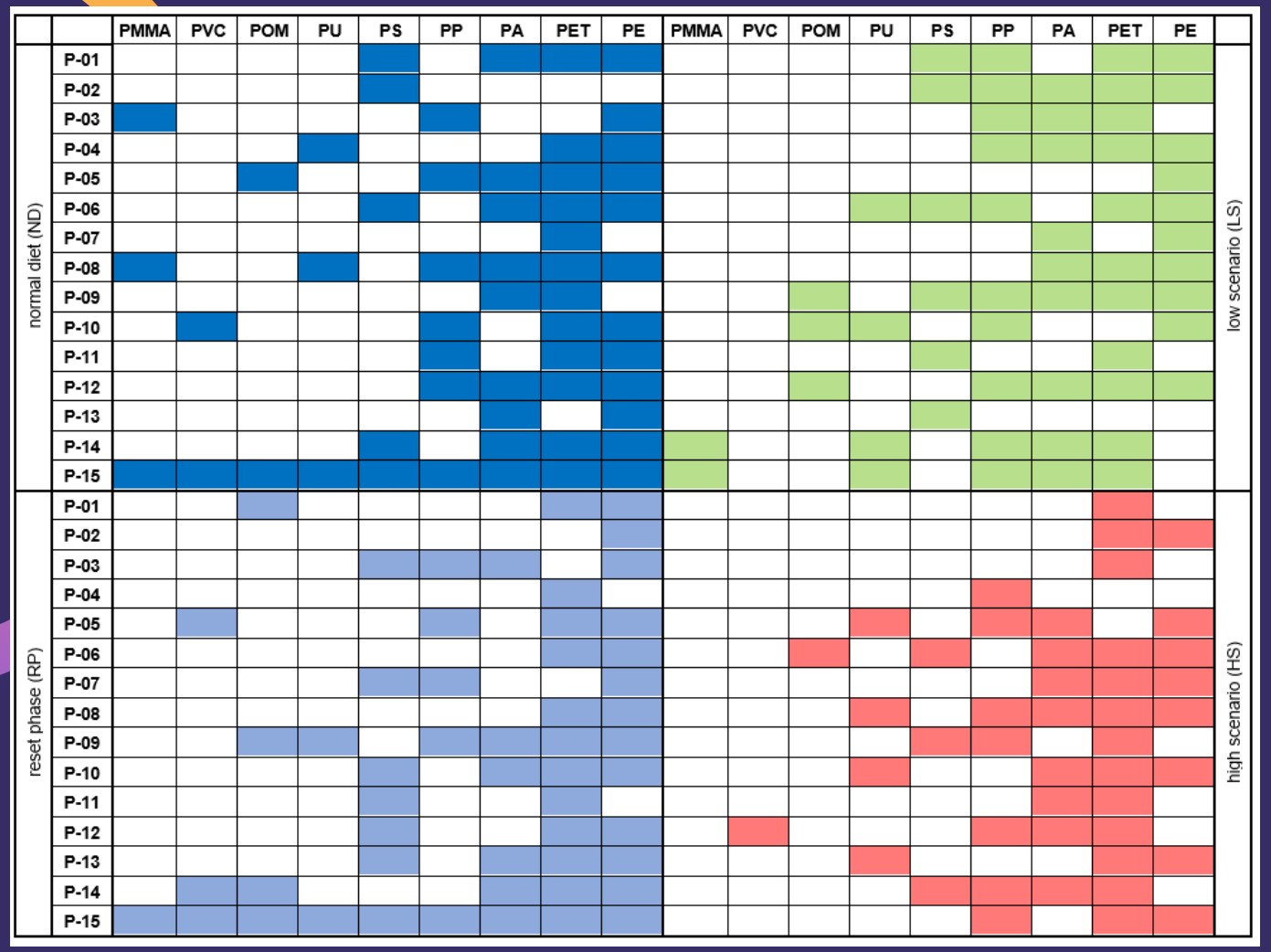
Normal plastic use scenario

- both ready-made foods and foods cooked from scratch
- mixture of plastic and non-plastic utensils

Low plastic use scenario

- food cooked from scratch
- packaged and cooked in/with non-plastic materials

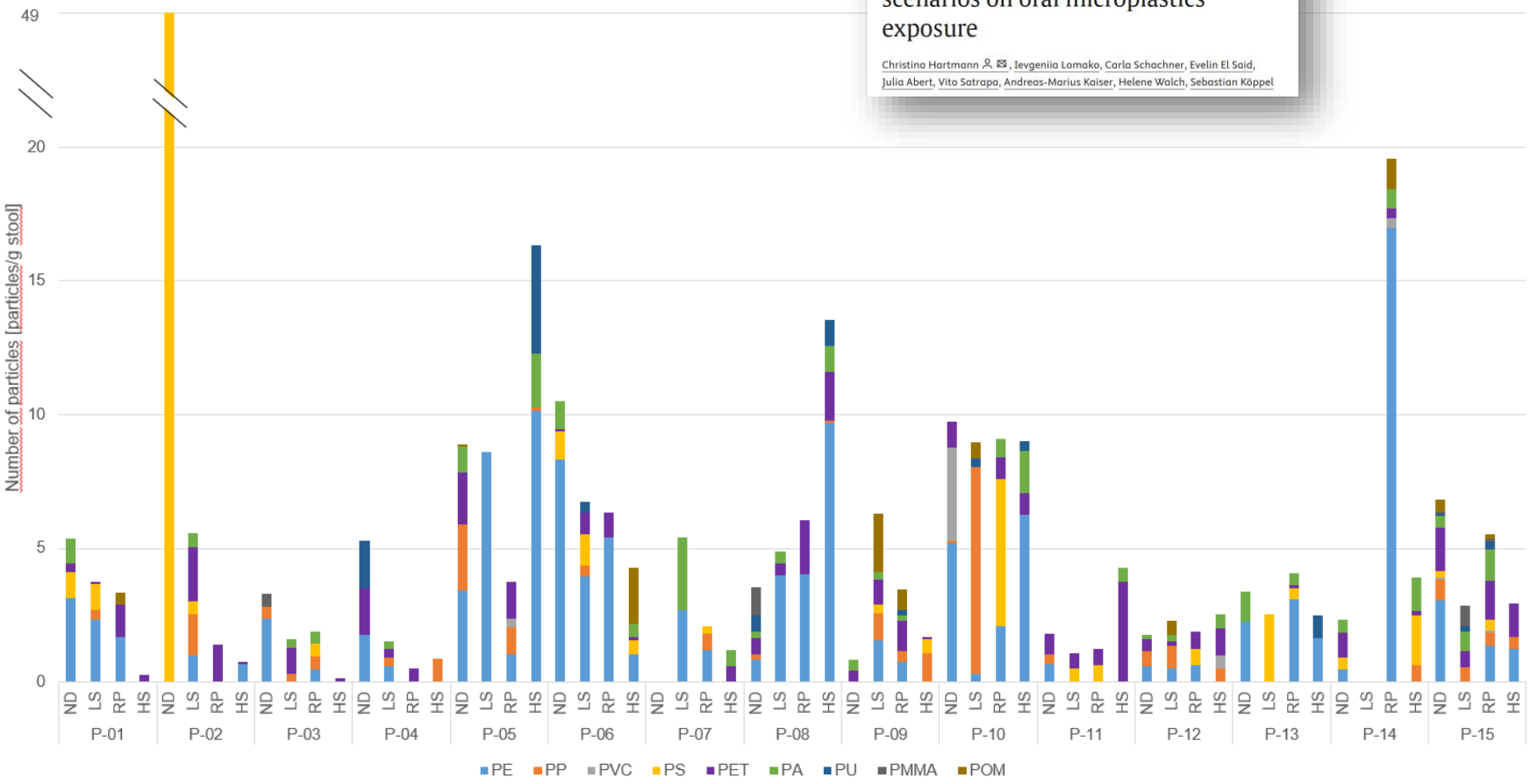
Results (1/2)



- MPs were detected in **95% of stool samples**
- On average, **3.3 MPs/g stool** were detected
- The **most common polymer type** for detected MPs was **PE**, followed by PET and PP

Results (2/2)

- There is **no identifiable correlation between the plastic packaging factor** (amount of packaged food/beverages consumed) and **number or type of MPs** in stool
- The authors suggest a possible positive correlation between degree of **processing** of the food consumed vs MPs in the stool




Science of The Total Environment
Volume 951, 15 November 2024, 175825

Assessment of microplastics in human stool: A pilot study investigating the potential impact of diet-associated scenarios on oral microplastics exposure

Christina Hartmann, Ievgeniia Lomako, Carla Schachner, Evelin El Said, Julia Abert, Vito Satrapa, Andreas-Marius Kaiser, Helene Walch, Sebastian Köppel

Hartmann et al., 2024. doi.org/10.1016/j.scitotenv.2024.175825

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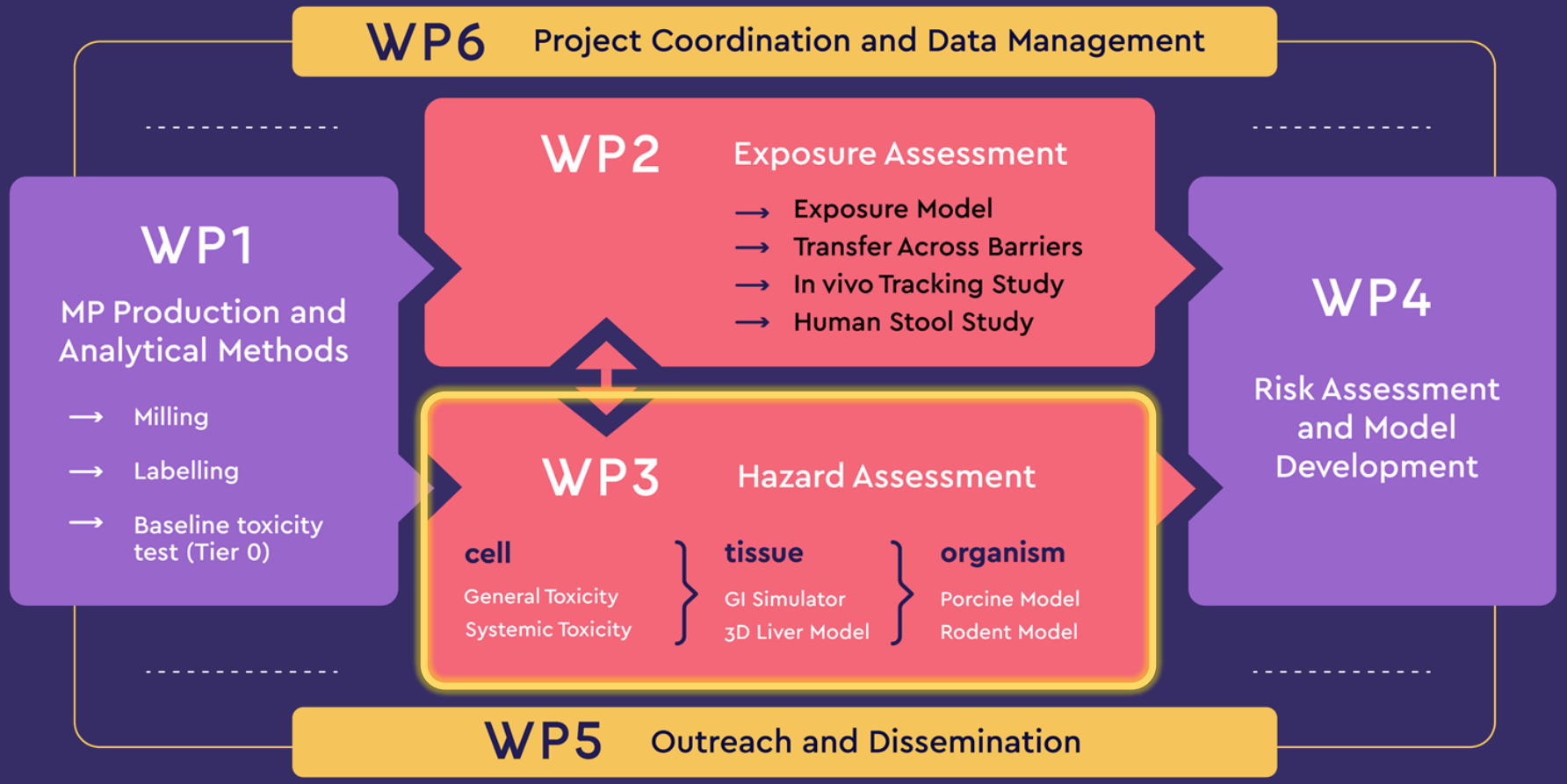
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Focus on WP3

WP3
Hazard assessment

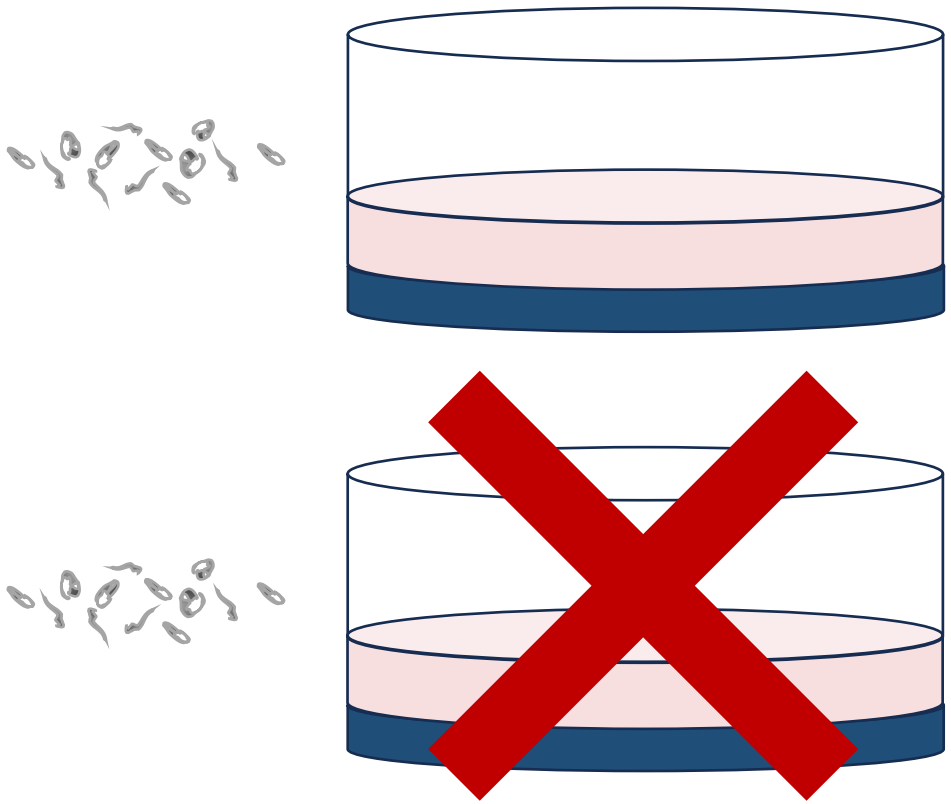
In vitro
- Tier 0: baseline assessment
- Tier 1: general toxicity
- Tier 2: systemic toxicity*

Ex vivo
- Gastrointestinal simulator
- 3D Liver model*

In vivo
- Porcine model
- Rodent model

*based upon demonstrated internal exposure

Microplastics and *in vitro* exposures

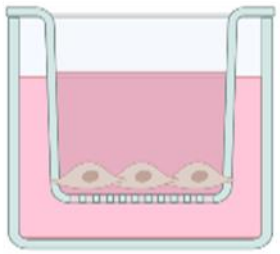


Sinking particles

Floating particles

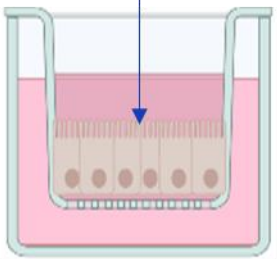
How to ensure cell exposure?

Tier 0: *In vitro* testing of particles- Conventional model



Undifferentiated cells

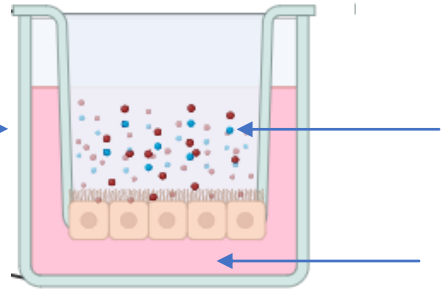
Microvilli structure



Culturing for 21 days to create a complete monolayer

Tight junctions between cells

$\rho_{object} > \rho_{medium}$



Apical side (intestinal lumen-facing side)

500µl – exposure volume – 12well transwell

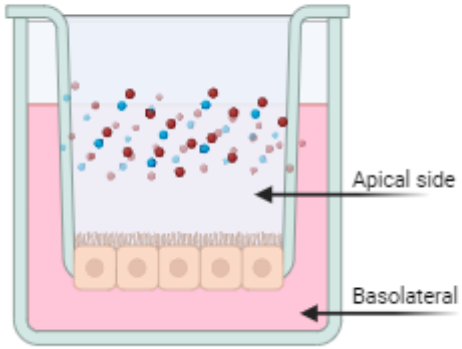
Basolateral side (blood-facing side)

1.5ml – basolateral volume

Cells exposed to sediments and potentially aggregated particles

≠

$\rho_{object} < \rho_{medium}$

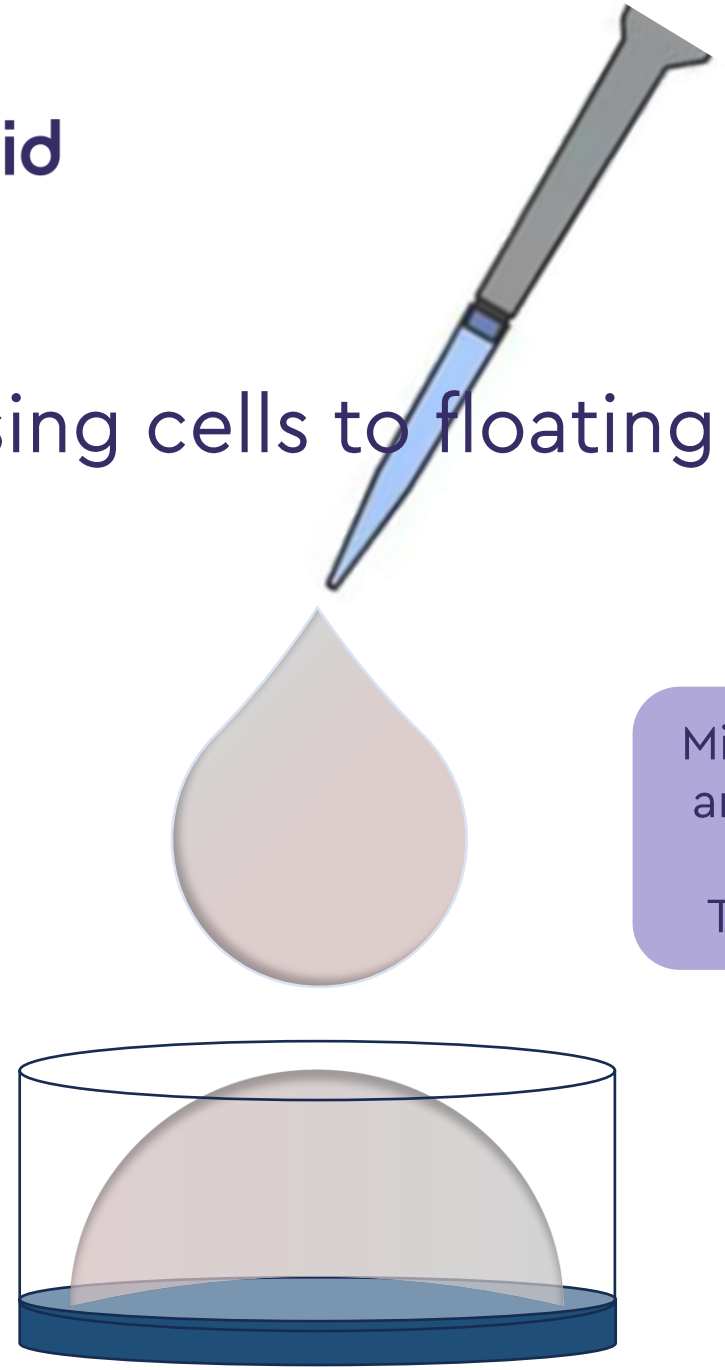


No contact with cells at the bottom of the culture plate, model not suitable for exposure assessment

Work of Maria Kloukinioti

brigid

Exposing cells to floating particles



Microdosing particles and media to ensure contact:
The **droplet** model

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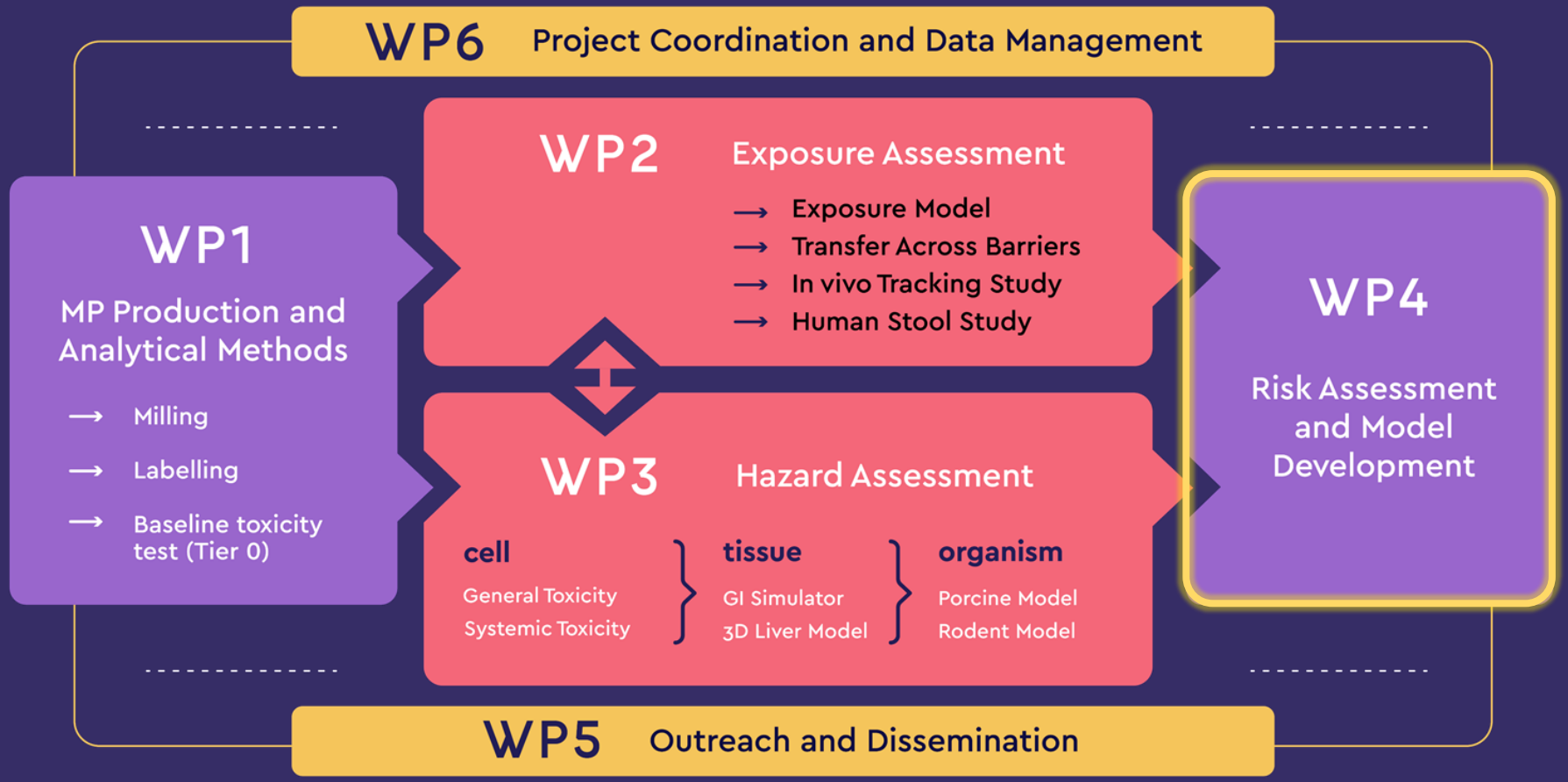
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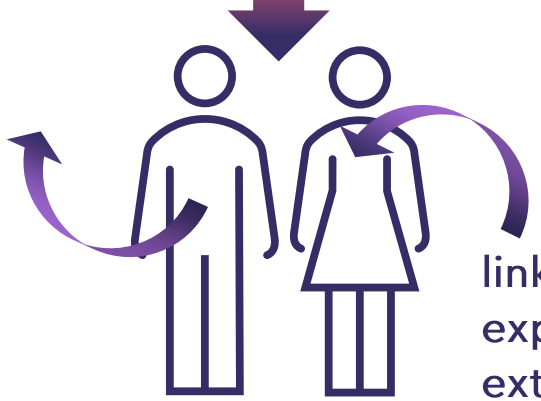
Focus on WP4: Risk Assessment

In vivo hazard studies

Hybrid approach

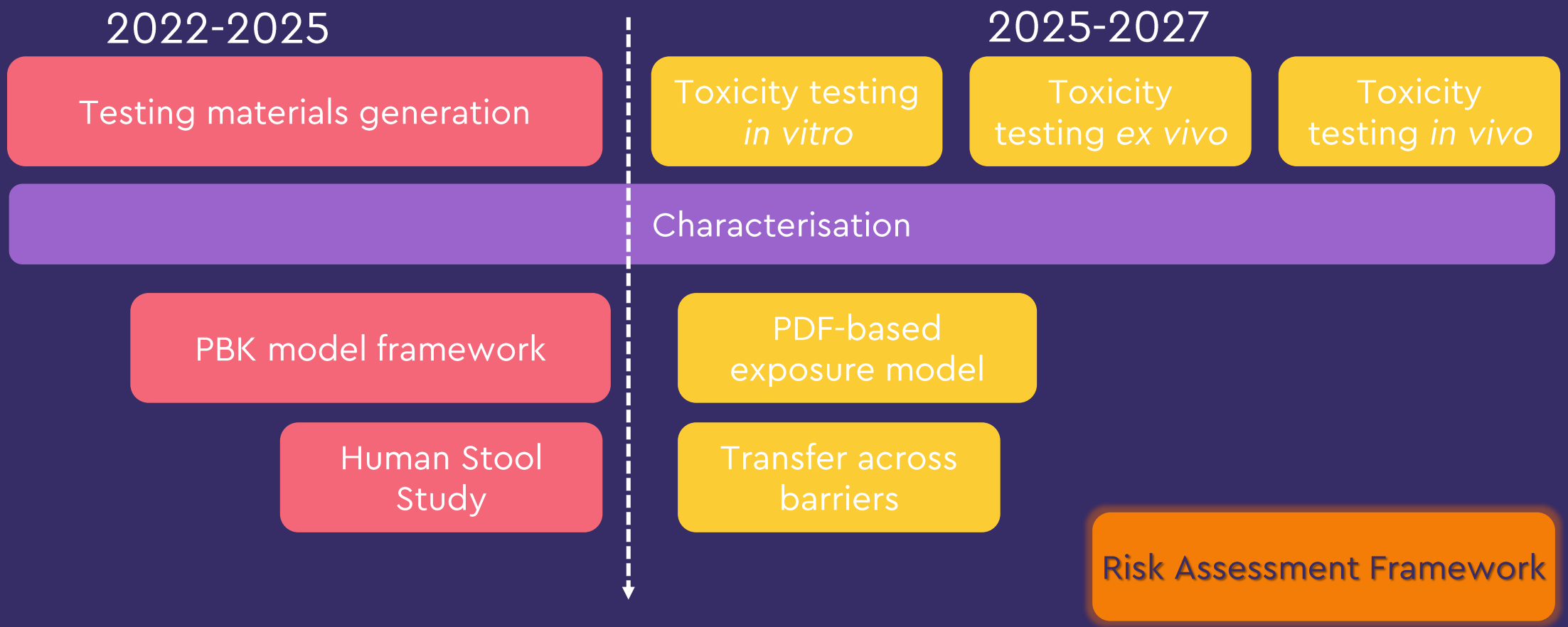
New Approach Methodologies (NAMs) data

human internal exposure from external sources estimation



linking measured internal exposure to potential external sources

What's next on the horizon?



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Research Impact

- (As much as possible) **real-world polymers** are being assessed in the project
- Results will feed **Risk Assessment frameworks**, which can help explain the polymer-related differences in effects and the potential risk to human health
- The information needs to be transparently and clearly communicated to all stakeholders, supporting technical advocacy on ongoing and upcoming policy files (e.g., REACH Restriction on Synthetic Polymer Microparticles, Pellet Loss Prevention Regulation, Ecodesign Directive, Corporate Sustainability Reporting Directive)

brigid

bridging the knowledge gap on microplastics' impact on human health

Thank you for your attention

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PLASTICS EUROPE

Enabling a sustainable future