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# Environmental Impacts of Bioplastics (ULTRA-BIO Project)

BBC Day Presentation

15 April 2025

# Agenda

Moderated by Yvonne van der Meer (MU)

- Introduction of ULTRA-BIO project, Iris Vural Gursel (WR)
- Presentation on the Preliminary work on Stage 1, Richard Padi (UU)
  - Overview of important regulations & policies
  - Overview of contested issues
- Participants' feedback - Wooclap exercise
- Q&A and open discussion



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# Environmental Impacts of Bioplastics (ULTRA-BIO Project)

Introduction of ULTRA-BIO project, Iris Vural Gursel (WR)

BBC Day Presentation

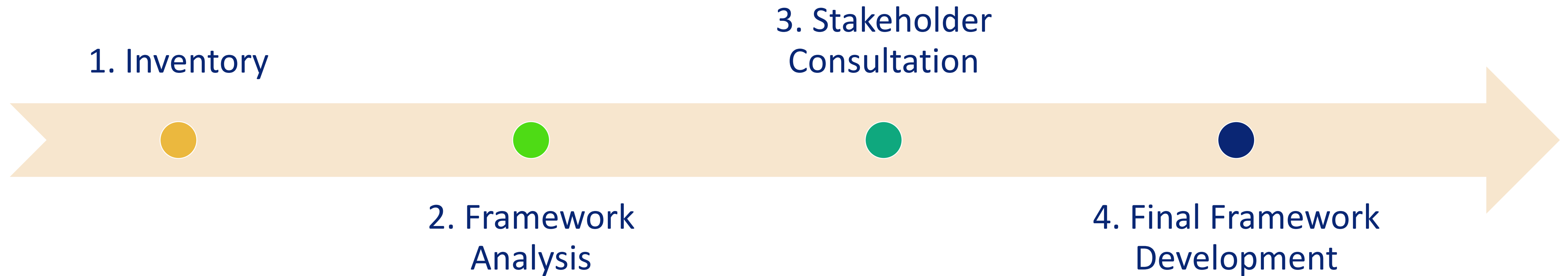
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# ULTRA-BIO project overview

- BBC PL 8: Techno-economic Assessment & Lifecycle Assessment
- Unified Life-cycle Assessment for TRAcing and evaluating BIObased products' environmental performance (ULTRA-BIO) – Phase 1 of PL8
- Objective: Develop a standardized methodology for assessing the environmental impacts of biobased products across their lifecycle, enabling consistency with national and European regulations.



# Stages of the ULTRA-BIO project



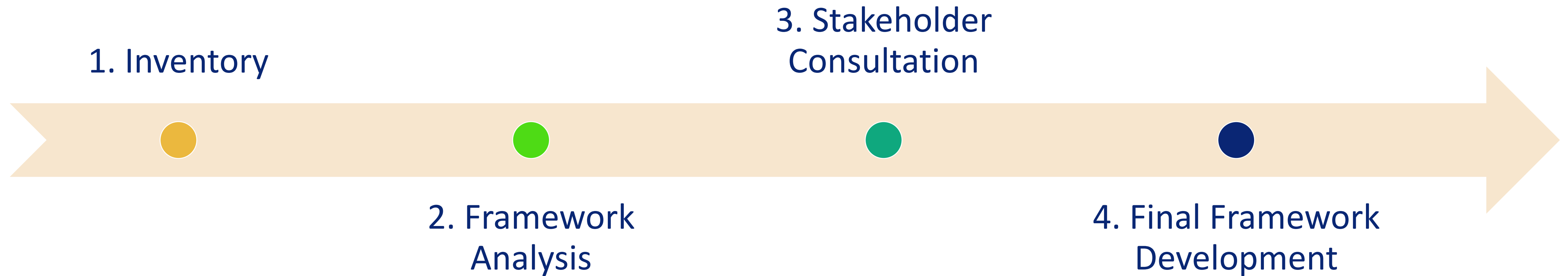
## Stage 1 (Inventory):

- Review relevant standards/documents and conduct interviews to identify key 'contested issues' and challenges in LCA methodologies.

## Stage 2 (Framework Analysis):

- Analyze key 'contested issues' and develop strategies to address the identified challenges in LCA methodologies.
- Draft a holistic LCA framework with recommendations for key challenges.

# Stages of the ULTRA-BIO project



## Stage 3 (Stakeholder Consultation):

- Engaging researchers, industrial actors and policy makers to validate the draft framework and address comments/feedback received.

## Stage 4 (Final Framework Development):

- Finalize the framework based on stakeholder feedback and devise guidelines and recommendations

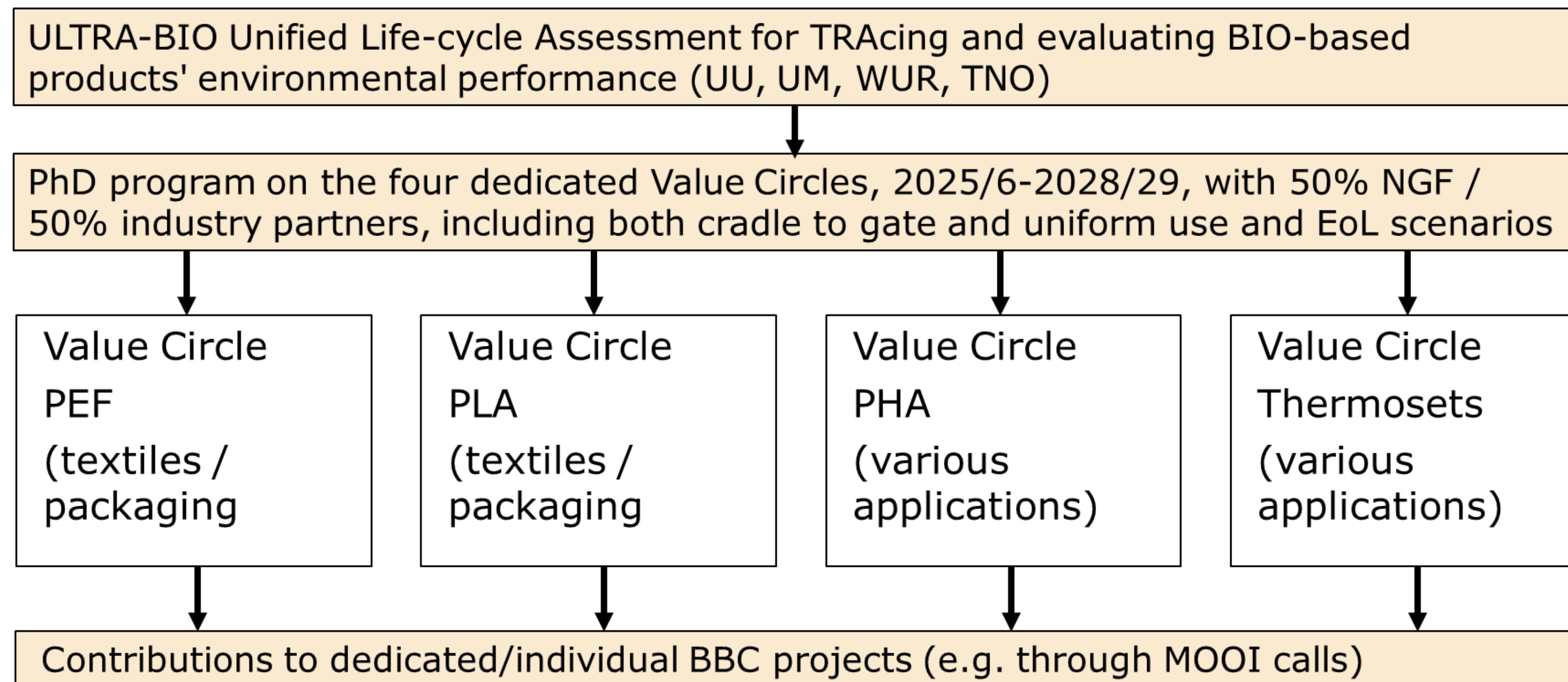
# Expected results of the ULTRA-BIO project

- 1. Inventory Report: Overview of regulations and 'contested issues.'**
- 2. Draft LCA Framework: Methodological approaches for key challenges.**
- 3. Stakeholder Feedback Report: Validated framework insights.**
- 4. Final Framework: Comprehensive LCA methodology and guidelines.**

# Follow-up activities of the ULTRA-BIO project

- Application of the framework in selected value circles of BBC, as well as pilot studies and PhD projects
- Continuous alignment with evolving EU and Dutch regulations.
- Development of outreach materials for policymakers and the public.

## ULTRA-BIO forms the basis for the Phase 2:





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# Environmental Impacts of Bioplastics (ULTRA-BIO Project)

Preliminary work on Stage 1, Richard Padi (UU)

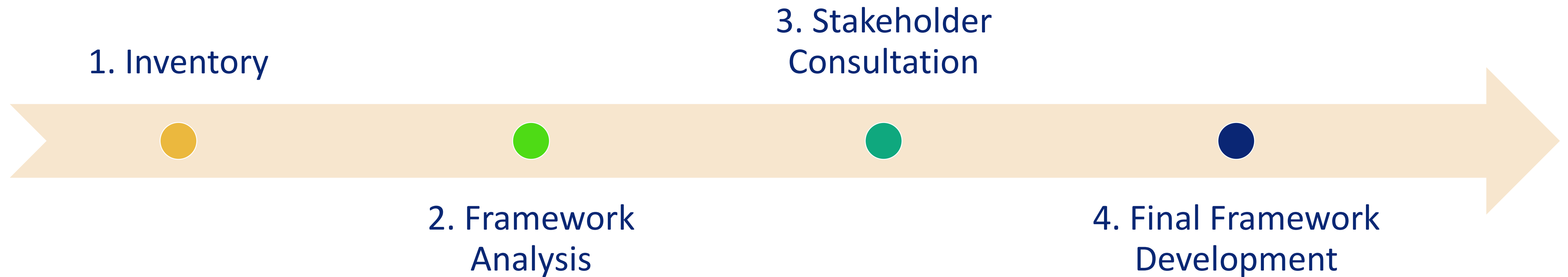
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# Main objectives of this presentation

1. Provide update on our progress in Stage 1 of the study
  - ✓ Present key legislations and policies identified
  - ✓ Discuss contested issues identified during the study
2. Gather feedback on the most relevant legislations and contested issues

# Stage 1 (Inventory) of the ULTRA-BIO project



## Stage 1 (Inventory):

- Review Dutch & EU regulations/standards relevant to LCA for biobased products.
- Conduct interviews with experts/industries.
- Identify key 'contested issues' and challenges in LCA methodologies.

# Key regulations/directives/policies for plastics

Three groups of regulations/policies shaping the future of plastics:

## 1. Focused on sustainable plastics

- ✓ EU strategy for plastics in the circular economy
- ✓ EU Policy Framework on Biobased Biodegradable and Compostable Plastics
- ✓ Nationale Circulaire Plastic Norm (NCPN)
- ✓ EU Safe and Sustainable by Design Chemicals and Materials (SSbD)
- ✓ New Circular Economy Action Plan (NCEAP)
- ✓ European Green Deal

... driving change by promoting recycling, innovation, and sustainability

... ensuring these materials contribute to sustainability without misleading green claims

... mandates that plastic products must contain  $\geq 15\%$  recycled or bio-based content in 2027, increasing to 25-30% by 2030

## 2. Targeting plastic waste management

- ✓ Basel Convention / Plastic Waste Amendment
- ✓ EU Waste Shipment Regulation
- ✓ EU Landfill Directive-2018
- ✓ EU Waste Framework Directive
- ✓ EU Chemicals Strategy for Sustainability (CSS)

... controls plastic waste trade to ensure responsible disposal and prevention of burden shifting

... tightens landfill rules, cutting waste disposal and promoting recycling

... prioritize waste prevention, reuse, and recycling to promote circular economy

## 3. Addressing sustainable plastic usage

- ✓ EU Single-Use Plastic Directive (SUPD)

... bans/restricts harmful disposable plastics, like food containers and cutlery, encouraging a shift to sustainable alternatives



# Key regulations/directives/policies for plastics

## At the sectoral level:

### 1. Packaging

- ✓ EU Packaging and Packaging Waste Regulation\_2025
- ✓ New Circular Economy Action Plan (NCEAP)
- ✓ Verpact's sustainable packaging target- Factsheet on Environmental Claims

... play a crucial role as they set a clear goal- all packaging must be reusable or recyclable by 2030 to drive waste reduction

### 2. Textile

- ✓ Dutch Extended Producer Responsibility (EPR) for Textiles Decree (2023)
- ✓ EU Strategy for Sustainable and Circular Textiles
- ✓ EU green public procurement criteria for textiles products and services
- ✓ New Circular Economy Action Plan (NCEAP)

... holds producers accountable for the collection, reuse, and recycling of textiles to promote a circular economy

... transform the textile industry by 2030- ensuring products are durable, repairable, recyclable, and largely made from recycled fibers

### 3. Construction / building

- ✓ Construction Product Regulation (EU 305/2011) (Update forthcoming)
- ✓ Energy Performance of Buildings Directive-EPBD (EU 2024/1275)
- ✓ New Circular Economy Action Plan (NCEAP)

... ensures construction materials meet safety, sustainability, and performance standards across the EU market

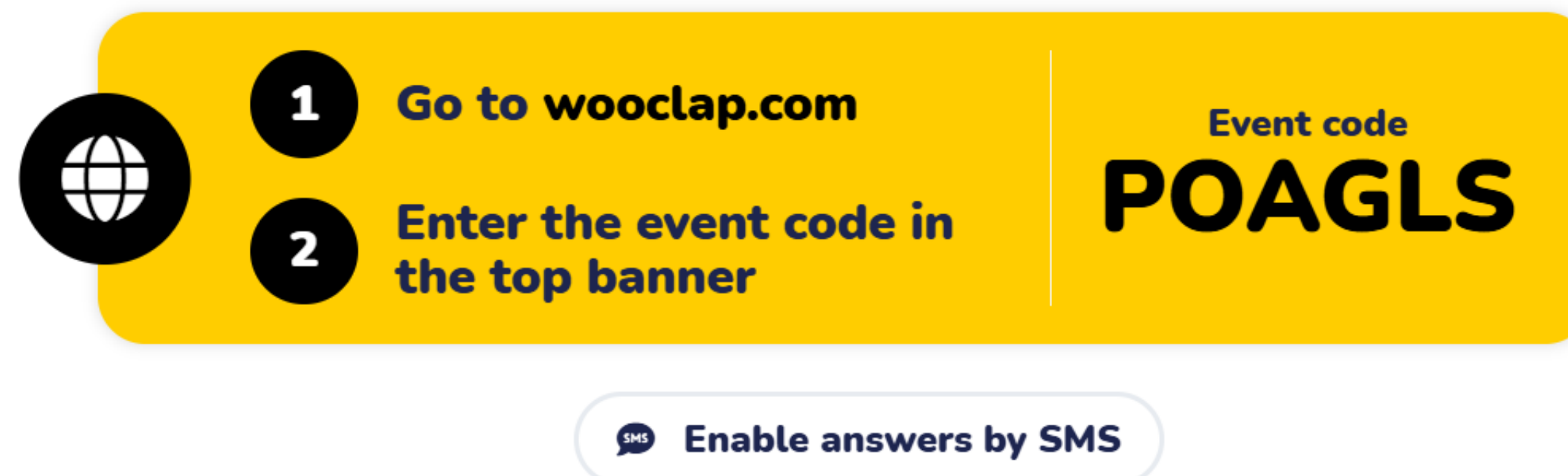
... mandates that all new buildings in the EU be zero-emission by 2030, with public buildings achieving this by 2028, aiming for a fully decarbonized building stock by 2050



# Feedback on regulations / directives / policies

1. Are there any relevant Dutch / International regulations we missed?
2. Have we missed any key regulations or policies for the various sectors?
3. Identifying the most important regulations.


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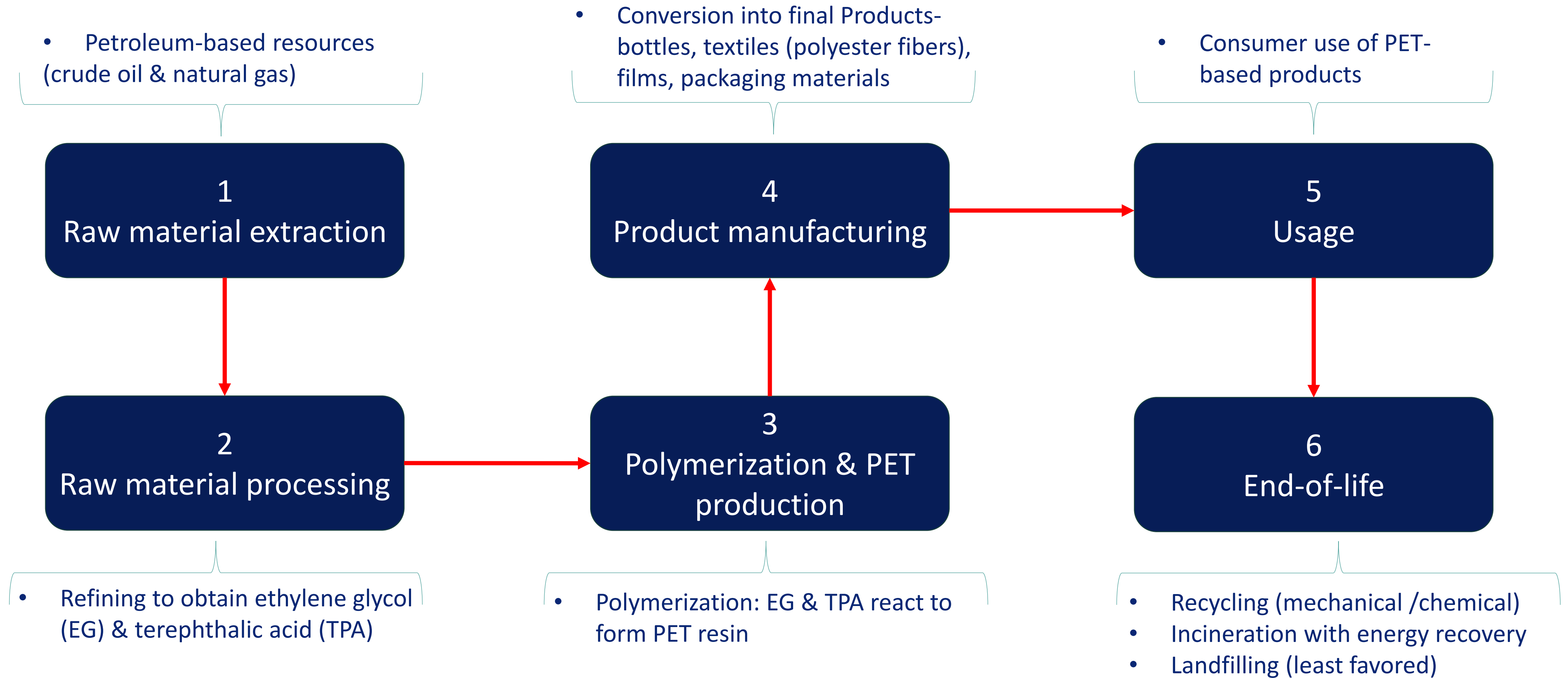
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# Our next activity focus

1. Discuss contested issues / challenges in environmental impact assessment
  - ✓ Illustrate the challenges using fossil-based / bio-based plastics' life cycles as examples.
    - ❖ Describe the life cycle stages
    - ❖ Explain two of the main contested issues
  - ✓ Present a comprehensive list of the contested issues- from perspectives of:
    - ❖ Production / use
    - ❖ Waste / end-of-life
    - ❖ Generic life cycle assessment
2. Gather feedback on the contested issues

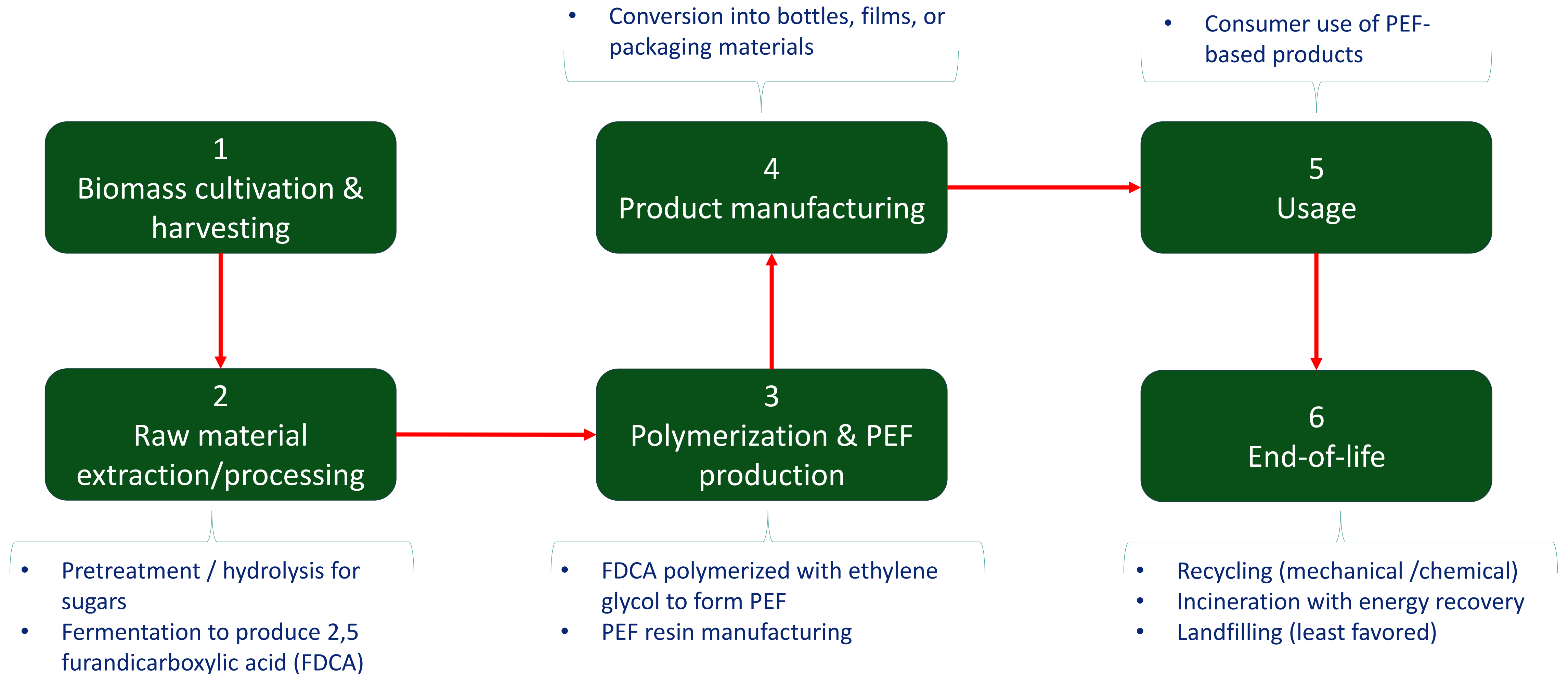
# Illustration of contested issues / challenges

## *Life cycle of fossil-based plastic: Polyethylene terephthalate (PET)*



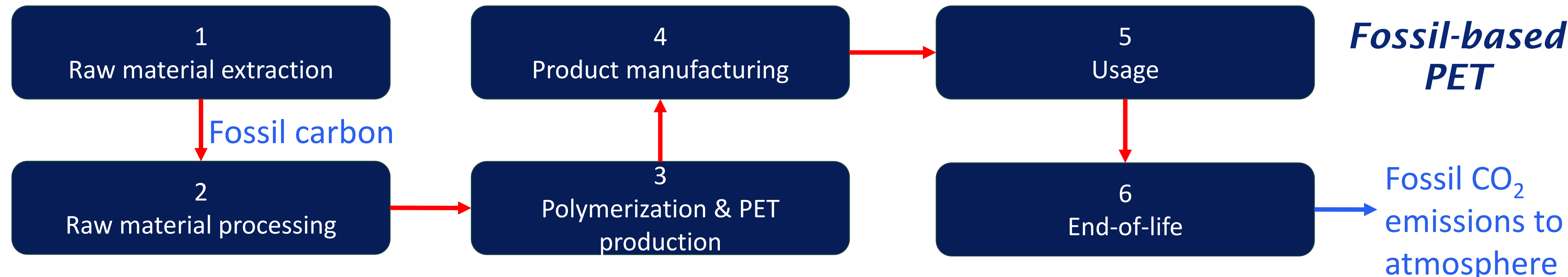
# Illustration of contested issues / challenges

## *Life cycle of bio-based plastic: Polyethylene furanoate (PEF)*



# Contested issue 1- Biogenic carbon accounting

Takes millions of years to form

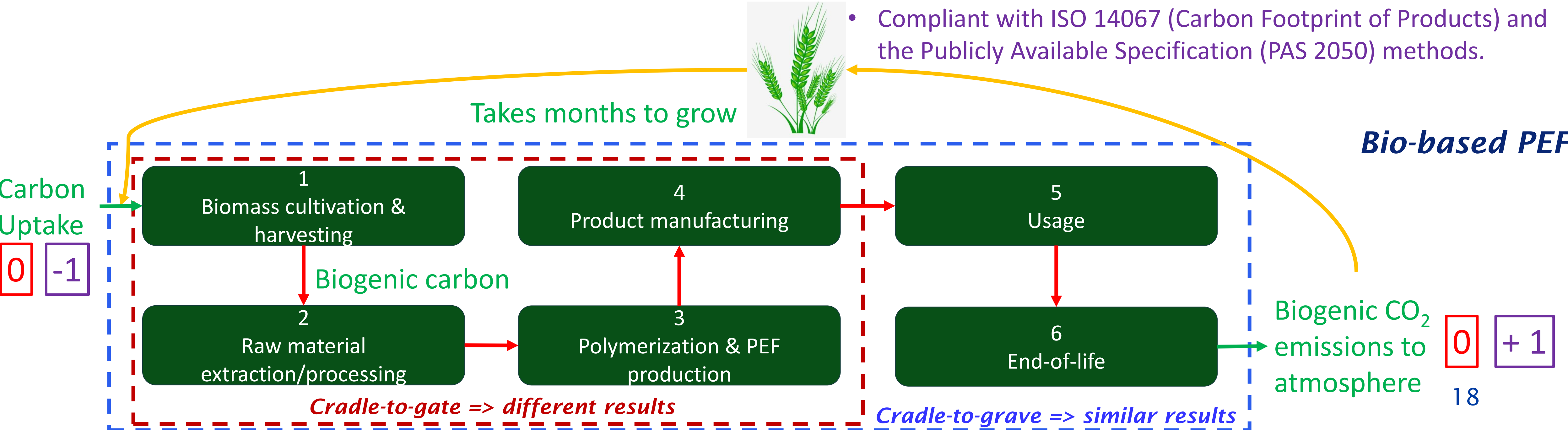


**0/0 approach:**

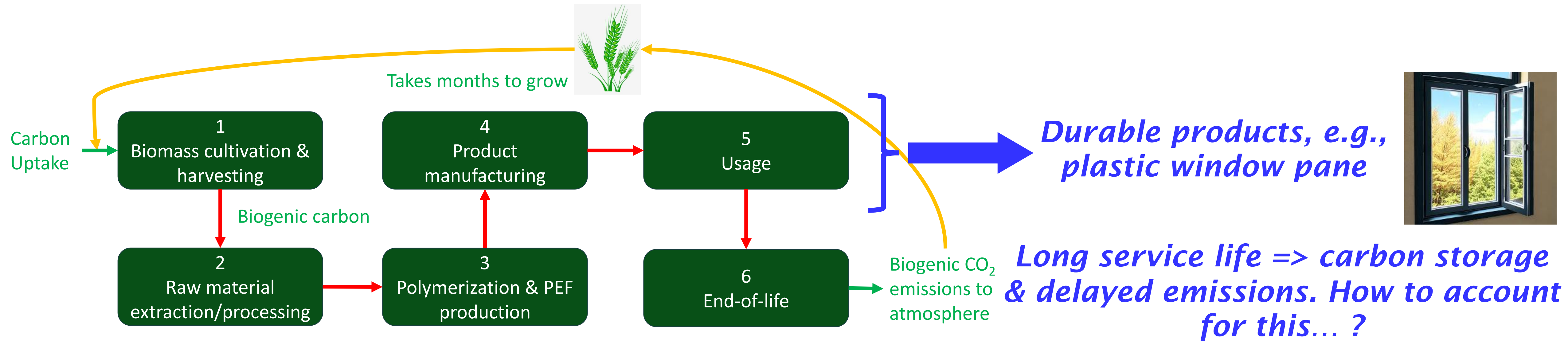
- Treats biogenic carbon as neutral by ignoring carbon uptake/emissions.
- Does not track carbon stocks & cycle.
- Compliant with Product Environmental Footprint (PEF) method.

**-1/+1 approach:**

- The CO<sub>2</sub> incorporated in biomass during the growth phase is incorporated as a removal (-1) and an emission when it is released at end-of-life (+1).
- Compliant with ISO 14067 (Carbon Footprint of Products) and the Publicly Available Specification (PAS 2050) methods.



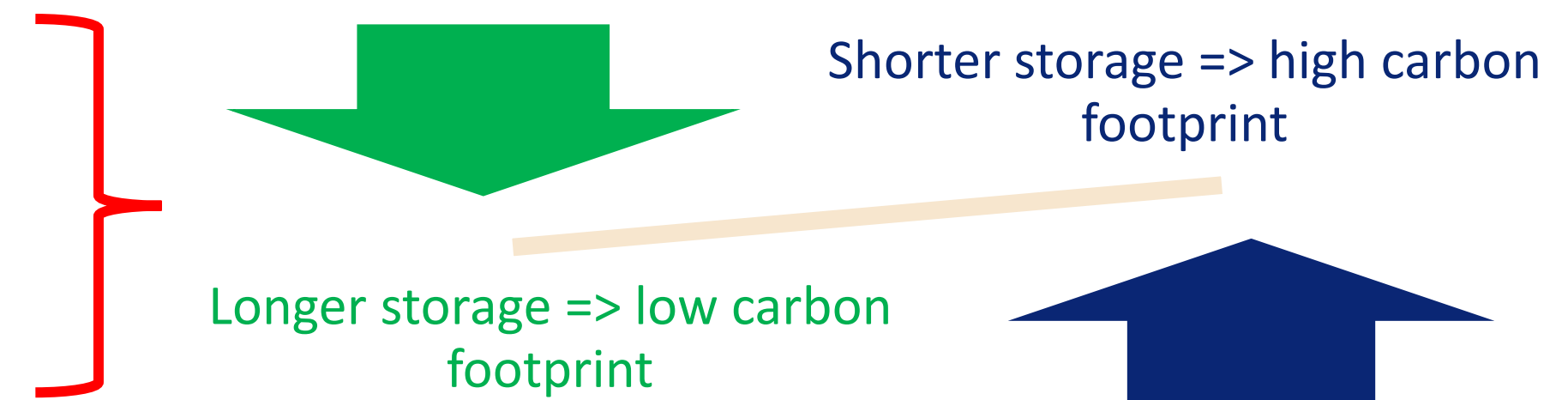
# Contested issue 2- *Temporary carbon storage & delayed emissions*



## Existing methods:

- **Greenhouse gas (GHG) protocol's stock change approach**
  - ✓ Simplified- no carbon stock changes (corresponding to 0/0 approach)
  - ✓ Stock-change approach (corresponding to -1/+1 approach)
- **Storage discounting frameworks**
  - ✓ Carbon discounting based on years of storage. E.g., assuming 100 yr storage, 1/100 of the C stored is accounted for per year.

- Some guidelines consider carbon removals that last >100 yrs to be "permanent".
- Durable bio-based products mostly considered as temporary carbon sinks (< 100 yrs lifespan).



- **Product Environmental Footprint (PEF) methodology**- follows 0/0; dynamic methods that account for temporal factors under consideration.
- **ISO 21930 (Buildings & Construction)**- allows C storage/discounting, but must be separated from the main impacts.
- **EN 15804 (construction materials)**- does not allow discounting of emissions and removals.

# List of important issues re environmental assessments

## *Perspectives of important issues*



Production / use



Waste / end-of-life



Generic LCA

# List of important issues re environmental assessments

## Production / use perspective

### Sustainable production / uses

- **Biobased sources**
- **Biogenic carbon storage- short/long-term perspective**
- Prospective LCA guidance for novel/emerging biobased products
- Biomass production aspects in bioplastics
- Land use change impacts and emissions

Lack of standardized framework to assess potential environmental impacts of emerging technologies (incorporating future scenarios, technological development & market evolution)

Biomass feedstock cultivation for bioplastics could lead to land use change & emissions / biodiversity loss => Lack of well-defined assessment methods.

# List of important issues re environmental assessments

## Waste / end-of-life perspective

### Waste / End-of-life

- Microplastics or broader end-of-life scenarios; avoiding persistent plastics
- Location of end-of-life
- Burden shifting- transport to other areas
- Burning biobased plastics
- Recycling conventional plastics vs bioplastics
- How to deal with landfilling
- End-of-life allocation
- Biodegradation modelling

Microplastic release during use/end-of-life contaminate ecosystems & pose human health risk => No standards/methods for tracking/assessing microplastic release

Lack of standardized methods for addressing different end-of-life scenarios / locations

# List of important issues re environmental assessments

## Generic LCA perspective

### Generic LCA

- Where to start and end calculations
- Scoping- scenarios addressing why the LCA
- Decision context of the LCA
- **Biogenic carbon accounting (-1/+1)**
- **Temporary carbon storage (dynamic LCA, other crediting methods)**
- **Impact assessment methods- differences in results**
- Co-product allocations
- Carbon offsetting
- Biodiversity in LCA
- Including exploration phase in fossil LCA
- Hurdle of lack of transparency in fossil industries
- Sectors that apply mass balance approach (e.g., chemical industries)
- Defining FU on mass basis vs functional equivalence basis
- Circularity indicators

Different context leads to different results- harmonizing for equal comparison


These fossil-based LCA concerns are debatable- some records indicate that they have been addressed

Lack of standardized definitions/metrics, making it challenging to consistently measure/compare the circularity of products and systems

# Feedback on contested issues / challenges


1. Have we missed any relevant contested issues/challenges?
2. Which ones are most important?

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# Q & A and Open Discussion



**Further discussion/suggestions...?**

***[r.k.padi@uu.nl](mailto:r.k.padi@uu.nl) ;***

***[f.pellengahr@maastrichtuniversity.nl](mailto:f.pellengahr@maastrichtuniversity.nl)***

## *Relevant standards/codes*

On the international front:

Standards /  
codes

### International Standards:

- **ISO 14040:2006** –Principles and framework for LCA.
- **ISO 14044:2006** –Requirements and guidelines for LCA.
- **ISO 22526-4:2023**–Carbon and environmental footprint of biobased plastics.
- **ISO 14067** – Carbon Footprint of Products (CFP).
- **ISO 21930** – Sustainability of Building Products.

- The relevant standards:
  - ✓ Mainly ISO standards on Life Cycle Assessment, Product Carbon Footprints, and the Sustainability of building materials.
  - ✓ Provide essential frameworks for evaluating environmental impacts of products/materials throughout their life cycle

# Relevant standards/codes

Standards /  
codes

## European Standards:

- **EN 16760:2015** –LCA for bio-based products (excluding food, feed, and energy).
- **EN 16751:2016** – Sustainability criteria for bio-based part of bio-based products.
- **EN 16785-1:2015** –Method for determining bio-based content in products (radiocarbon & elemental analysis).
- **CEN/TR 16957:2016**–LCI guidelines for End-of-life phase of bio-based products.
- **EN 18027:2023** – LCA Requirements for Biobased vs. Fossil-Based Products.
- **EN 13432** – Compostability Standard for Packaging.
- **EN 17556** – Biodegradation of Plastics in Soil.
- **EN 14995:2007** – Test/specifications for evaluation of compostability of plastics.
- **EN 15804:2012+A2**– LCA for Construction Materials (+A3 forthcoming)

## At the European level:

### The relevant standards:

- Span across multiple areas
  - ✓ Criteria for Life Cycle Assessment / sustainability for biobased products
  - ✓ Compostability tests and standards for plastics
  - ✓ Life Cycle Assessment guidelines for construction materials.
- Play a critical role in guiding sustainable practices and sustainability assessments in biobased/plastic industries.