Plastics Circularity Multiplier

TERMINUS

in-built Triggered Enzymes to Recycle Multi-layers: an Innovation for Uses in plastic-packaging

Time control of the circularity of plastic multilayer packagings

Vincent Verney
Institut de Chimie de Clermont-Ferrand
Terminus Coordinator
Vincent.Verney@sigma-clermont.fr

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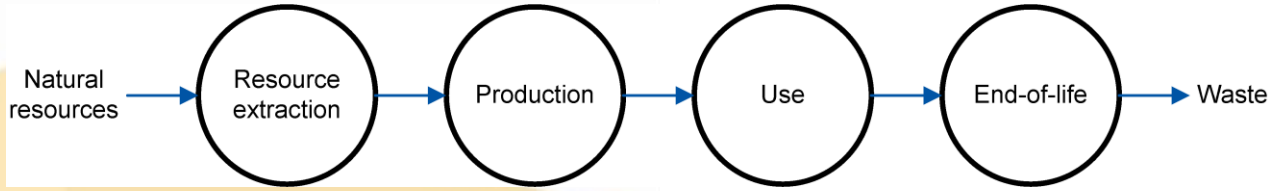
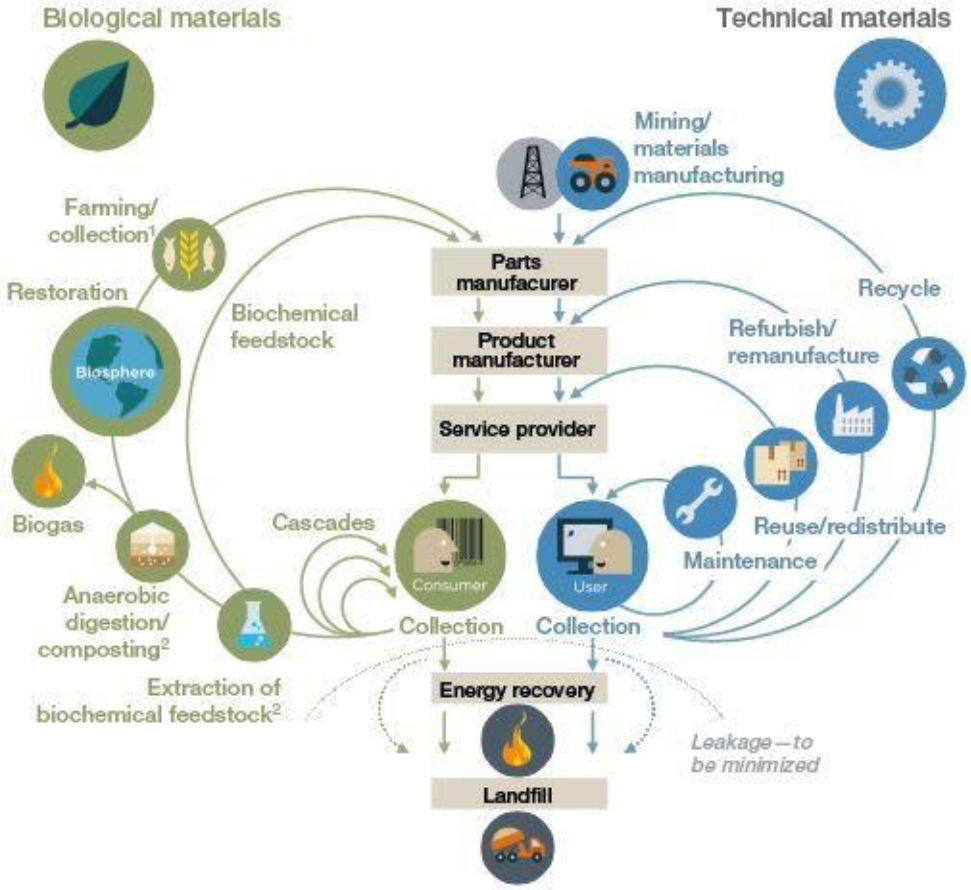
From linear to circular economy



➔ Take ➔ Make ➔ Use ➔ Throw and Dispose



https://www.ellenmacarthurfoundation.org/circular-economy/infographic

Questions?

- Clear and precise definition of circularity?
  - *Bio based vs petrol based / Biodegradable / Recyclable*
- How to measure circularity?
  - *Metrics and their relevance?*
- How to assess the environmental benefits linked to the jump from LE to CE?
  - Connecting CE metrics to LCA indicators ?

Time dimension of Circularity

- Time renewal of the resource

➔ *Metrics = Carbon use time ? Zero time? Reference time?*

- Service time (ST)+ Material Lifetime Durability (MLD)

➔ *MLD ≥ ST (preferable ≈) at every cycle to ensure fiability!*

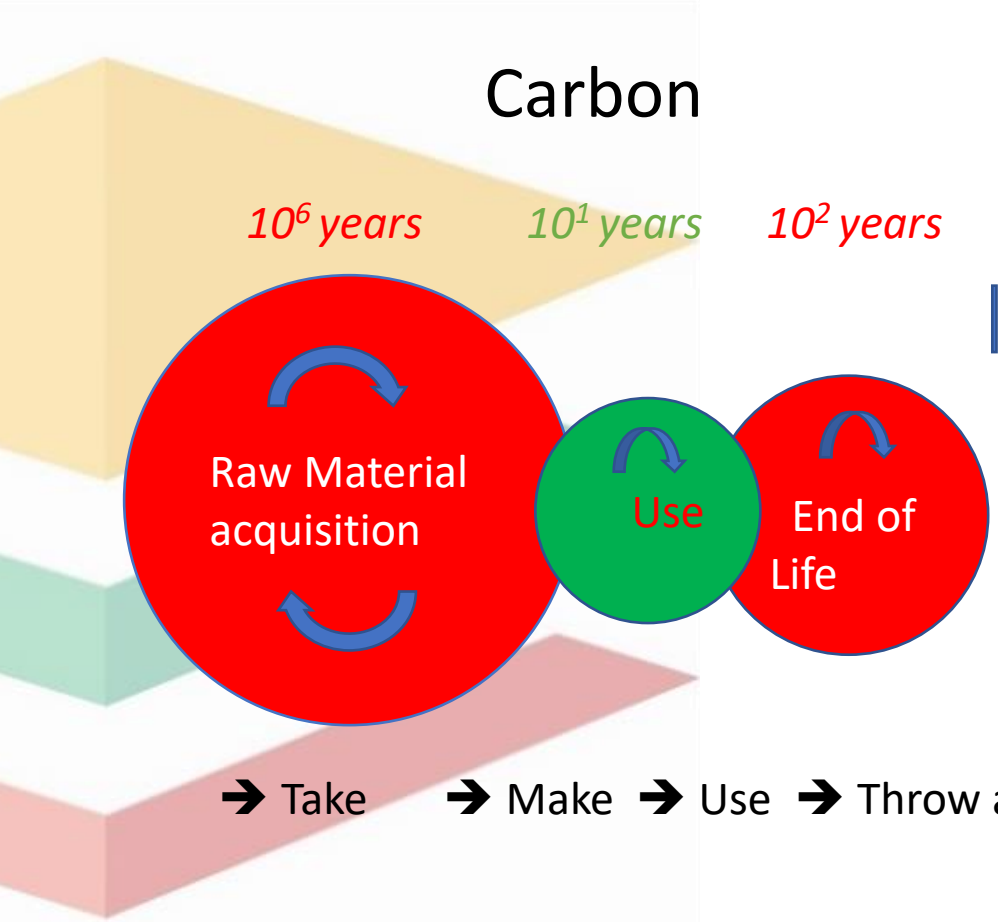
➔ *Recycled material = ST preferably longer for cycle 2 than for cycle 1 : ST_n, …,$ST_2 > ST_1$*

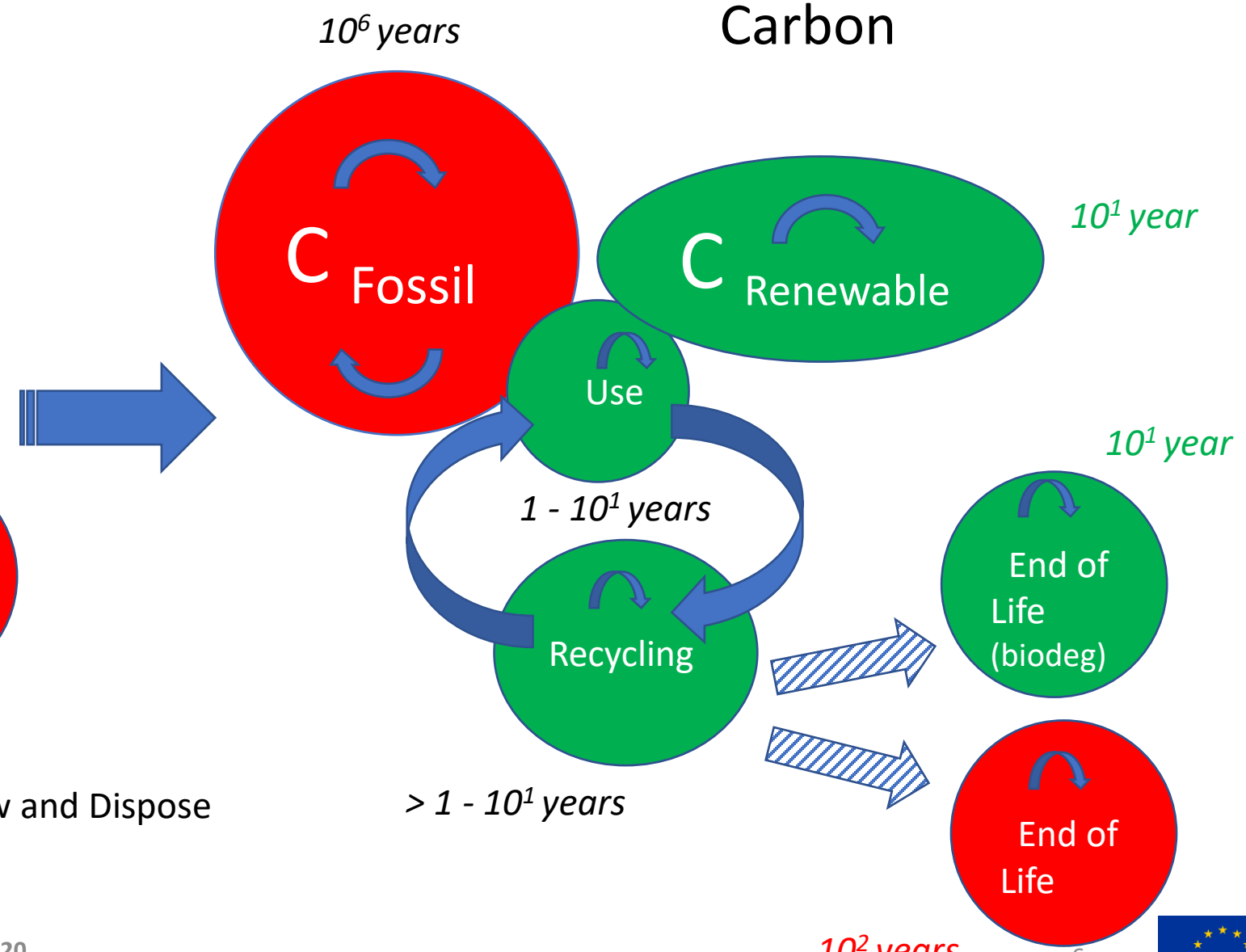
Material /Service vs Lifetime Durability

- Physical / mechanical
  - ➢ Molecular weight changes
  - ➢ loss of properties - Material failures
- Chemical (aging)
  - ➢ Oxidation by-products : carbonyl and hydroxyl groups (FTIR)

Circularity = a matter of time

Fossil pastics





Objective of the project

TEMINUS addresses the challenge of unlocking recycling and reuse of flexible multi-layer and multi-compound packaging

- Range of smart enzyme-containing adhesive or tie layer polymers
- Intrinsic self-biodegradation properties
- On-demand controlled biodegradation of adhesives and tie-layers
- **Enable separation of different layers of packaging, which can then be recycled after having been collected and sorted**

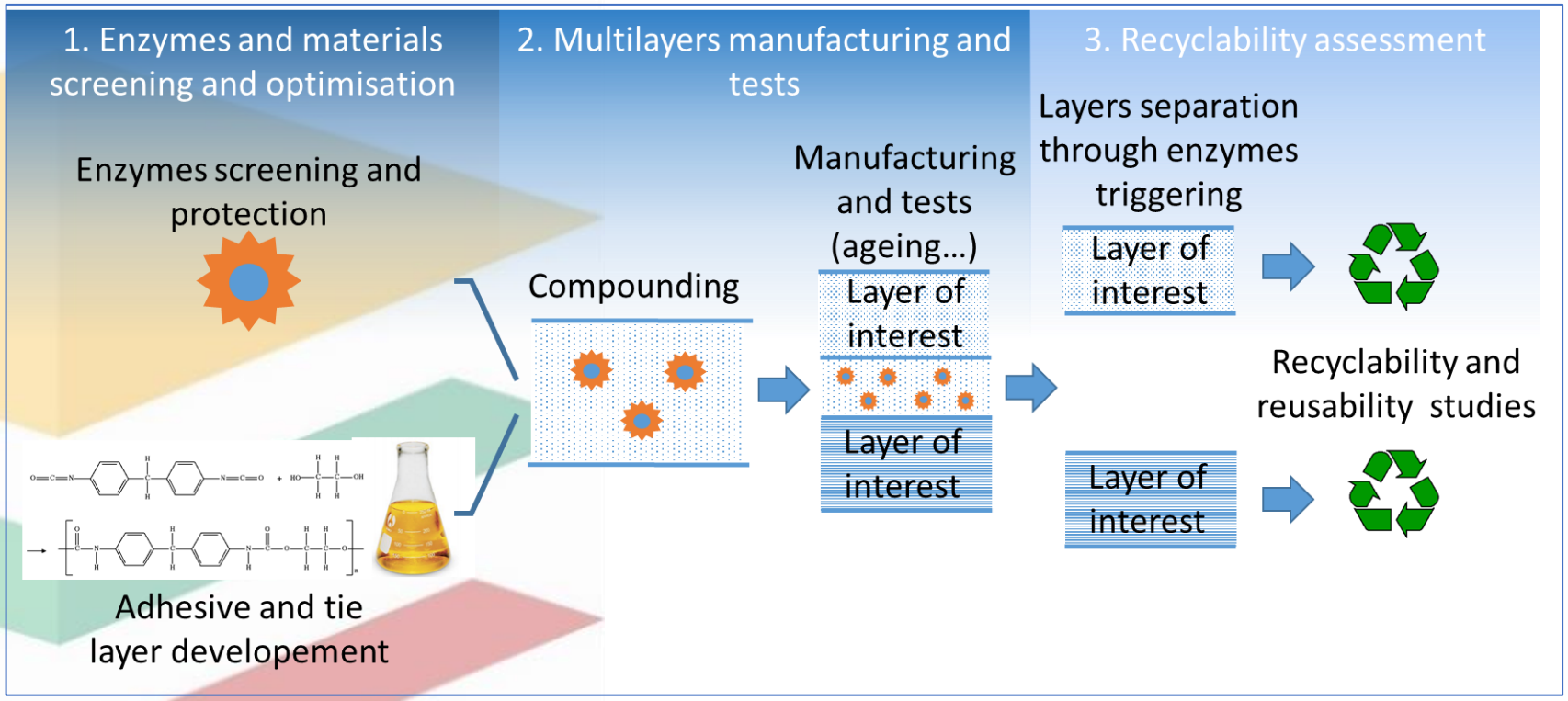
Background

Multi-layer packaging

- **Widely used due to many properties**
- **Used for packaging of food, beverages, cosmetics, pet food, etc.**
- **Extend lifetime of goods, helping reduce food waste**

- **Due to complex structures, these materials are unrecyclable**
- **Almost 100% of plastic multi-layer packaging is incinerated or landfilled**

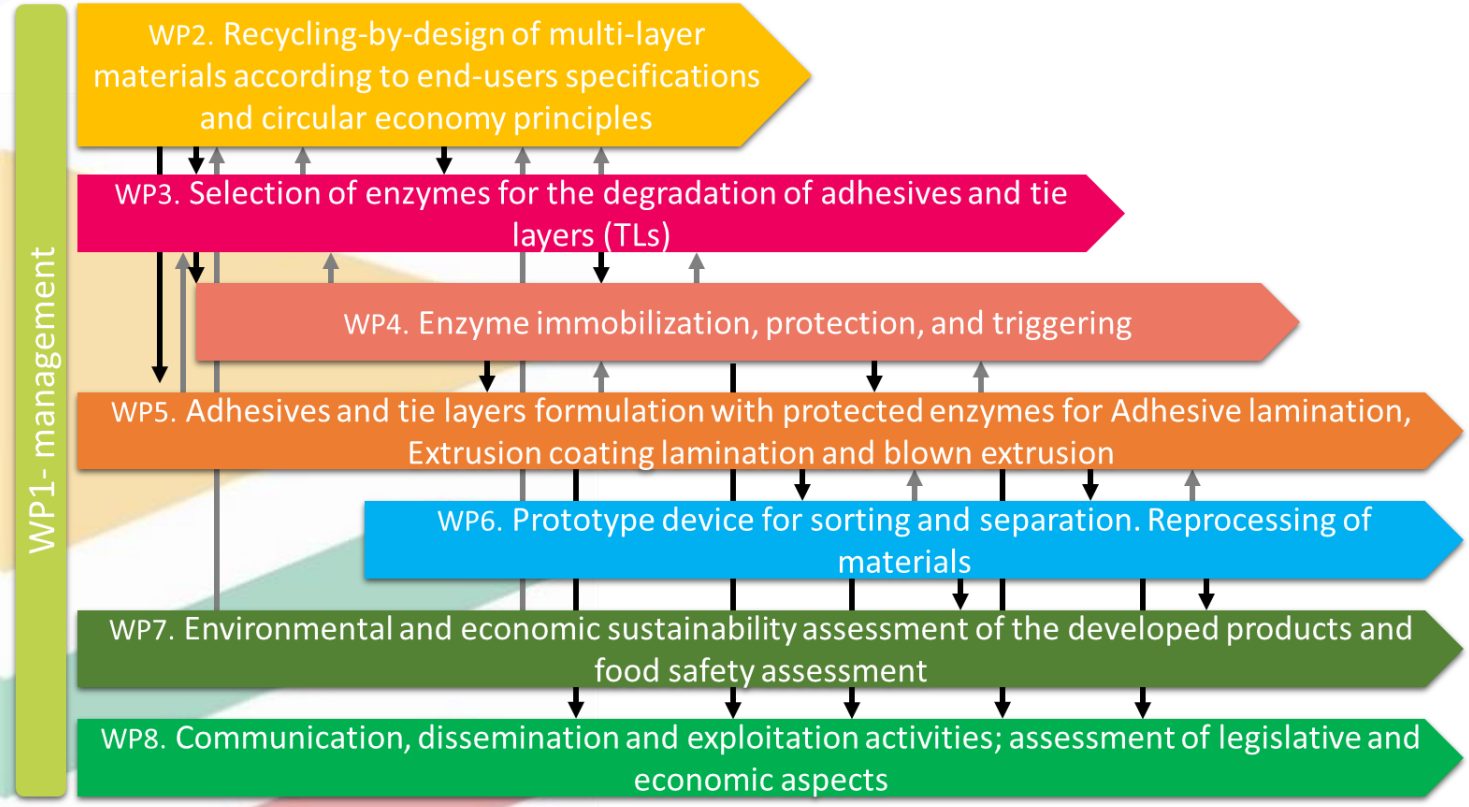
Description of the project



13 partners : 5, 74 M€- Duration : 01/01/2019 – 31/01/2023

Partners

Organization of the project



Main results (M20) :

- Enzyme selection
- Improvement of enzyme thermal stability – Use of Natural Deep Eutectic Solvents (NADES) *
- Demonstration of triggering
- Circular metrics / Initial LCA / Food contact
- Dissemination
  - Open research Data
  - Zenodo Terminus community https://zenodo.org/communities/terminus-h2020
  - Web : https://www.terminus-h2020.eu/
  - Social media

** Improving laccase thermostability with aqueous natural deep eutectic solvents*
Astrid E.Delorme, Jean-Michel Andanson and Vincent Verney
International Journal of Biological Macromolecules,163, 2020, 919-926, https://doi.org/10.1016/j.ijbiomac.2020.07.022.

Circular Economy inputs

- Follow up the Ellen Macarthur foundation methodology
- Selection of pertinent metrics
- **MRS** $(\%) = \left[\frac{(\%\ \boldsymbol{recyclable\ content} * \mathbf{2}) + (\%\ \boldsymbol{recycled\ content} * \mathbf{1})}{\mathbf{3}}\right] * \mathbf{100}$

(Material Reutilization Score)

- **MCI = 1 – LFI* F(X)**

Material Circularity Index

- *Development and/or improvement of new metrics*

Expected final results

- 15% improvement in economic efficiency of end-of-life management
- 80% reduction of landfilling for multi-layer plastic packaging
- 55% reduction of overall plastic landfilling
- 65% decrease in the overall CO_2 footprint
- MRS: ≈ 0 ➔ ≈ 90%

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European Commission

ENVIRONMENT

New ENV website >

European Commission > Environment > Circular economy

EU Circular Economy Action Plan

A new Circular Economy Action Plan for a Cleaner and More Competitive Europe

The European Commission has adopted a new Circular Economy Action Plan - one of the main blocks of the European Green Deal, Europe's new agenda for sustainable growth.

The new Action Plan announces initiatives along the entire life cycle of products, targeting for example their design, promoting circular economy processes, fostering sustainable consumption, and aiming to ensure that the resources used are kept in the EU economy for as long as possible.

It introduces legislative and non-legislative measures targeting areas where action at the EU level brings real added value.

Actions

The new Circular Economy Action presents measures to:

- Make sustainable products the norm in the EU;
- Empower consumers and public buyers;
- Focus on the sectors that use most resources and where the potential for circularity is high such as: electronics and ICT; batteries and vehicles; packaging; plastics; textiles; construction and buildings; food; water and nutrients;
- Ensure less waste;
- Make circularity work for people, regions and cities,
- Lead global efforts on circular economy.

TERMINUS

CE-NMBP-26-2018
Smart plastic materials with intrinsic recycling properties by design

Circular Economy
Circular Clustering activities !

Plastics Circularity Multiplier

Clustering H2020 / Horizon Europe Projects

Thank you for your attention!

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