# Biocompatibility or Compostability: Which is the real meaning? Some experiences of scientific dissemination

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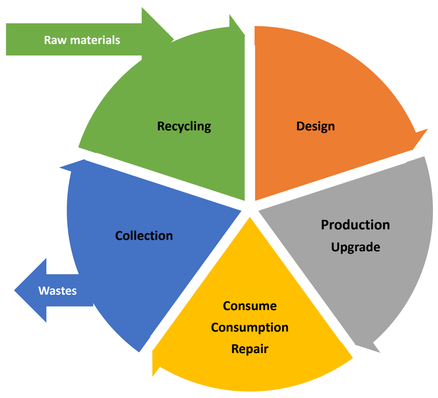
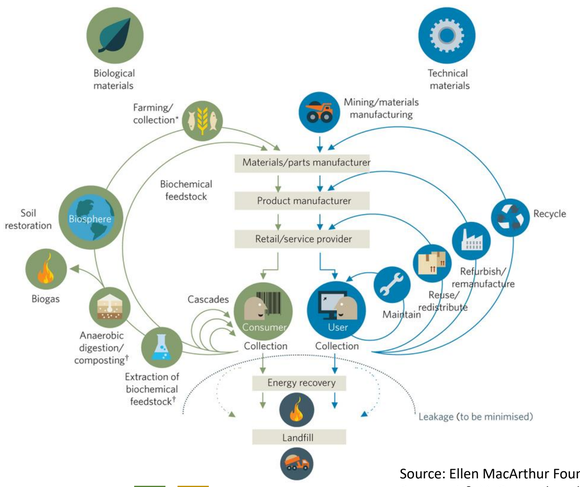
## Introduction

**The linear economic model** 'take-make-dispose' is based on the accessibility of large amounts of resources and energy. It is increasingly less suited to the reality in which we find ourselves operating. The initiatives in support of efficiency, which work to reduce resources and fossil energy consumed per unit of production, alone are necessary to delay the crisis of the economic model, but are not sufficient to solve the problems caused by the finite nature of the stock.


**Circular economy** "is a generic term to define an economy designed to be able to regenerate on its own. In a circular economy the flows of materials are of two types: biological ones, able to be reintegrated into the biosphere, and technical ones, destined to be upgraded without entering the biosphere ".
The circular economy **is therefore a planned economic system to reuse materials in successive production cycles and reducing waste to the minimum.**




Technical and biological cycles can be distinguished in the model. Consumption happens only in biological cycles, where food and biologically-based materials (such as cotton or wood) are designed to feed back into the system through processes like composting and anaerobic digestion.




Source: Ellen MacArthur Foundation circular economy team drawing from Braungart & McDonough and Cradle to Cradle (C2C)

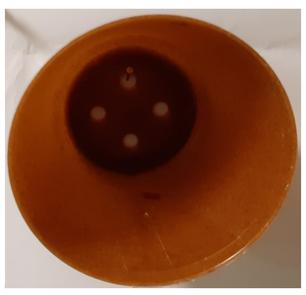
Inside these cycles living systems are regenerated, such as soil. In this way, renewable resources for the economy are provided. At the same time, inside the technical cycles products are recovered and restored, such as components, and materials through strategies like reuse, repair, remanufacture or (in the last resort) recycling.

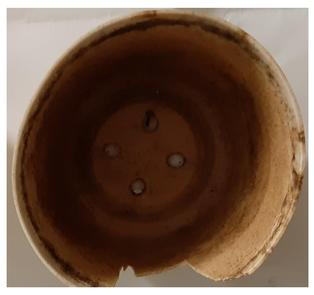
## Biodegradability

**Biodegradability:** a substance can be decomposed by biological processes, induced by living microorganisms (bacteria and fungi). A material is biodegradable when, due to micro-organisms such as bacteria or atmospheric agents, it breaks down into simple organic molecules such as water, carbon dioxide, methane. Almost all materials degrade, but the difference is related to the duration of the process. It can have short or even very long times.

This **biodegradation** happens by a natural process without any human intervention. The definition of "biodegradable" does not include how quickly or slowly that degradation takes place. The rate of degradation depends on many environmental conditions, such as temperature, humidity, and availability of oxygen (although biodegradation can occur with and without oxygen).

**Biodegradability** is a synonymous of compostability if the degradation concerns at least the 90% of the basic components within six months. To be officially recognized, this value is defined and verified according to the ISO 14855 method.






Always

Sometimes

## Compostability

**Compostability** is a characteristic of a packaging or in general of a plastic that is it allows to decompose during a composting process. The evaluation is based on pass-non-pass values that characterize the compostable packaging from those not compostable.

According to **the UNI EN 13432**: 2002 standard, to define itself as compostable, a material must have the following characteristics:

→*Biodegradability* is determined by measuring the actual metabolic conversion of the material in carbon dioxide, is quantitatively evaluated with a standard test method: EN 1 4046 (also published as ISO 14855: biodegradability under controlled composting conditions). The acceptance level is 90% to be reached in less than 6 months.

→ *Disintegrability*, is fragmentation and loss of visibility in the final compost (absence of visual contamination). Measured with a composting test on a pilot scale (EN 14045). The material under examination is bio degraded together with organic waste for 3 months. At the end the compost is sieved with a 2 mm sieve of light. Residues of test material larger than 2 mm are considered non-disintegrated. This fraction must be less than 10% of the initial mass.

→ *Absence of negative effects* on the composting process. (eco-toxicity) Requirement verified with a composting test on a pilot scale.

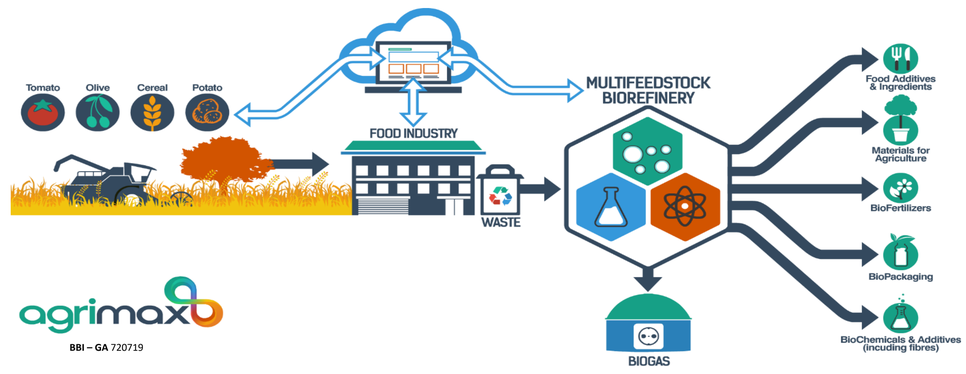
→ The material must have a *low concentration of heavy metals* added to the material .

→ The pH values, the salt content, the concentrations of volatile solids, nitrogen, phosphorus, magnesium and potassium must remain below the established limits.



## Research and dissemination

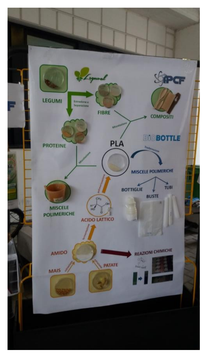
The projects carried out in IPCF are disclosing the **holistic potential of agro-value chains** (residues and by products from the culture and processing of legumes, tomato, cereals, olives, potato) through the selection of case-scenarios firstly developed to a pilot scale and then transferred in new applications as food additives, packaging and agricultural materials among others.


The projects targets:

- **the use of co-products and by-products** of processed agro-waste production for valorization by extraction of the biobased fraction and use of the leftover biomass as **additives in biodegradable or compostable composites production and as a source of biogas by anaerobic digestion.**
- multiple benefits for producers and consumers since proteins are biodegradable raw materials suitable for melt processing, are a source of nitrogen in agriculture applications and have the ability to improve barrier properties in packaging, while maintaining biodegradability of the final package.

As an output of the projects, the **organization of training activity** through participation in public events, the request of schools to visit the facilities of the Institute where the research activities are carried out, for the dissemination of the knowledge about biodegradability, compostability, and valorization of bio-wastes are in progress.







## Conclusion

Furthermore, starting from the fundamental knowledge on environments and its protection available, since last year, these activities are also organized within an environmental awareness program (Win on Waste-WOW) during the Researchers' Night in which the IPCF operates in collaboration with technicians and technicians of other CNR institutes of Pisa (besides IPCF, ICCOM, IBF, IFC, IGG, IIT, IRET, ISTI) and one from La Spezia (ISMAR).

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