CIRCULAR ECONOMY

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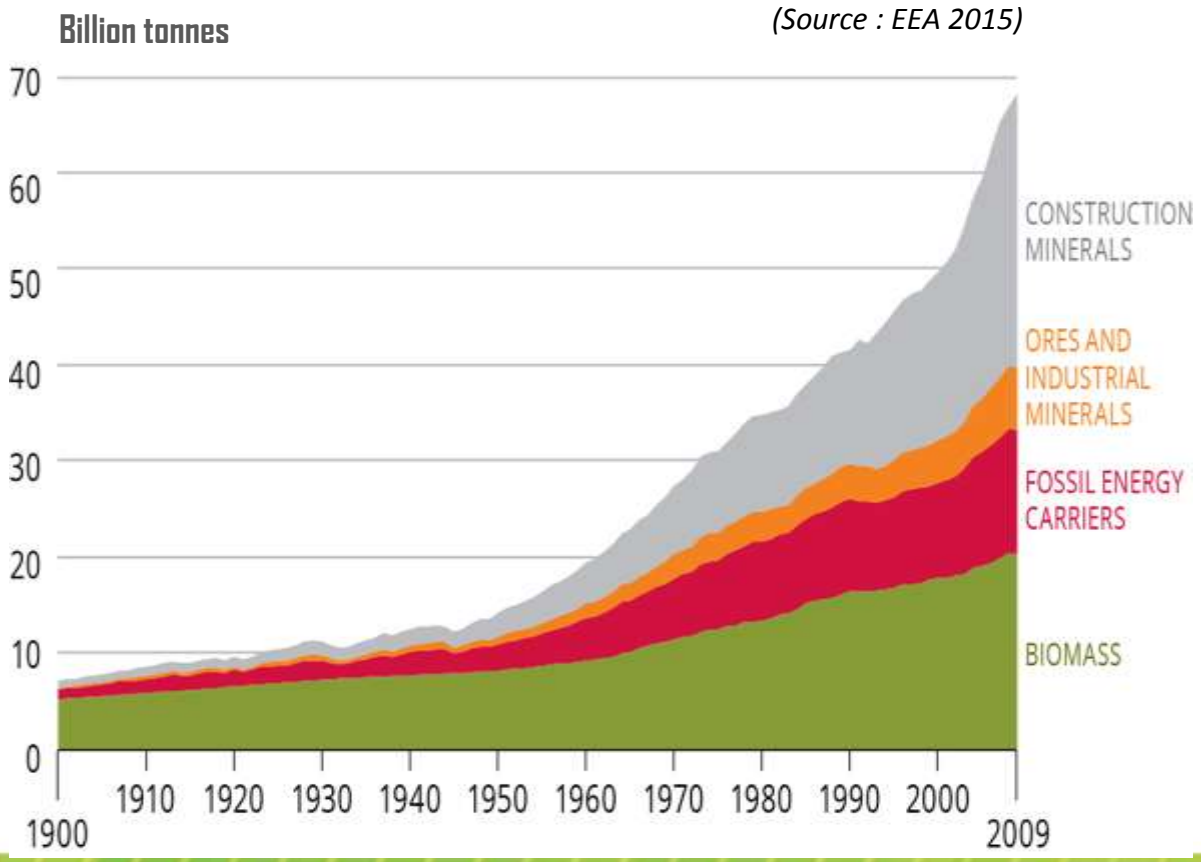
World population and resource consumption

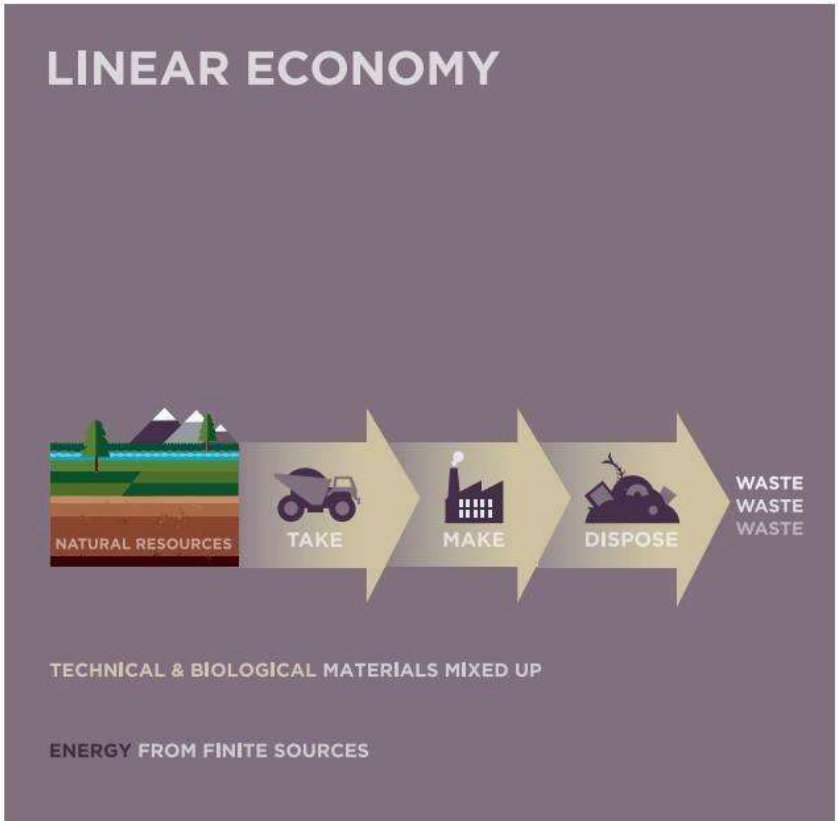
Since 1900 the world population has grown by a factor 4. Resource consumption has grown by a factor 10 and it is expected to double by 2030

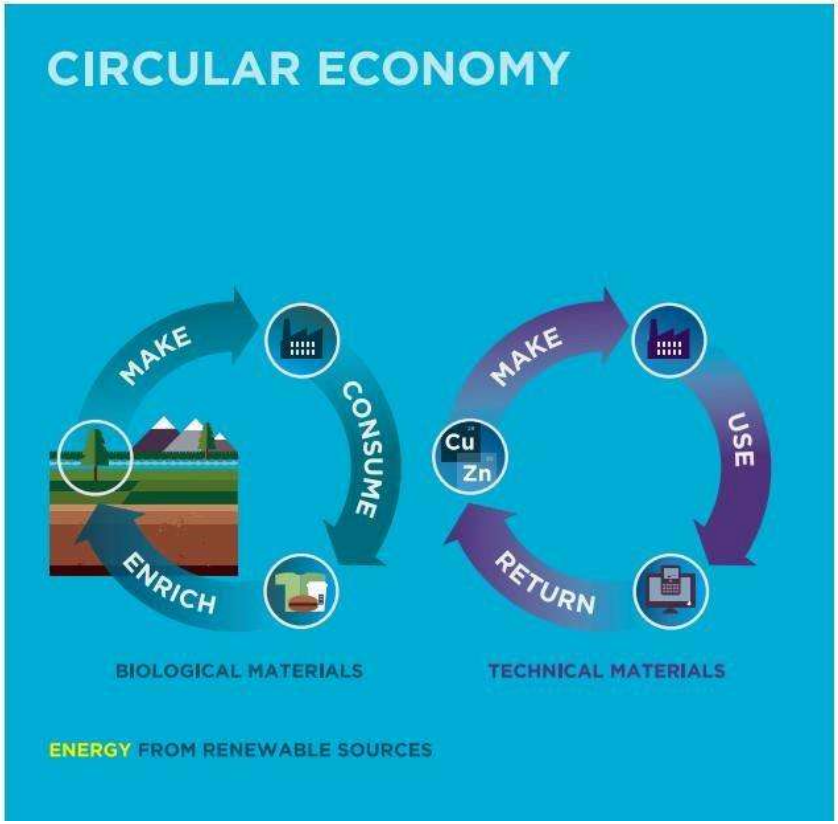
(Source : EEA 2015)



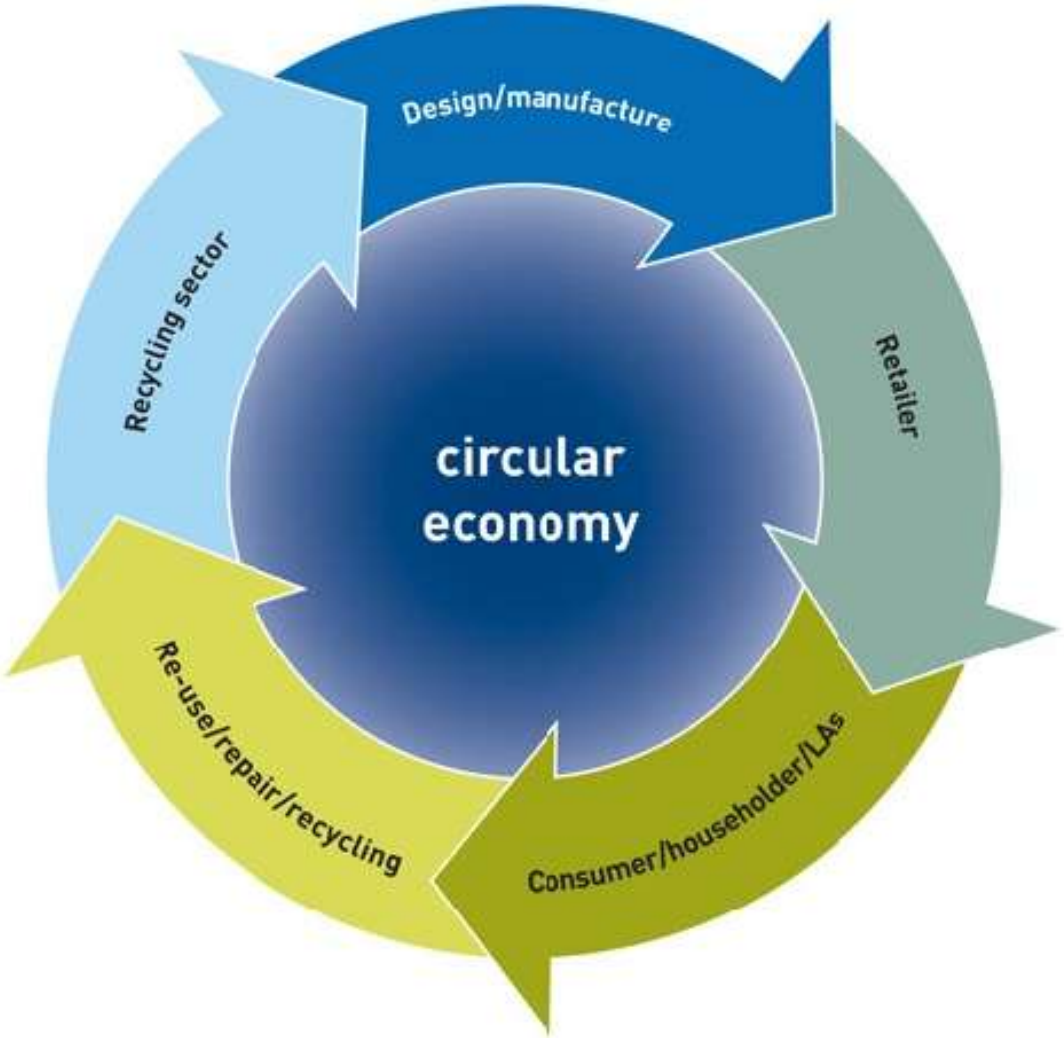
At the root of the growing interest for the circular economy there is the **no longer avoidable need to save both renewable and non renewable natural resources** according to a more efficient use.

From linear to circular economy





Circularity - Some definitions



Circularity in material use and the reduction of waste

*A circular economy refers to an ind**ustrial model regenerative by intention**, in which products are designed to facilitate reuse, disassembling, restoration and recycling to allow that a large amount of materials are re-used instead of being produced by primary extraction (Ellen MacArthur Foundation, 2013)*

*A circular economy refers to a model in which we **keep resources in use as long as possible** to extract the maximum value from them whilst in use, and then to recover and regenerate products and materials at the end of their service life (Edie, 2013)*

Post consumer use and imitation of natural cycles.

*In **closed loop supply chains**, in addition to typical forward flows there are reverse flows of used products (post-consumer use) back to manufacturers. Examples include supply chains with consumer returns, leasing options and end-of-use returns with remanufacturing (Souza, 2012).*

*The circular economy requires a very careful management of two material flows: **biological nutrients** (biomasses) to be returned safely to the biosphere to restore the natural capital; **technical nutrients** (materials) designed to keep quality and circulate without entering back in the biosphere (Green Alliance, 2011)*

The EU Commission will present a circular economy strategy by end of 2015

- Our economies have referred to a linear pattern growth (take-make-consume-dispose) assuming that resources are abundant, available, and cheap to dispose.

- Instead we need a **circular model for the economy** in which materials and products are **re-used**, **repaired**, **refurbished and recycled.**

- A more efficient resource use will disclose **new growth opportunities** and job creation: increasing resource productivity by 30% by 2030 could boost GDP by 1% while creating 2 million new jobs.

- Moving towards a circular economy is at the heart of the resource efficiency agenda established under the **Europe 2020 Strategy** for smart, sustainable and inclusive growth.

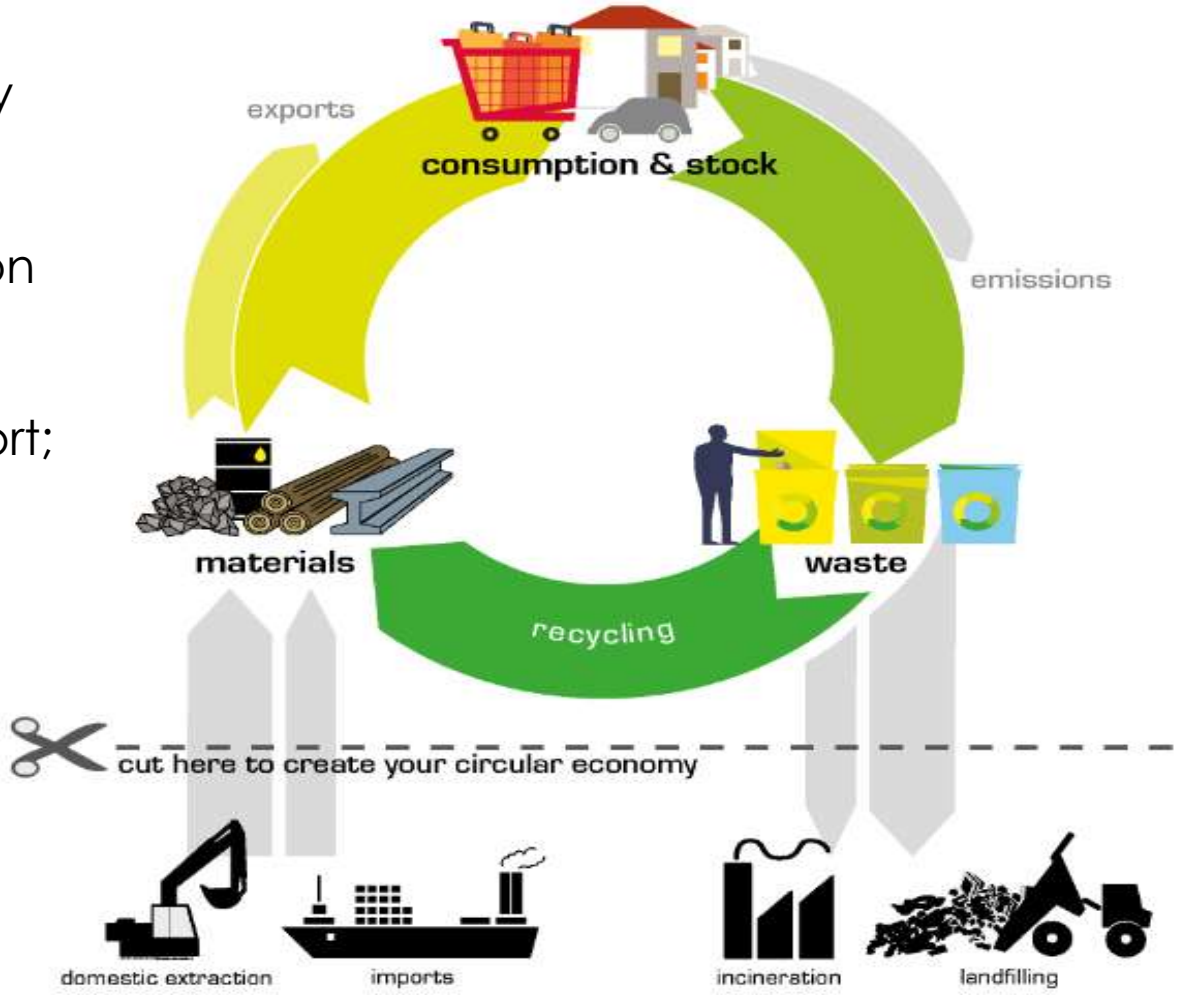
In pills..

The circular economy allows **to cut**:

i. resource extraction and production;

ii. raw material import;

i. waste disposal.

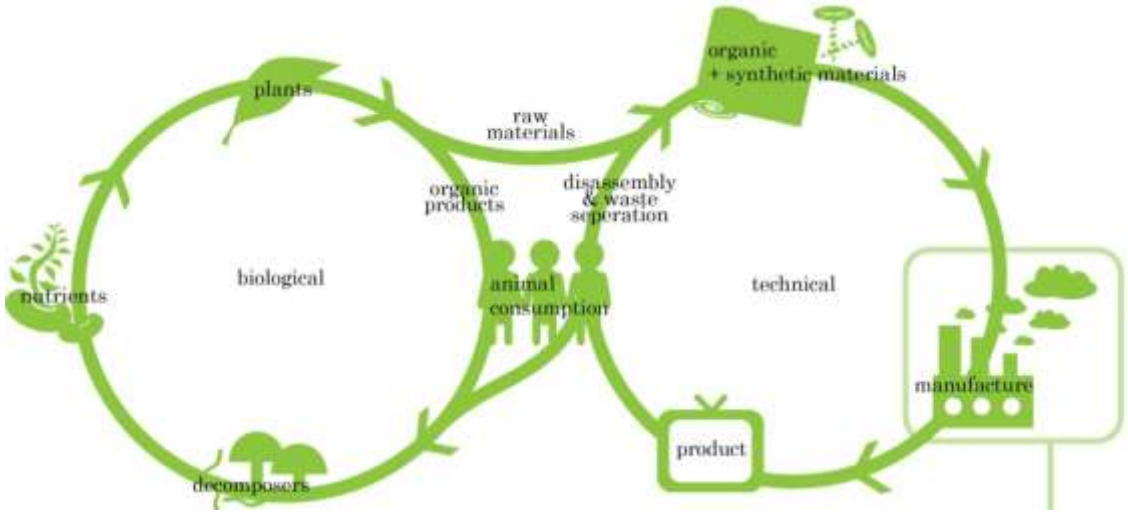


At the origins of the circular economy

The idea of **circular flows of materials** as a model for the economy when resources are scarce and limited was proposed in **1966** by K. E. Boulding, that compared the economy of the earth to that of a spaceship.

By analysing the production cycles, the **industrial ecology** has focussed on impacts arising from inefficient use of energy and materials as well as impacts related to waste production and disposal.

In the '70s, W. R. Stahel has introduced the **closed loop concept**, illustrated by the expression ***Cradle-to-Cradle*** (in opposition to Cradle-to-Grave).



At the origins of the circular economy

The **industrial symbiosis** (P. Laybourn, 1999) or industrial metabolism, focuses on sustainable management (by quantity and quality) of materials and energy entering and leaving production processes. This is done by enabling networks of industries from different sectors to exchange energy and resources according to demand and offer mechanisms (i.e. waste of one industrial sector might be a raw material for other production purposes; heat produced by a process can be recovered in another process; shared logistics, etc.).

The **biomimicry** (J. Benyus, 2002), by studying the natural processes as models to be replicated in human activities, has inspired the idea of imitation of natural cycles able to continuous regeneration. The biomimicry idea has been recently adopted by G. Pauli in presenting the Blue Economy.

Focus on 7 issues for the development of a circular economy

1. Develop eco-design

New engineering, or re-engineering, of production processes, goods, services and value chains according to the eco-design criteria by:

- **boosting** resource and energy efficiency;
- **eliminating** toxic and dangerous chemicals;
- **reducing** environmental impacts in production, consumption and end-of-life management;
- **increasing** products re-use, regeneration and material recycling;
- **preventing** waste production and disposal.

2. Analyse and modify existing products and production processes

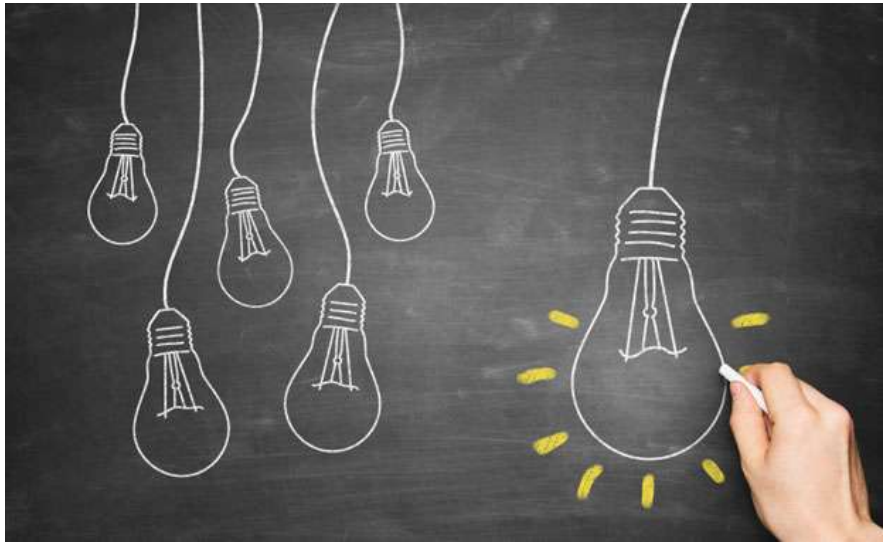
- Verify and improve the current scientific and management models (Life Cycle Assessment algorithms, environmental management systems - ISO, EMAS-, certification of products) to **make the circular economy criteria more effective**;

- Adopt very specific models to **maximize resource efficiency** towards zero waste.

3. Develop research and eco-innovation

In order to enable circular economy models to reduce material and energy consumption while lasting and improving well-being, it is important to refer, more and better, to the greatest renewable resource we have: **knowledge**

Scientific **research and innovation** applied to the fields of new materials, of product design and of supply chain optimization, can help to **multiply the opportunities for resource efficiency** through reuse, regeneration, duration and recyclability of products, components and materials.



4. Develop production and use of renewable energy and materials

Circular economy models require to **move away from fossil fuels** – which are limited, not renewable and with high climate impact**- in favour of renewable energy sources** only.

Though most of them, if properly managed, can be recycled with limited environmental impacts, more complex is to **move away from use of non renewable materials**. However, a more consistent way towards circular economy models requires the **adoption of renewable materials**, provided that their production **should not compete** with food production and the preservation of natural capital and ecosystem services.

5. Zero waste to dispose

In a circular economy model waste are not disposed, but re-used as resources.

In this respect, it is necessary to make **waste prevention policies** more effective and efficient as well as to identify and **remove barriers** that prevent the maximization of recycling of all type of waste.

Energy recovery from waste should be minimized and has to be addressed according to the **best available technologies** in terms of efficiency and reduced environmental impacts.

6. Address inner, multiples and cascade circles

- The power of **inner circles** refers to minimizing material usage by addressing the recovery of end-of-life products in the value chain close to the consumption phase. Within this approach, very little has to be changed in products (i.e. refurbishment and remanufacturing) prior to return to use. This approach allows high return on collection and treatment costs in comparison to disposal.

- The power of **multiple circles** refers to maximizing the number of consecutive cycles - be it reuse, remanufacturing, or recycling- and/or the time in each cycle. This approach best fits with business models related to de-linking of the property of products by consumers.

- The power of **cascade circles** refers to diversifying reuse across the value chain allowing that waste of one consumption phase, easily become a raw material for producing other goods.

7. Targets and national action plans

With reference to already existing consolidated experiences (such as that of the People's Republic of China that integrates a circular economy program in the five-year action plan for the development of the national economy), while waiting for the circular economy package of measures announced by the EU Commission by end 2015, it might be useful to start defininig a **National Action Plan,** according to well defined measures and targets.

The UK circular economy action plan

The "**Waste and Resource Action Program**" of the UK government addresses the following goals by 2020

- reduce raw material national demand by 30 million tonnes;
- reduce waste generation by 50 million tonnes;
- increase material recycling up to 20 million tonnes

...according to the following guidelines

- manufacture goods with less material requirement;
- reduce waste generation both in production processes and trading of products;
- reduce the production of disposable goods;
- moe from selling of products to leasing of services.

Three issues to debate about circular economy limits

1. The rebound effect as in the Jevons paradox.

The increase of efficiency in materials use, allowing the reduction of production costs and selling prices, can promote an increase of consumption and so the pressure on natural resources.

It is very important to keep in mind that the circular model may allow a relative decoupling –reduction of material use by unit of product–, but not necessarily an absolute saving of resources.

In fact, when the consumption increases, materials recovered from end-of-life products do not satisfy the demand of raw materials for new productions.

Three issues to debate about circular economy limitations

2. Material recycling is not for free or unlimited

Some loss of material quantities from products happens during use, re-use and recycling phases (i.e. think about car tyres or scrap in recycling activities).

The **recycling activity is not free of resource consumption**: it requires machineries, energy, water and additional materials.

There are materials more easily recyclable, such as glass, or more difficult to recycle such as some plastic polymers. In general materials are not recyclable indefinitely. It is important to avoid the mistake of considering the circular economy as a sort of "*perpetual motion*" that allows unlimited industrial growth

Three issues to debate about circular economy limitations

3. Circularity in use of biomasses and renewable materials allows improvement in resource efficiency, but do not ensure *per se* sustainability in ecological and social terms.

The biomass use for industrial and energetic purposes, even if managed within circular models, **may compete with food production**. However, food production have to be the priority of the agricultural sector.

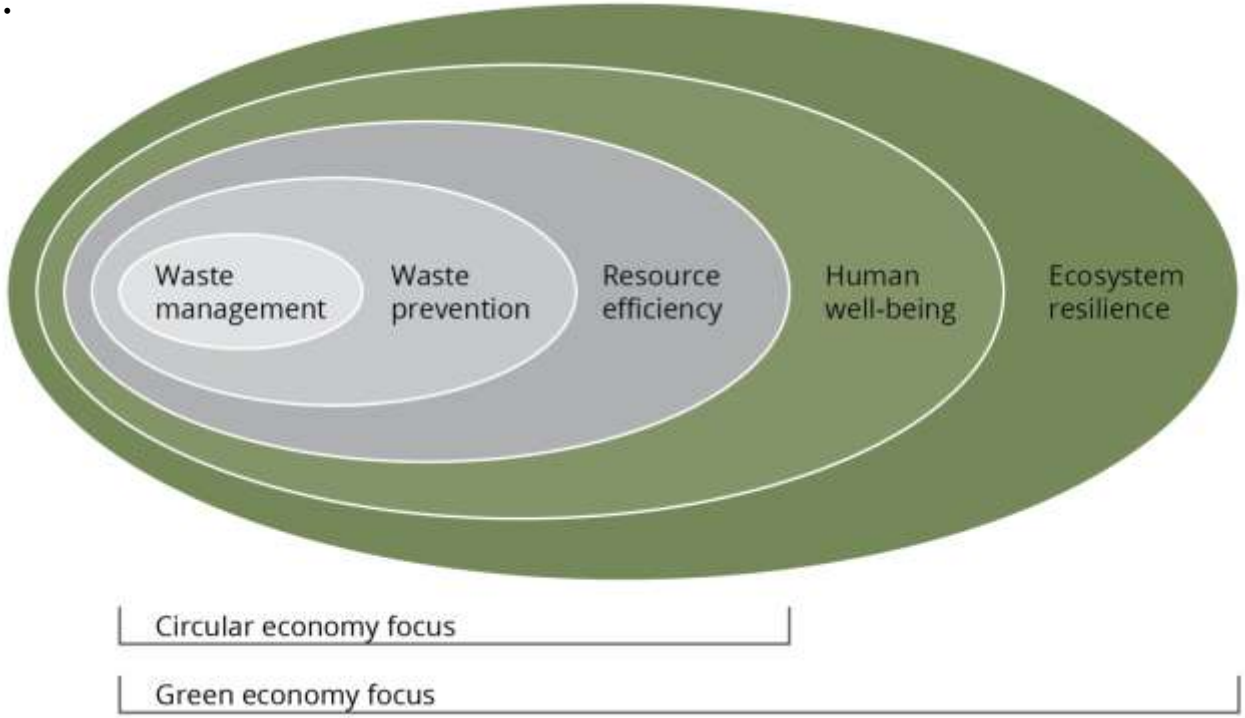
As in the natural cycles, circular models based on renewable materials return organic materials to the soil. In nature this happens according to the resilience and the restoration time of ecosystems.

This is not the case of the circularity models for renewabvle materials within industrial schemes: in cutting a forest **the loss of biodiversity is not offset** by giving back to soil organic materials from wood recycling.

The circular economy in the green economy

According to the European Environmental Agency (2015), the **circular economy is a relevant part of the green economy**, which deals also with the **human welfare** (i.e. lifestyles and consumption models for an extensive and inclusive well-being) and the **ecosystems resilience** (i.e. natural capital and ecosystem services preservation).

(Source: EEA 2015)



Thanks for your attention