The name of the concept:
Closed-loop economy

Sustainable development goals (SDGs)

Goal 8: Decent work and economic growth

Goal 9: Industry, innovation and infrastructure

Goal 12: Reasonable consumption and production

Definition

The **closed-loop model** is a biomimetic (life-imitating) approach, which takes nature as an example and considers that the systems should work like organisms, processing nutrients that can be **fed back into the cycle** – hence the terms 'closed loop' or 'regenerative' usually associated with it.

Using the 'nature as teacher' framework of thinking, industrial products and systems are designed and developed to mimic nature–they are **driven mainly by renewable energy sources and mimic the closed loops of natural ecosystems**. Industrial products are designed in what is called a **'cradle-to-cradle' process**. End products that cannot be composted (e.g. metals) go back to industry in a closed loop – as a valuable, easy to manage 'nutrient' (Webster & Johnson, 2010).

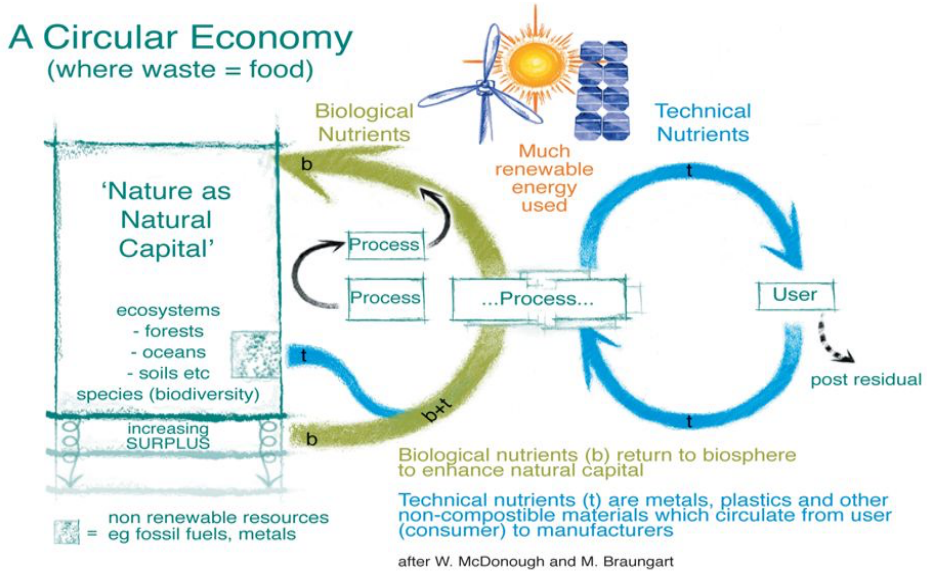

Fig. 1. A Circular Economy (where waste = food)

Source: Webster, K., & Johnson, C. (2010). Sense & Sustainability Educating for a circular economy (2nd ed.).

In a circular economy, recovery is a priority rather than incidental. From the design phase, the product will be easy to disassemble, with individual components able to be replaced. The materials used will have a low environmental impact and not pose health risks to users or recyclers, and will be more likely to be reused or refurbished. In fact, the product may be owned by the producer; the user pays for the license, and the manufacturer is responsible for its collection and recycling at the end of its life (Friends of the Earth (HK), 2017). Under this approach, w**aste in production, supply, use and disposal is minimized** and a maximum proportion of the original resource is recovered. To be able to reuse most of the processed material, products are designed in ways that their input materials can be recovered at high quality levels using minimal energy (Ellen MacArthur Foundation, 2016b).

Goals/ principles/ models related to the concept

1. **Principles of a circular economy**
   a. Waste does not exist in the lifecycle of a product. The product is disassembled and reused after serving its purpose.
   b. Consumables are made of biological ingredients or nutrients that can be safely returned to the biosphere. Durables are made up of technical materials, e.g. metal and plastics that cannot be returned to the biosphere. So plastic or glass will only be made into durables with a design to be reused.
   c. Energy used to fuel this entire cycle should be renewable by nature to decrease resource dependence and increase system resilience.

2. **Conceptual diagram of a circular economy**

   The circular economy model takes the **full lifecycle of a product** into account. Since some small amount of residual waste cannot be avoided, new resources always need to be added to the production process to some extent. However, **the aim of the circular economy is to keep this residual waste as small as possible and to rely on recycled resources for the major share of economic processes** (European Commission, 2014).

   To ensure that natural capital is preserved as much as possible, that resources yields are optimized and that system risks are minimized, the transition to a circular economy requires a **whole systemic change** throughout value chains. Technological innovation is only part of the required transformation, **innovative solutions** in organizational thinking, **civil society participation, financing methods and government policies are essential**.

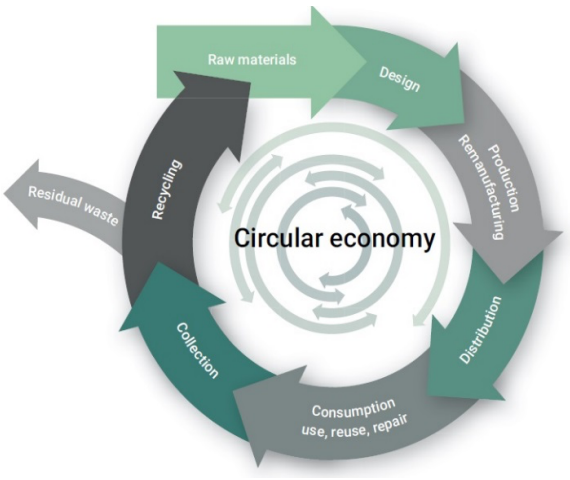

Fig.2. Circular economy (Adapted from European Commission, 2014)

The innovations necessary for a circular economy need to cover **waste-minimizing designs, new business models and new recycling technologies as well as changes in consumer behavior**. For example, product design should ensure that products have a longer lifespan and are easy to maintain. Also, products can be designed in a modular way so that broken components can be replaced and repair is easy. When technological change is fast, it should be possible to upgrade products by changing only outdated components. At the end of the life of the product, it should be easy to disassemble it and to reuse or recycle its parts (Bocken et al. 2016).

3. George Chan's Dream Farm I model

The sustainable system **closes the energy and resource use cycle**, maximizing storage and internal input and minimizing waste, rather like the lifecycle of an organism that is autonomous and self-sufficient.

In the Dream farm 1 model (Figure 2) the anaerobic digester takes in livestock manure plus wastewater and generates biogas, which provides all the energy needs for heating, cooking and electricity. The partially cleansed wastewater goes into the algal basin where the algae produce all the oxygen needed to detoxify the water by photosynthesis, making it safe for fish. The algae are harvested to feed chickens, ducks, geese and other livestock. The fishpond supports a compatible mixture of 5–6 fish species. Water from the fishpond is used to 'fertigate' crops growing in the fields or on the raised dykes. Aquaculture of rice, fruit and vegetables can be done in floats on the surface of the fishpond. Water from the fishpond can also be pumped into greenhouses to support the aquaculture of fruit and vegetables.

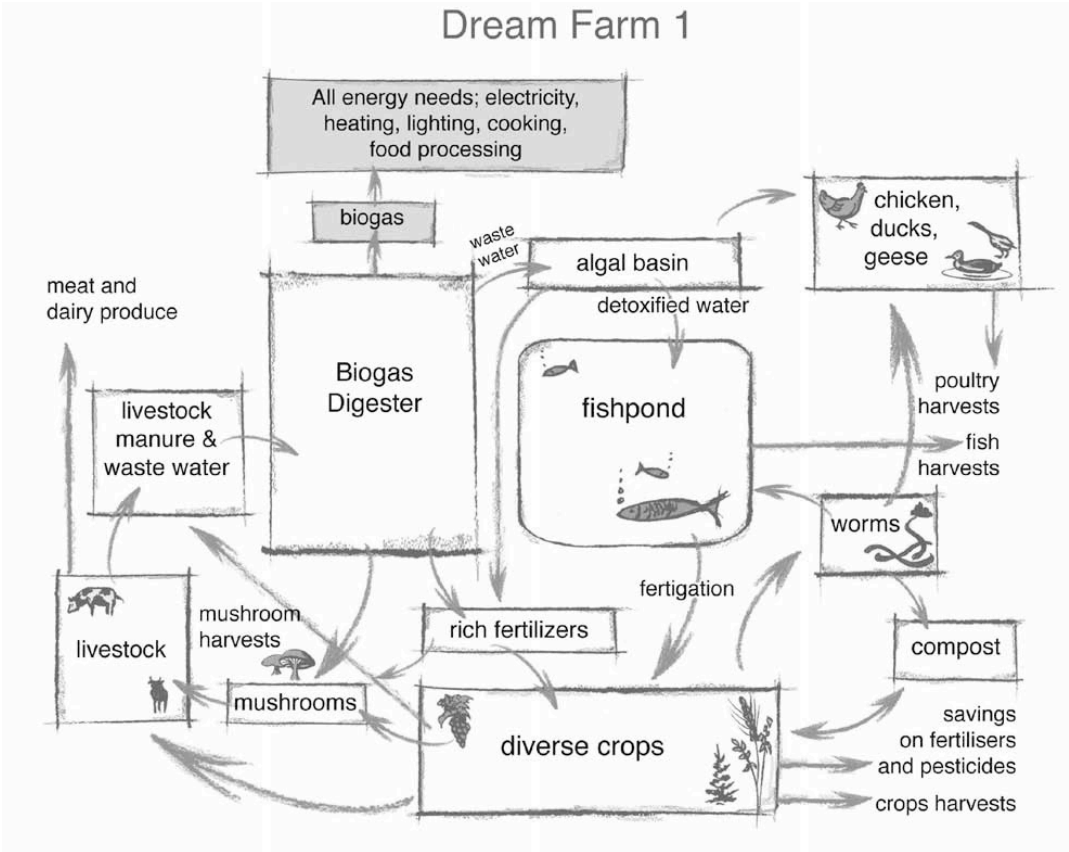

Fig. 3. George Chan's Dream Farm I model

The anaerobic digester yields a residue rich in nutrients that is an excellent fertilizer for crops. It could also be mixed with algae and crop residues for culturing mushrooms after steam sterilization. The residue from mushroom culture can be fed to livestock or composted. Crop residues are fed back to livestock. Crop and food residues are used to grow earthworms to feed fish and fowl. Compost and worm castings condition the soil. Livestock manure goes back into the anaerobic digester, thus closing the grand cycle. **The result is a highly productive farm that's more than self-sufficient in food and energy.**

Daily Life

Application in daily life

1. Zero waste for the old cloths

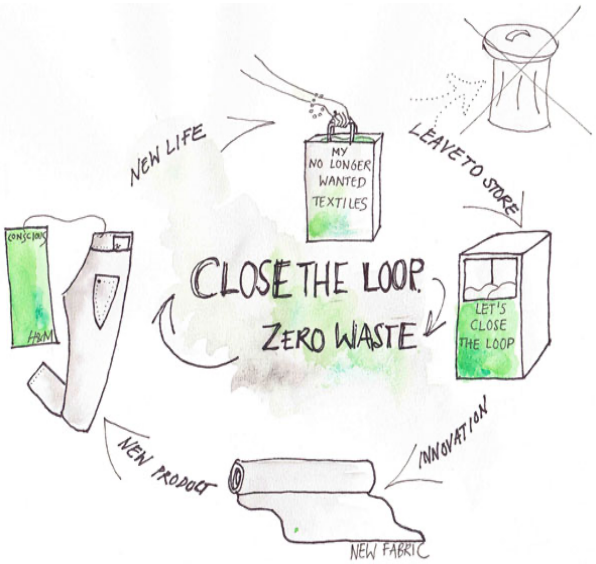

Fig. 4. Close the Loop – Zero Waste

Fig. 5. Used Clothes Collection Bin in Hong Kong

Source: Shayon, S. (2015). H&M Joins the Circular Economy with 'Close the Loop' Recycled Denim Line.

2. Glass recycling – Ekko Glass

Ekko Waste Solutions is a multi-award winning innovative glass recycling company that has developed bespoke glass bottle crushing machines, glass collection vehicles and systems, which make closed-loop glass recycling a reality.

Source: Home: Ekko Glass. Retrieved from http://www.ekkoglass.com/

Fig. 6. Machines of Ekko Waste Solutions

3. Waste Electrical and Electronic Equipment (WEEE) – Mobile phones

Mobile phones are often regarded as fashionable items that make up a great percentage of Waste Electrical and Electronic Equipment (WEEE). However, most used mobile phones are still of considerable value as they have materials like gold, silver, rare earth metals embedded in them. Given the low collection rate of mobile phone waste, various circular activities can help (Ellen MacArthur Foundation, 2015):

- Setup of a collection system, e.g. lease/buy back model, improved customer dialogue
- Selling the entire phone 'as is' after collection, remarketing, and ensuring customers' personal data are completely erased
- Stripping out the reusable components, e.g. camera, display battery and charger for the production of new devices
- Refurbishment of end-of-life smartphone

Changing product design and improving treatment technologies, e.g. using less adhesives for easy future disassembly

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Application in specific industries

Link to case studies in different sectors:

Waste management sector

- How sustainable fashion contribute to closed-loop economy
- Sludge treatment in T. Park

Description of the related issues

The weaknesses in Hong Kong's recycling industry

China announced it will ban imports of 24 types of low-grade waste recyclables by the end of 2017, which will increase the pressure on Hong Kong's landfill. However, Hong Kong's recycling industry couldn't do much about it. Some of the weaknesses in Hong Kong's recycling industry are discussed below.

First, Hong Kong doesn't recycle. Most, if not all, of the city's collected recyclables are exported, and almost 98% of that is shipped to China to be dealt with.

Second, comparatively little processing is done locally prior to export. Exporters are mostly shipping low-value materials.

Third, for a modern city, Hong Kong's recycling system is surprisingly primitive, and still relies on informal waste pickers to salvage recyclables – something more common in developing countries. It also highlights inefficiency of the city's social security net.

Calls to reduce consumption are well meaning, but they don't tackle the core issues. Producers should be held responsible for the entire lifecycle of their products. At the moment the cost of the resulting waste treatment is often offloaded onto cities – and their citizens through rates. The cost should, however, be paid by manufacturers and importers.

That money could then be used to support the recycling industry by subsidizing recycling operations and education on resource recovery and sustainable consumption. In addition, the government must transform the recycling industry. Shipping out our waste for others, such as China, to deal with is neither sustainable nor a long-term solution.

For the time being, the industry has to work on processing waste recyclables into higher-grade commodities, by for example pulping mixed paper waste and pelletizing plastic waste. This is important because the import ban covers low-grade waste products – including unsorted paper and paperboard and PET waste.

In the long term, the Government must focus on developing Hong Kong's ability to reuse resources locally. Investment should be put into expanding recycled products. The Government itself must also support the local green industry by buying products and services that cause minimal adverse environmental impacts, thereby creating a circular economy.

Source: Friends of the Earth (HK). (2017). Exporting recyclables is not a long-term solution to Hong Kong's waste problem | Hong Kong Free Press HKFP

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