Closing the Loop and Zero Discharge Technologies

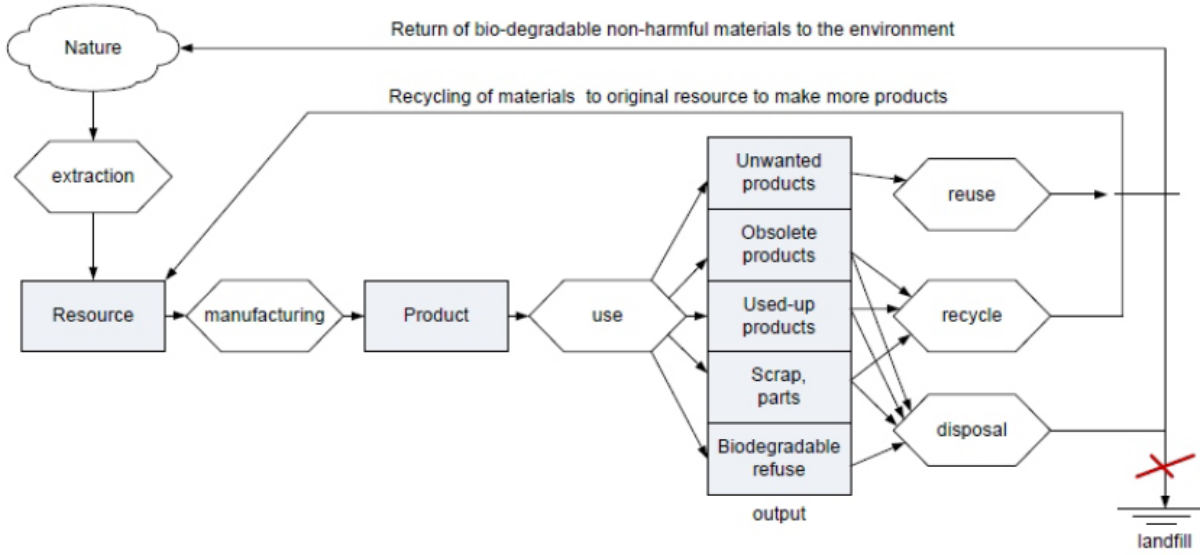
Closed-loop recycling is the process by which a product or material can be used and then turned into a new product (or converted back to raw material) indefinitely without losing its properties during the recycling process.

A Closed-Loop program is based on three principles: collection, manufacturing and purchasing. Collection is diverting and gathering materials that are recyclable so that they may be processed. In the second phase, manufacturing, the collected, Recyclable Materials are processed and then used in the production of a product. Finally, the newly made product is then sold to a third party before being reused and restart the process again.

A few things to consider:

- The recycled materials should provide the same quality of the product (no deterioration). *For example, almost all recycled aluminum from soda cans is suitable to produce the same cans.*
- There should be no accumulation of contaminants or toxins in the multiple recycling loop, which canmake the secondary product less safe.
- The recycled material can also feed manufacturing process for a different product or industry, which may require different type of recycling

The other part of closed-loop recycling concept is bio-degradable disposal. Everything that cannot be recycled or comes as a by-product in manufacturing process should return to the environment with no harm. Diagram in Figure 5.2 summarizes the above considerations. While starting from the same extraction, manufacturing, and use stages, the outputs in the closed-loop scheme become equally usable resource for the manufacturing chain. Greater fraction of materials should be designed for recycling and reuse. The refuse that is inevitable is biodegradable and brings no harm when returned to the environment.



Closed-loop material flow. In ideal case no permanent solid waste is generated – all materials are returned as nutrients for natural or technical food chains.
Credit: Mark Fedkin

In any sustainability scenario, closed-loop approach is the goal. But it would take radical changes and innovative thinking at the level of product and process design.

To a greater extent, this closed loop thinking is advocated in the book of William McDonough and Michael Braungart "Cradle-to-Cradle". The authors suggest that every product and all packaging should have a complete closed-loop cycle mapped out for each component, i.e., pathways should be identified for each component to either be recycled indefinitely or to return to the natural ecosystem.

Zero Discharge

Zero discharge is the goal of eliminating discharges of pollutants by industry, government, and other agencies to air, water, and land with a view to protect both public health and the integrity of the environment .

One possible objective of pollution prevention is zero discharge of pollutants. This is sometimes referred to as "virtual elimination", since even zero discharge cannot solve the problem of contaminants already in the environment.

Zero discharge of pollutants is possible using pollution prevention methods (while control methods cannot achieve zero in theory and are even less effective in practice, usually owing to lax enforcement). For instance, we can envisage automobile production in which there is zero

discharge of pollutants from the plant; other waste is recycled and the product (the car) consists of parts which are reusable or recyclable.

Certainly, zero discharge of specific pollutants has been achieved - for example, by modifying the production process in wood pulp mills so that no dioxins or furans are discharged in the effluent. The aim of zero discharge has also been written into environmental laws and into the policies of bodies commissioned to abate pollution.

In practice, zero discharge often gives way to target reductions - for example, a 50% reduction in pollution emissions by such-and-such a year. These targets or interim targets are usually in the form of "challenges" or aims by which to measure the success of the pollution prevention programme. They are rarely the product of a feasibility analysis or calculation, and there are invariably no penalties attached to failure to attain the target. Nor are they measured with any precision.

The following principles are help to achieve the zero discharge

- Design closed-loop systems
- Ensure processes (manufacturing, recycling, etc.) happen close to the source
- Conserve energy
- Don't export harmful waste
- Engage the community and promote change
- Keep products and materials in the loop as long as possible
- Build systems that provide feedback for continuous improvement
- Support local economies
- Promote materials as resources
- Minimize polluting discharges to land, water, and air
- Consider the true costs of opportunities
- Promote the **Precautionary Principle**
- Promote the **Polluter Pays Principle**
- Develop adaptable, flexible, and resilient systems