1.9: Sustainability and the Eco-Economy

An important component of green technology is **life-cycle analysis** (assessment) which considers process and product design in the management of materials from their source through manufacturing, distribution, use, reuse (recycle), and ultimate fate. The objective of life-cycle analysis is to determine, quantify, and minimize adverse resource, environmental, economic, and social impacts. The four major facets of life-cycle analysis are(1)determination of the scope of the assessment; (2) inventory analysis of materials mass and energy to enable development of mass and energy balances; (3) analysis of impact on the environment, human health, and other impacted areas; and (4) improvement analysis to determine ways in which greater efficiencies maybe achieved.

Life-cycle analysis is summarized in Figure 1.9.1. Note that there are several possible recycling loops ranging from simple product reuse through material reprocessing and fabrication to waste mining in which wastes are processed to reclaim useful materials that can go back into the manufacturing process.

The **eco-economy** is one in which the production of goods and services is totally integrated with the natural world. The practice of **eco-efficiency** (Figure 1.9.2) enables provision of affordable goods and services to satisfy human needs sustainably, doing so with the minimum consumption of Earth's natural capital and with most efficient utilization of energy. The practice of eco-efficiency has several major aspects related to sustainability. Dematerialization seeks to meet economic needs with minimum amounts of material using renewable and recycled sources wherever possible. Analogous to dematerialization is "de-energyization" which uses only minimum amounts of energy and takes energy from renewable sources. Service and knowledge flows are substituted for material flows wherever possible. Using natural ecosystems as models, production loops are closed to the maximum extent possible. Sustainability is enhanced by shifting from a supply-driven to a demand-driven economy. Rather than manufacturing large quantities of material goods that are then vigorously marketed, the emphasis is placed upon finding the real needsof consumers, then meeting them in the most efficient way possible. Functional extension is achieved by manufacturing products with enhanced functionality and selling services to increase product functionality. Eco-efficient products are designed to be as durable as possible consistent with their intended uses, to be long-lived, and designed for ease of recycling of components and materials. Dispersion of toxic materials is minimized or eliminated in eco-efficient systems.

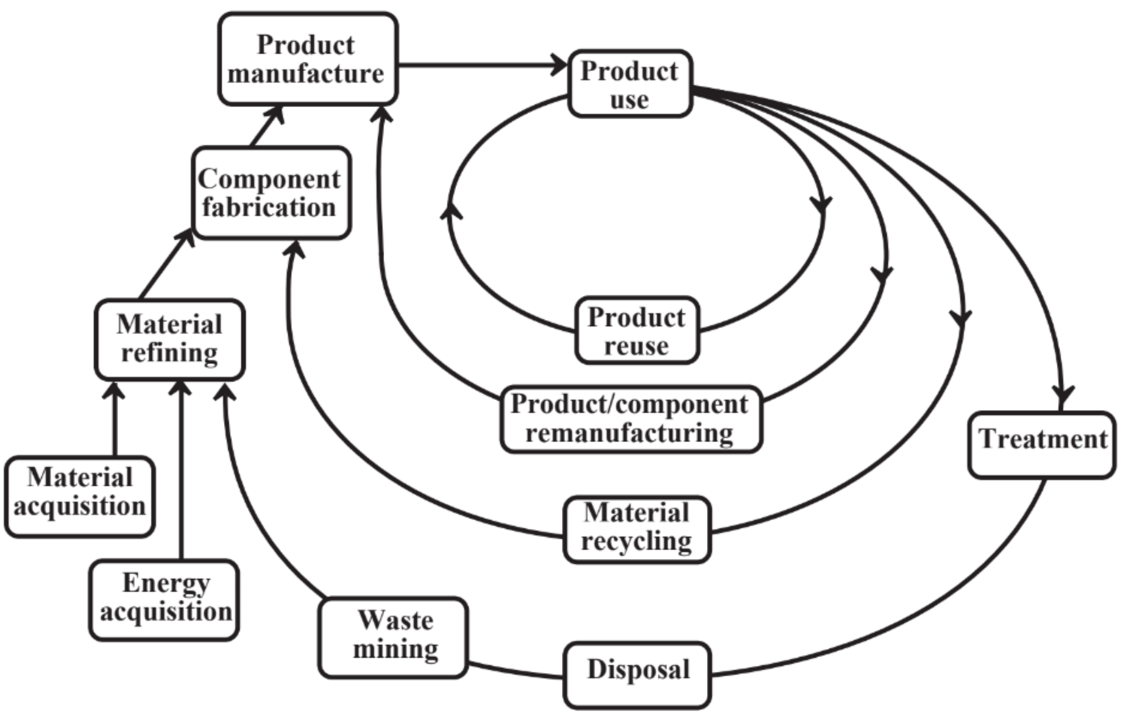

Figure 1.9.1. Various levels of materials use employed in life-cycle analysis. The inner loops are most desirable from the viewpoint of sustainability

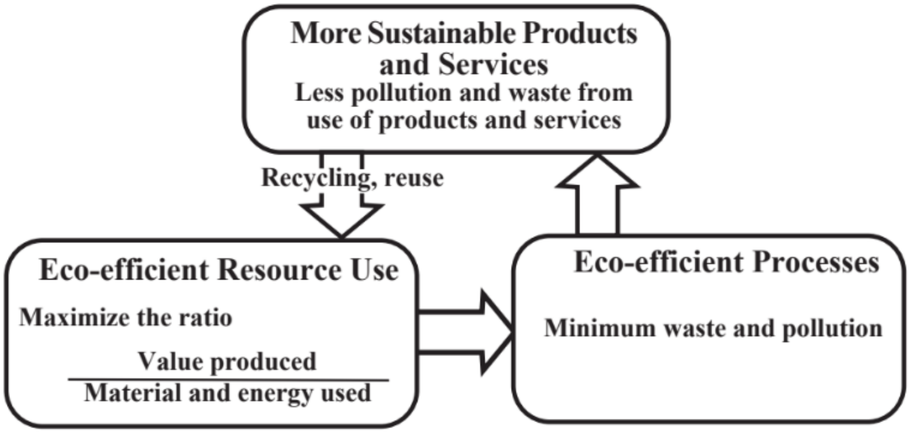

Figure 1.9.2 Achievement of sustainability with eco-efficient resource use and eco-efficient processes