

國立臺北大學自然資源與環境管理研究所  
112 學年度第二學期『清潔生產與工業生態學』

課程進度(01)：清潔生產、工業生態、永續工程  
Cleaner Production, Industrial Ecology, and Sustainable Engineering

● CLEANER PRODUCTION: A GENERIC INTRODUCTION

- UNEP Definition (Silva and Gouveia, 2020)
  - ⇒ The first definition of Cleaner Production (CP) known was launched in 1990 by UNEP-IEO (United Nations Environmental Program -- Industry and Environment Office) and defined CP as “the continuous application of an integrated preventive environmental strategy applied to processes, products, and services to increase overall efficiency and reduce risks to humans and the environment.” 持續應用整合型之環境策略於製程、產品及服務中，以增加效益並降低對人類及環境之風險。
- 《[中華人民共和國清潔生產促進法](#)》(2002/06/29 通過、2012/02/29 修正)
  - ⇒ 本法所稱清潔生產，是指不斷採取改進設計、使用清潔的能源和原料、採用先進的工藝技術與設備、改善管理、綜合利用等措施，從源頭削減污染，提高資源利用效率，減少或者避免生產、服務和產品使用過程中污染物的產生和排放，以減輕或者消除對人類健康和環境的威脅。
- 《[環境基本法](#)》(民國 91 年 12 月 11 日公布)
  - ⇒ 第 6 條：事業進行活動時，應自規劃階段納入環境保護理念，以生命週期為基礎，促進清潔生產，預防及減少污染，節約資源，回收利用再生資源及其他有益於減低環境負荷之原（材）料及勞務，以達永續發展之目的。
- Synonyms and Easily Confused Words
  - ⇒ Waste Minimization and Pollution Prevention
  - ⇒ Green Production and Green Productivity
  - ⇒ Sustainable Production => Sustainable Consumption and Production (SCP)
  - ⇒ Cleaner Production (CP) and Clean Development Mechanism (CDM)

● INDUSTRIAL ECOLOGY AND SUSTAINABLE ENGINEERING

- A Working Definition of Industrial Ecology (Graedel and Eckelman, 2023)
  - ⇒ Industrial ecology is the means by which humanity can deliberately approach and maintain sustainability, given continued economic, cultural, and technological evolution. The concept requires that an industrial system be viewed not in isolation from its surrounding systems, but in concert with them. It is a systems view in which one seeks to optimize the total materials cycle from virgin material, to finished material, to component, to product, to obsolete product, and to ultimate disposal, and to carefully evaluate the impacts of the industrial system on the environment.
- Sustainable Engineering (Companion of Industrial Ecology, Graedel and Allenby, 2010)
  - ⇒ The practice of sustainability from the perspective of the engineer. (The concept of sustainability can be defined as “the possibility that human and other forms of life will flourish on the planet forever.”)
- What is Sustainable Engineering (Reddy et al., 2019)
  - ⇒ Sustainable engineering is the development of engineering solutions to advance human life to maximize benefits and minimize adverse impacts to the environment, the economy, and the society (“the triple bottom line”) throughout the life cycle of a project. Sustainable engineering can be applied regardless of value chain position or the magnitude of a project – it is scalable and applied across molecular, product, process, and system design.

TABLE 3.1 Relating Current Environmental Problems to Industrial Responses to Yesterday's Needs

Yesterday's need	Yesterday's solution	Today's problem
Nontoxic, nonflammable refrigerants	Chlorofluorocarbons	Ozone hole
Automobile engine knock	Tetraethyl lead	Lead in air and soil
Locusts, malaria	DDT	Adverse effects on birds and mammals
Fertilizer to aid food production	Nitrogen and phosphorus fertilizer	Lake and estuary eutrophication

The old idea: There are "natural" areas and there are "industrial" areas

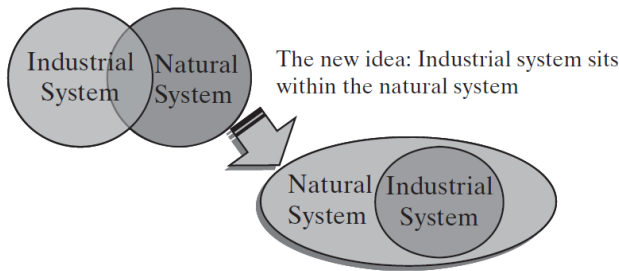
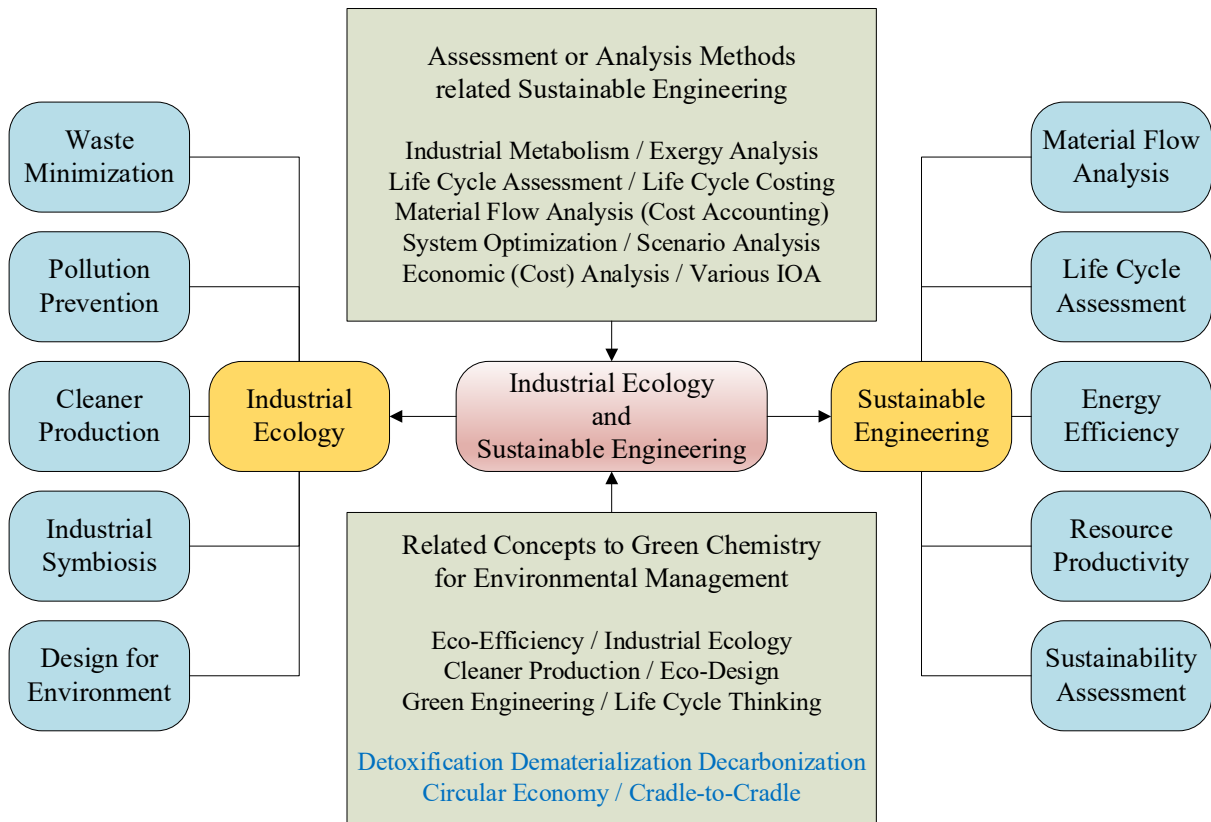


Figure 3.1

The transformation from natural and industrial systems as essentially independent entities to the realization that the industrial system is embedded within the natural system.



- HOMEWORK ASSIGNMENT #1 (2024/03/05) : 請比較並區隔以下名詞之定義
  1. Corporate Social Responsibility (CSR) and Environmental, Social and Governance (ESG)
  2. Cleaner Production (CP) and Clean Development Mechanism (CDM)
  3. Benefit, Efficiency, and (Cost)-Effectiveness
  4. Detoxification, Dematerialization, and Decarbonization
  5. Carbon Neutrality, Climate Neutrality, and Net Zero Emission