Sustainable Development

Sustainable development is a form of development that “meets the needs of the present without compromising the ability for future generations to meet their own needs.”

Brundtland Report 1987

Sustainable development was conceived as a programme more for poverty and mal-distribution alleviation than for environmental protection.
Roles for Industrial Ecology I in SD

- Model: Equilibrium population dynamics
- Analogies to ecosystems
  - Highly interconnected [food] web of producers and consumers (but basically open loop flows)
  - Inter-organizational relationships: Competition and predation
- Analogical potential for sustainable development
  - Cyclical (closed-loop) material flows (LCA, LCM)
  - Community, cooperation, and mutualism (IS, EIN)
  - Exergetically effective energy interchanges (IS, EIN)

Industrial ecology I can reduce environmental unsustainability
Natural System Metaphors Used in Industrial Ecology I

- Industrial economies have a *metabolism*, like that of a *community* or *system* of *interconnected organisms* of many *diverse* species. (The biological/ecological metaphor)

- Some industrial development patterns are *symbiotic* (strongly interdependent) and exhibit *mutualism*.

- Firms are like *organisms*.

- Our economic metabolism is wasteful unlike the *parsimony* of ecosystems.

- We can learn by imitating Nature knowing that she is a good *teacher*.
Reducing Unsustainability Does Not Create Sustainability

Sustainable development ignores the systemic underpinnings of our present state of unsustainability.
Sustainability is the possibility that human and other forms of life will flourish on the Earth forever.
Sustainable development is a modernist notion: determinate and measurable. “Sustainable” merely modifies development (wealth generation). Eco-efficiency is the key strategy. Wealth, at best, is a poor indicator of the state of the human and natural system.

Sustainability, as flourishing, is an (indeterminate) emergent property of a complex system. Its presence or absence signals the condition of the [human or natural] system. Sustainability, a noun, rests on “post-modernist” notions. It is observable, describable, but not measurable.
The Future: Industrial Ecology II

- Model: SOHO ecosystem
  - Open to material and energy flows
  - Steady states far from equilibrium
  - Indeterminacy: non-linear and non-reducible to components; multifinality
  - Chaotic and catastrophic behavior
    - Bifurcation and flips
    - Adaptive cycles (Holling)
  - Nested spatial, temporal hierarchical organization (holarchic)

- Analogic potential for sustainability
  - Industrial symbiosis evolution (Kalundborg)
  - Adaptive management models: resiliency
  - Precautionary principle
  - ??????
Kay’s Definition of Industrial Ecology

Industrial ecology is taken to be the activity of designing and managing human production-consumption systems, so that they interact with natural systems, to form an integrated (eco)system, which has ecological integrity and provides humans with a sustainable livelihood.
Sustainability won’t wait forever.