

New way of thinking about industrial systems with nature as model

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Environmental management

- Pollution control
- Pollution prevention
- Cleaner production
- Waste management
- Environmental conservation
- Environmental impact assessment
- Eco-efficiency
- Sustainable development
- Sustainable production and consumption

Status of Regulating and Cultural Services – MEA, 2005



Provisioning services		
Food	crops	↑
	livestock	↑
	capture fisheries	↓
	aquaculture	↑
	wild foods	↓
Fiber	timber	+/-
	cotton, silk	+/-
	wood fuel	↓
Genetic resources		↓
Biochemicals, medicines		↓
Water	freshwater	↓

Regulating services	
Air quality regulation	↓
Climate regulation – global	↑
Climate regulation – regional and local	↓
Water regulation	+/-
Erosion regulation	↓
Water purification and waste treatment	↓
Disease regulation	+/-
Pest regulation	↓
Pollination	↓
Natural hazard regulation	↓
Cultural services	
Spiritual and religious values	↓
Aesthetic values	↓
Recreation and ecotourism	+/-

↑ globally enhanced
↓ globally degraded

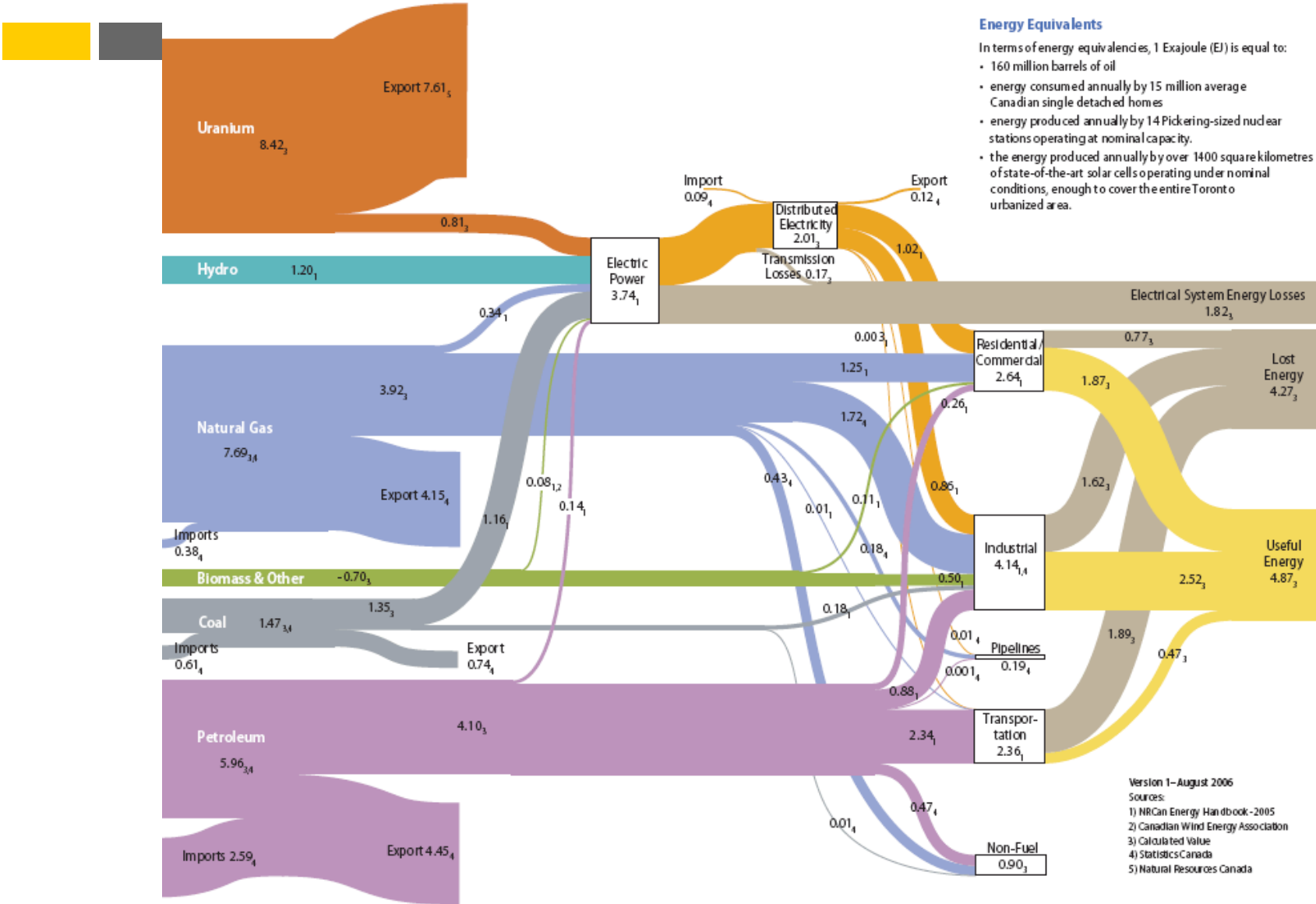
Source: Millennium Ecosystem Assessment, 2005.

U.S. (Canadian?) waste story

- 93% of resources are “consumed” before becoming saleable products.
- Of the 7% of resources that become a product, 80% are used only once before becoming waste.
- 99% of products become waste within 6 weeks of sale.

Allenby and Richards. 1994. U.S. National Academy of Engineering

Wasted energy



Version 1—August 2006
 Sources:
 1) NRCan Energy Handbook - 2005
 2) Canadian Wind Energy Association
 3) Calculated Value
 4) Statistics Canada
 5) Natural Resources Canada

Nature as model?

- **Ecosystems are resilient and relatively stable because of the biodiversity of species organized in complex web of relationships**
- **A major portion of the energy flows in a system are consumed in decomposition processes that make nutrients available**
- **Relationships are maintained through self-organizing processes rather than top-down control.**

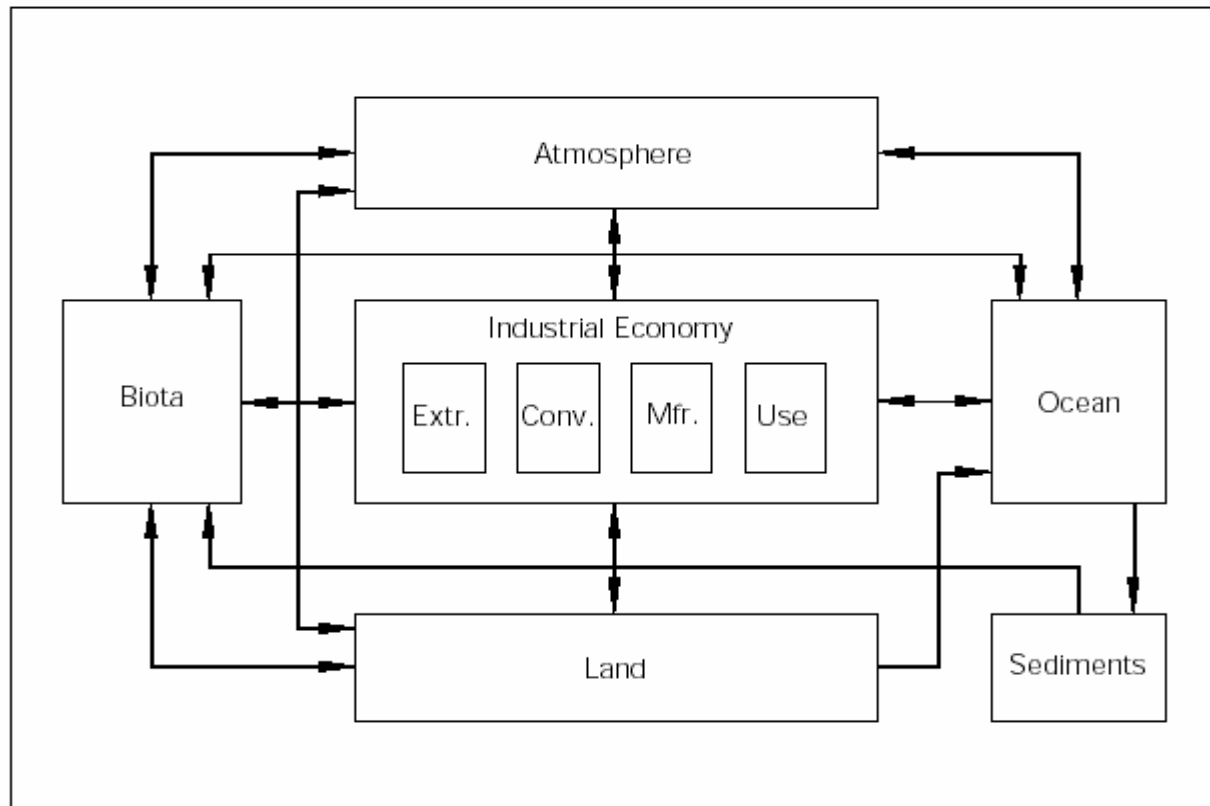
Nature as model?

- **Renewable energy is the main source of power for living systems**
- **In natural systems, there is no waste in the sense of matter that cannot be recycled or absorbed constructively**
- **Concentrated** toxic materials are generated and used locally
- **Each individual of a species in an ecosystem acts independently, yet its activity patterns mesh cooperatively with those of other species**

Rethinking industrial development

- Recognizing that resources flow between environmental and industrial systems.
- Thinking of products and materials as assets.
 - ▣ Forestry companies as fiber management companies
 - ▣ Mining companies as mineral management companies
 - ▣ Xerox, Interface: extended product responsibility
- Thinking of wastes as resources.
- Thinking of life-cycles rather than linear production systems.

Industrial metabolism

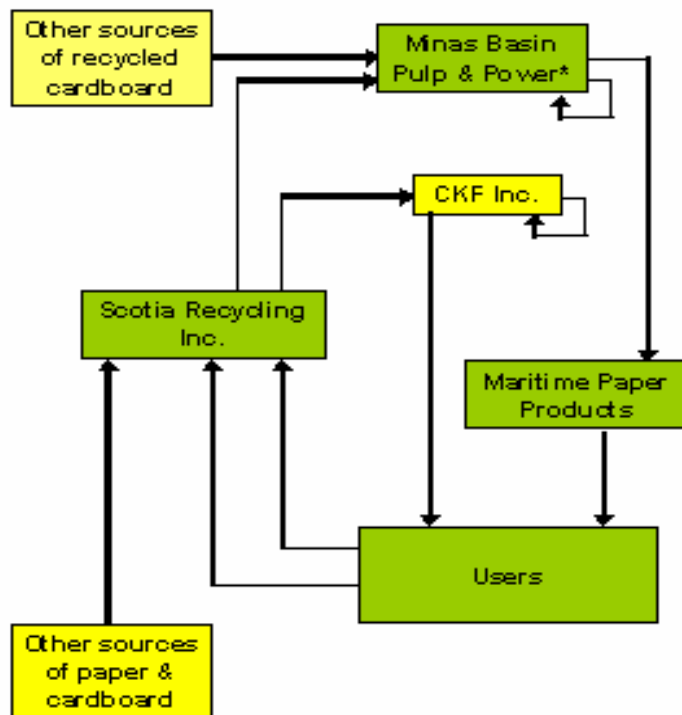


Materials flow from the environment to the environment

Nova Scotia Fiber Cycle

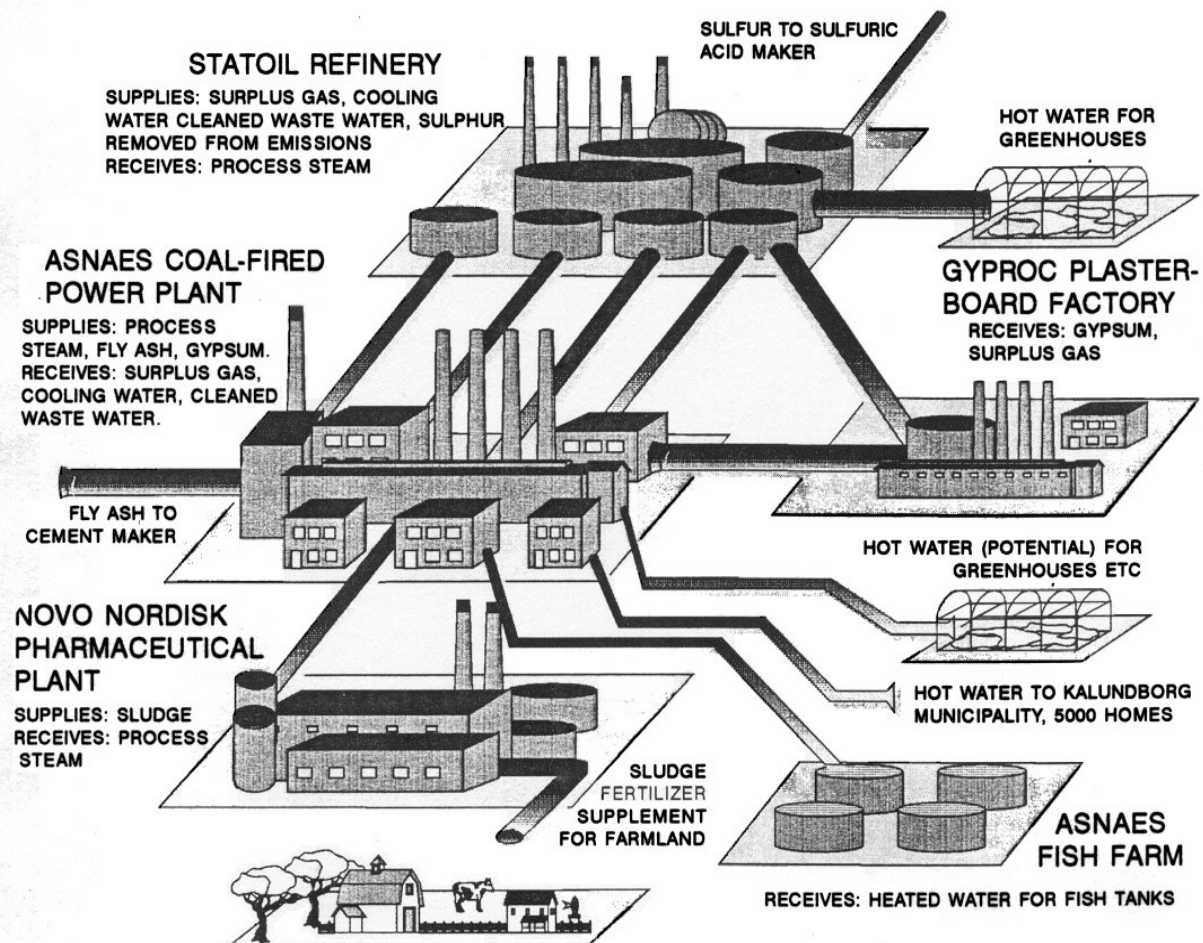
MATERIAL CYCLES - FIBRE

Closing material loops and cycling resources within an industrial park or cluster

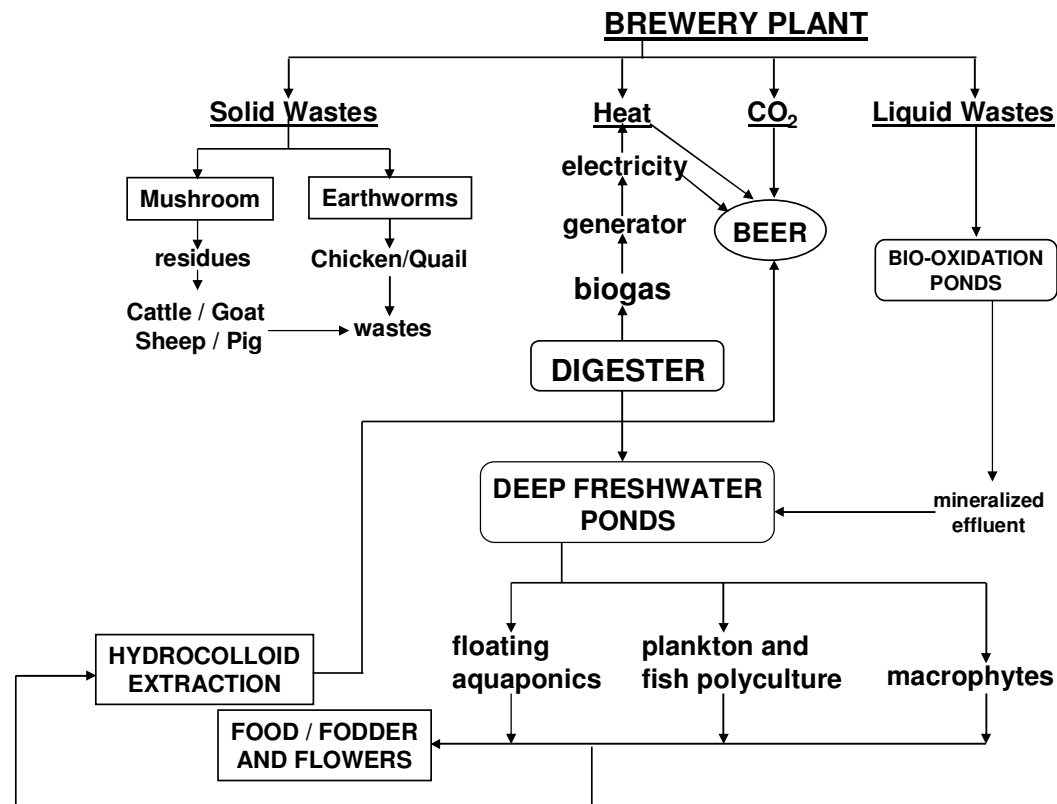


Some companies are beginning to manage their assets (materials) on a life cycle basis. The Scotia Investments, led by Minas Basin Pulp and Power, group of companies have been doing this for many years.

Industrial symbiosis, Kalundborg, Denmark



Bio-industrial clusters: The brewery-based zero emissions cluster



Main Products: beer, mushrooms, earthworms, micro-algae, fish, methane gas, plants

Industrial - community symbiosis in Finland

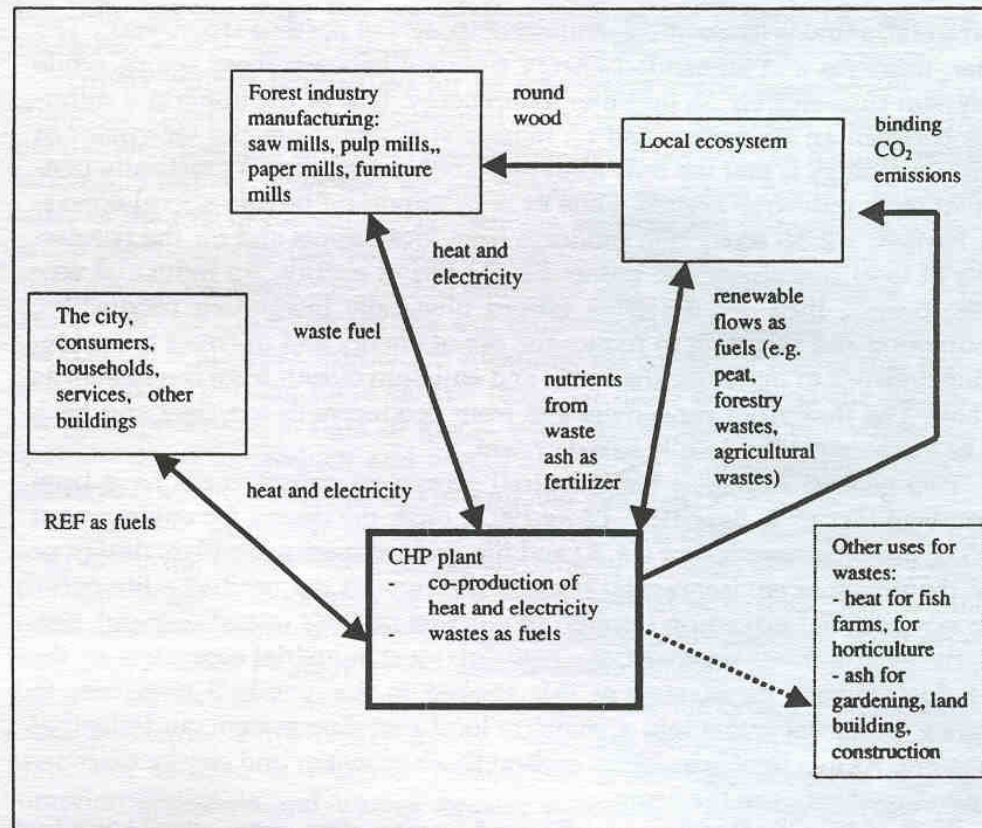
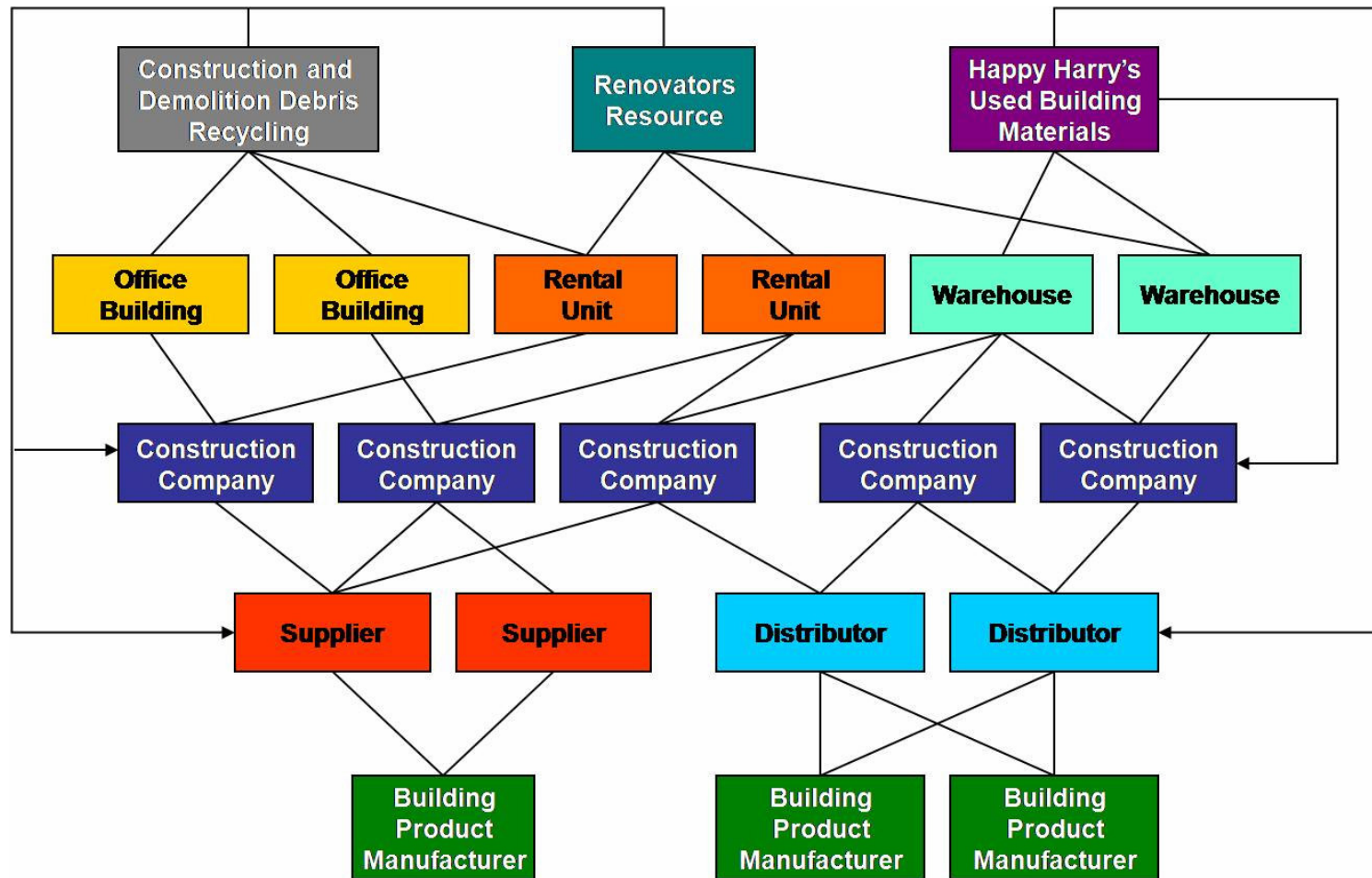
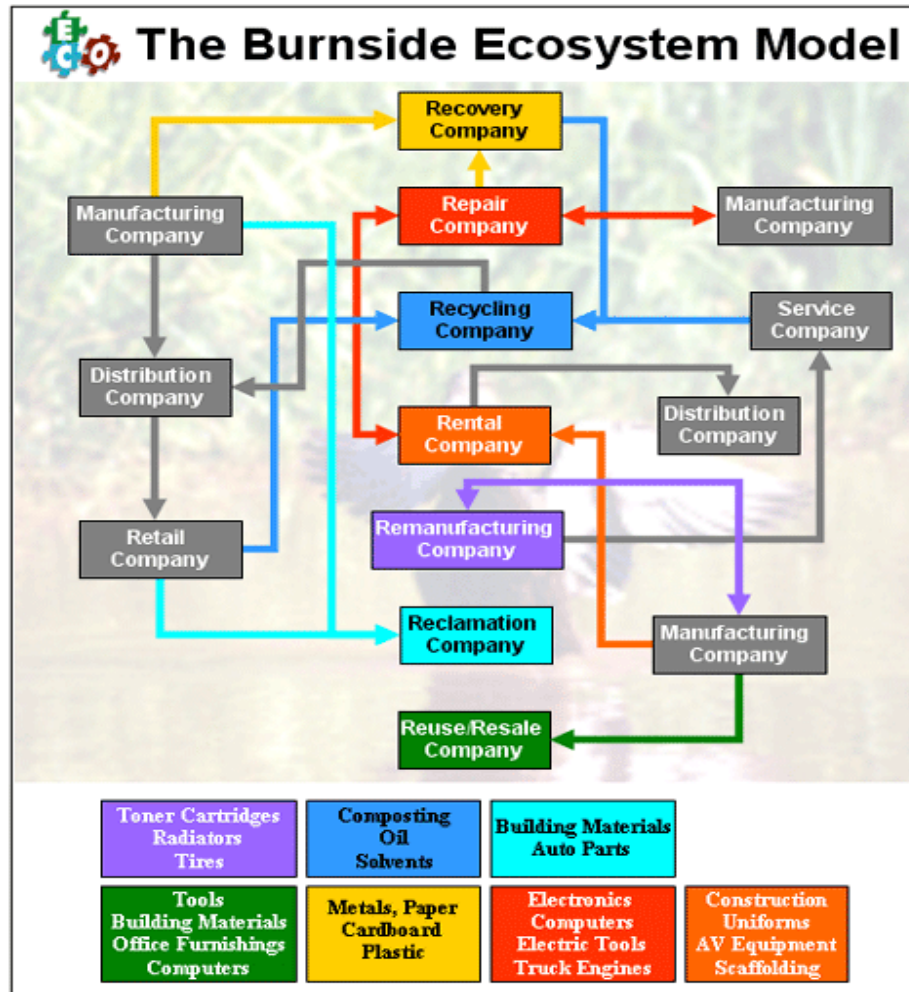


Figure 1 CHP-based energy production integrating production and consumption systems into a local industrial ecosystem

Creating industrial food webs



Burnside Industrial Ecosystem Model



A model that involves a diverse assemblage of producers, consumers, scavengers and decomposers and the interconnectedness among them.

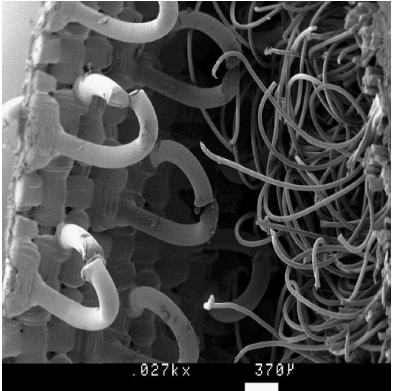
Policy directions

- If we are truly interested in sustainable production and consumption or environmentally sustainable industrial systems, then we need to ensure that
- both the products and by-products of an industrial enterprise can be effectively used for a productive and ecologically sound purpose
 - the materials of any product can be recycled or incorporated into a productive and ecologically sound purpose at their end of their intended use

Back to basics: Nature as model

- Mother Nature may not be perfect, from a human point of view, but she has been experimenting for millions of years and has developed all kinds of mechanisms and products that are much more elegant than anything we have produced. Perhaps we should be taking our cues from her.

Biomimicry



“The world we have created today as a result of our thinking thus far, has problems which cannot be solved by thinking the way we thought when we created them.”



Selected references

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