## Eco-Industrial Parks

An eco-industrial park involves a network of firms and organizations, working together to improve their environmental and economic performance. Some planners and researchers of EIPs have used the team "industrial ecosystem" to describe the type of symbiotic relationships that develop amongst participating firms.

According to Indigo's EPA research project, eco-industrial parks are defined as:

"An eco-industrial park is a community of manufacturing and service businesses seeking enhanced environmental and economic performance through collaboration in managing environmental and resource issues, including energy, water, and materials.

By working together, the community of businesses seeks a collective benefit that is greater than the sum of the individual benefits each company would realize if it optimized its individual performance only.

The goal of an EIP is to improve the economic performance of the participating companies while minimizing their environmental impact."

**Eco-Industrial Parks:**
**A Foundation for Sustainable Communities?**
**by Ernest Lowe, Indigo Development**

What exactly do we mean by "sustainable community development"? How do we begin implementing principles of sustainability in our communities? The new concept of eco-industrial parks (EIPs) offers one starting point for addressing these questions.

In order to be economically viable, most communities attempting to move toward sustainability will need to include an industrial sector in their economic mix. But to involve industry in strategies for sustainability will require fundamental improvements in industrial environmental performance and resource efficiency, as well as better integration of companies into their host communities.

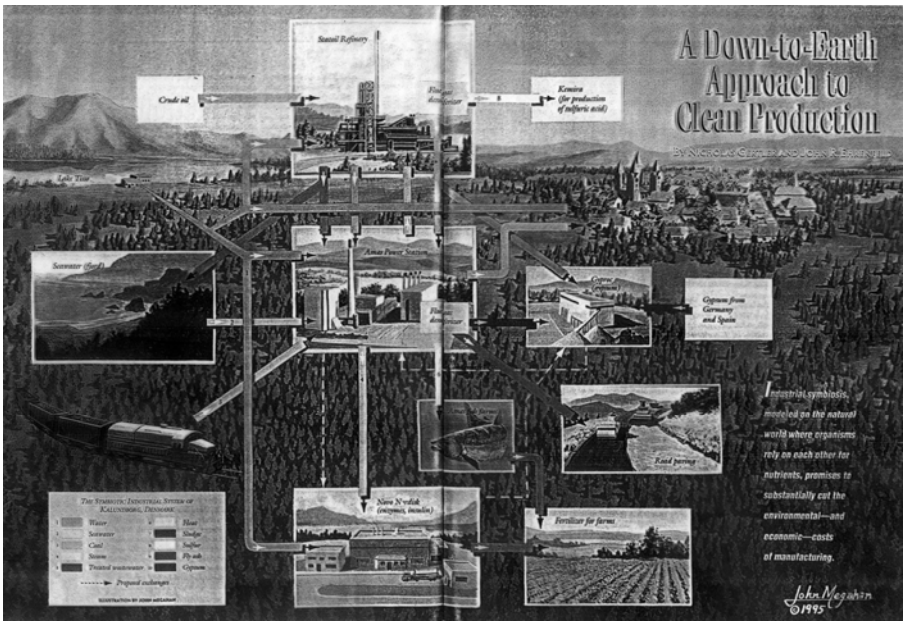
Though still a nascent concept, the EIP has emerged in a remarkably brief time as one interesting approach to this challenge. The EIP concept was first formalized in 1992-93 by Indigo Development, a team of people from Dalhousie University in Nova Scotia, and Cornell University's Work and Environment Initiative.

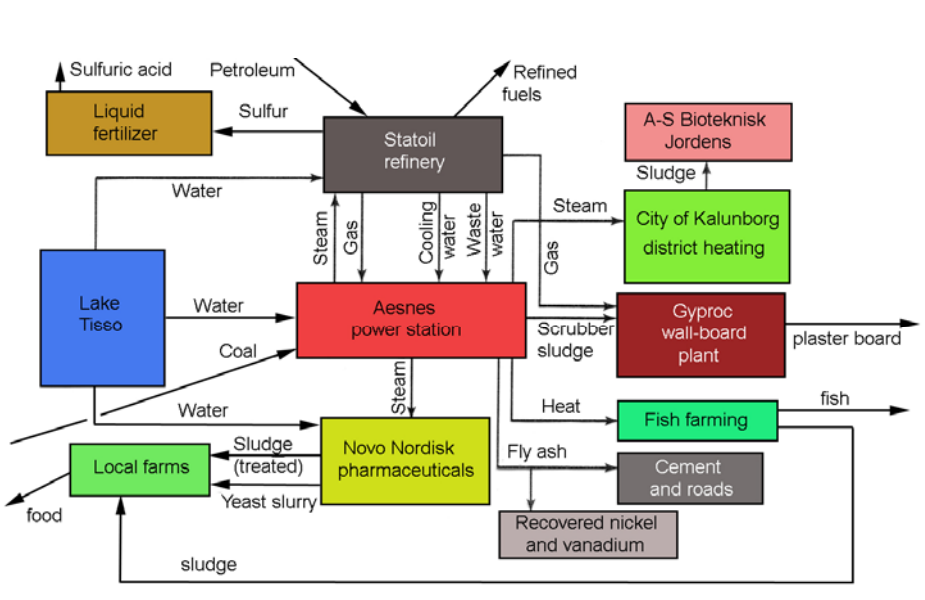
In 1994, the U.S. Environmental Protection Agency (EPA) awarded a contract to Research Triangle Institute and Indigo to flesh out the concept and undertake a case study.

By the fall of 1996, 17 projects declaring themselves eco-industrial parks were on the drawing boards in the U.S.; at least two had recruited their first tenants.

(Additional material at: http://www.indigodev.com/Ecoparks.html)

Town of Kalundborg in Denmark – A historical first and the prototypical example




Flows of resources in the eco-industrial system at Kalundborg, Denmark

(brief mention on page 299 of Mihelcic & Zimmerman, 2010)

## Results at Kalundborg:

Water:
- Asnaes Power Station has lowered its water consumption by 60%
- Withdrawals of water from lake Tissø have decreased by 50%

Fly ash from Asnaes Power Station:
- 30,000 tonnes per year are recovered, going to cement factories
- Nickel and Vanadium reclaimed from this ash

Desulfurization at Asnaes Power Station:
- $SO_2 \rightarrow CaSO_4 \rightarrow$ 100.000 tonnes of gypsum per year
- Also ammonium-thio-sulfate as by-product, going in production of 20,000 tonnes of liquid fertilizer (≈ annual Danish consumption of liquid fertilizer)

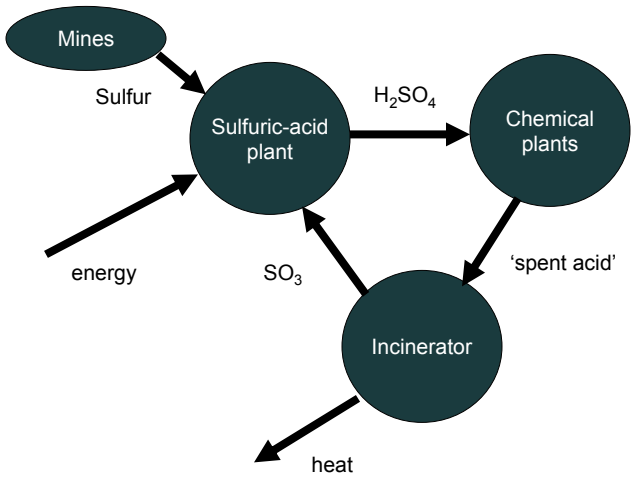
Yeast slurry from Novonordisk:
- Yields 70% of soy protein for pig farming → 800,000 pigs per year

Steam & Heat from various partners, esp. Asnaes Power Station:
- 30% improvement in energy utilization across the park
- meets 15% of Statoil Refinery's needs
- 4,500 households receive district heat (done away with 3,500 small oil-fired burners)
- makes possible aquaculture → 200 tonnes of trout and salmon annually

Solid waste:
- 130,000 tonnes of combustible waste incinerated per year
- capture of landfill biogas

→ electricity sold to industrial partners

A simple but effective arrangement in the so-called Houston Ship Canal are




(From O'Rourke, Connelly & Koshland, 1996)

North America's first certified green industrial park is the Irving Green Industrial Park in St. John, New Brunswick, Canada. The facility, built on the former St. John Shipbuilding site, is a $100 million project made with a focus on sustainable materials, as well as attracting companies that produce such goods.

In Baltimore, Maryland, Fairfield Ecological Business Park was established with strict environmental guidelines for its resident companies.

The Master Plan for the Choctaw Eco-Industrial Park in Oklahoma features native plant appropriate applications.

Other green industrial parks have been established in numerous states including Massachusetts, Virginia, Pennsylvania, Texas and Wisconsin, as well as overseas.

Green industrial parks can be a draw for industry. Volkswagen AG recently choose a reclaimed munitions site in Chattanooga, Tennessee, to build a $1 billion assembly plant. Europe's largest automaker said the Enterprise South site, in addition to the city's other green efforts, helped in the company's choice.

**A Southern Example**

In another example of a green industrial park, an industrial park on the north side of Huntsville, Alabama provides 250 acres that incorporates environmental protection into its design. A project of city government, the Tennessee Valley Authority and the Center for Economic Development and Resource Stewardship, the North Huntsville Industrial Park Conservation Design Demonstration Project is the largest such industrial park in the Southeast.

In Huntsville, plans call for the "green" industrial park to have features aimed at reducing pollutants that could enter groundwater and protecting sensitive areas. The land has gently rolling pasture and a ground water recharge area containing sinkholes that allow infiltration of rainwater to an underground aquifer.

The park has about 50 sites suitable for small industries. Recommendations include digging retention ponds, limiting the width of roads and growing gardens on the roofs of buildings to reduce storm runoff. Plans also call for walking trails and an observation deck for park employees and environmental education groups. About half of the farmland will be preserved.

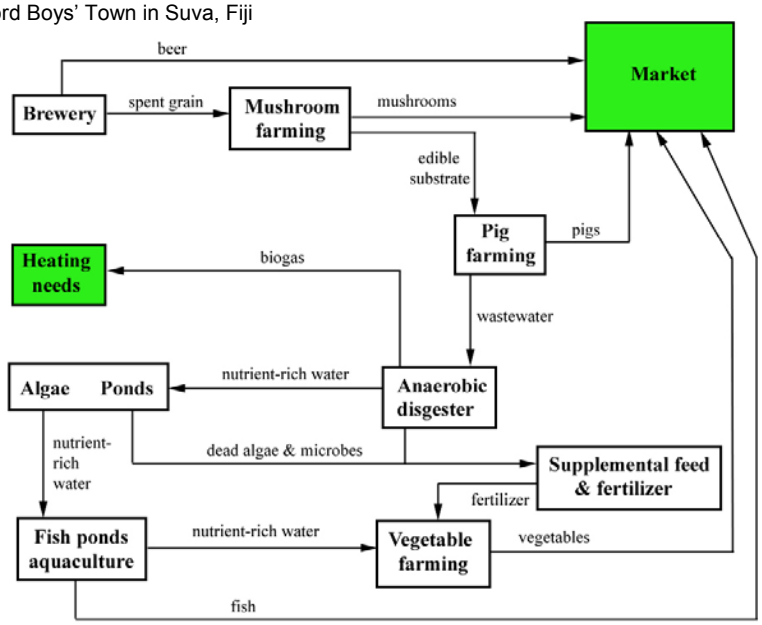
(Taken from **Green Industrial Parks** in Green Business Practices by Gina Hannah)
(http://green-business-practices.suite101.com/article.cfm/green_industrial_parks)

**Existing and Developing Eco-Industrial Park Sites in the U.S.**

1. Berks Country Eco-Industrial Park (Berks Co., Pennsylvania)
   A state/private project converting landfill into energy system for manufacturing.
2. Brownsville Eco-Industrial Park (Brownsville, Texas)
   Cross-border multi-firm resource-sharing strategy.
3. Burnside Eco-Industrial Park (Nova Scotia, Canada)
   Eco-Efficiency Center nonprofit run in coordination with Dalhouise University
4. Cabazon Resource Recovery Park (Indio, California)
   An EIP set up by a Native American tribe currently running a biomass electricity generation plant and a recycling-manufacturing company making products of used tires.
5. Civano Industrial Eco Park (Tucson, Arizona)
   Business center for the development of sustainable technology.
6. Coffee Creek Center (Chesterton, Indiana)
   A residential, office, and retail model supporting green tech and consulting groups.
7. East Shore Eco-Industrial Park (Oakland, California)
   Four alternative waste processing companies operating under environmental schemata.
8. Fairfield Eco-Industrial Park (Baltimore, Maryland)
   Major US and international corporations adhering to strict eco-guidelines in city-created "empowerment zone".
9. Franklin County Eco-Industrial Park (Youngsville, North Carolina)
   Solar-powered building in which all tenants sell or service products involving alternate energy, recycling, or sustainable building.
10. The Green Institute (Minneapolis, Minnesota)
    Four programs including re-use center to redistribute usable materials to public, a community gardening project, non-profit green technology advocacy group, and an eco-enterprise building housing companies and organizations.
11. Plattsburgh Eco-Industrial Park (Plattsburgh, New York)
    Research, recreational, industrial, and commercial facilities on abandoned air force base near Canadian border.
12. Port of Cape Charles Sustainable Technologies Industrial Park (Eastville, Virginia)
    HUB Zone, foreign trade zone, and Virginia Enterprise Zone with specific incentives for photovoltaic producers, clean fuel vehicle manufacture, and recycled material producers.
13. Raymond Green Eco-Industrial Park (Raymond, Washington)
    Located within a sustainably harvested forest, works with local resources and processes waste streams on site.
14. Riverside Eco- Park (Burlington, Vermont) (now named Intervale Food Center)
    An agro-industrial park using biomass and other cooperative reprocessing techniques.
15. Skagit County Environmental Industrial Park (Skagitt County, Washington)
    Recovery center which includes production, community center, sales and marketing center, and environmental business center.
16. Shady Side Eco-Business Park (Shady Side, Maryland)
    Marine-based park with high level of local community participation.
17. Trenton Eco-Industrial Complex (Trenton, New Jersey)
    Urban network, not geographically contiguous.
18. The Volunteer Site (Chattanooga, Tennessee) (now named Enterprise South Eco-Industrial Park)
    Business development center site on underused military facility using "cluster" approach to target specific industries

(*Source*: http://www2.ucsc.edu/gei/eco-industrial_parks.html)

Flow resources in the integrated biosystem of Montford Boys' Town in Suva, Fiji




**Intervale Food Center in Burlington, Vermont** **(formerly Riverside Eco-Park)**

The Intervale Food Center is a sustainable agricultural-based project emerging from discussions between an ad hoc group of citizens and City officials who recognized the potential of an eco-park as a model of sustainable development. This eco-park has been conceived as a partnership of the public, private, and non-profit sectors. It exemplifies sustainable development through emphasis on the principles of cooperative industrial ecology - waste products from one industry become the raw materials for another.

The vision for the Intervale Food Center is the integration of sustainable agriculture with cutting-edge technology. This is accomplished with a firm commitment to the facility's relationship with the community as an employer, good neighbor, and incubator for new business. A bedrock principle of the eco-park is to be a model of environmentally sound and equitable economic development. This four-acre parcel utilizing the existing McNeil Generating Plant is being developed to improve both Burlington's economy and quality of life.


It will consist of a complex of greenhouses and buildings utilizing "waste" heat (steam), a by-product from burning wood chips (renewable bio-mass fuel technologies) at the McNeil Plant. The McNeil Plant has also taken an innovative step in renewable energy production with the biomass gasification project. The wood gasification process has the potential to generate electricity more efficiently and at a lower cost by converting wood or other organic materials into a gaseous, energy-intensive fuel source that can be used in high efficiency gas turbines.

The facility will be comprised of 10,000 square feet of business space and 50,000 square feet of bioshelter (greenhouse) space. Ideal tenants are those who can then utilize the low-grade heat produced at the McNeil Plant to complete the energy-waste-energy cycle through a symbiotic closed loop. The eco-park currently has community gardens, citywide composting, wind power, and a Living Machine demonstration project.

The eco-park is envisioned to include a range of sustainable and restorative uses related to organic agriculture, biotechnology, aquaculture, and 'living machine' technology. The living machine utilizes living plants to complete the chemical conversion to turn liquid organic waste from the food industry into viable products such as fertilizer and fish food. It is now growing healthy talapia and hydroponic plants adjacent to the building site and provides an open classroom for the community and educational institutions.

http://www.usc.edu/schools/sppd/research/NCEID/Profiles/Mini_Sites/Intervale_Food_Center.html

**River Street Market**
**Carborro, North Carolina**

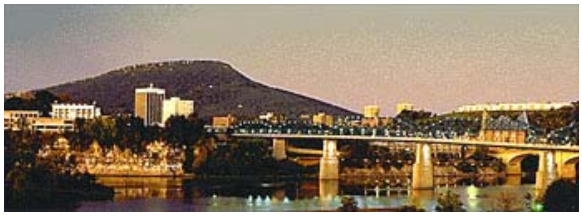
Starting with a block grant from the municipality, an enterprising group set out to put Carborro on a sustainable track. The nucleus is a member-owned (cooperative) foodstore. Around it are a restaurant and cultural attractions.

Through its store, the Weaver Street Market promotes local produce, natural foods and reduction of consumption. The emphasis on local, organic produce has a trickle effect: enhanced sense of place, self sufficiency, sustainable farming practices, protection of local water resources, *etc*.

**Chattanooga, Tennessee**

In the 1970s and early 1980s, after much suburban growth, the downtown of Chattanooga was in decline and was plagued by a few environmental problems.

In 1984, the city began to develop a community-wide vision that incorporated sustainable community concepts into city planning.



The major driving force behind the revitalization was the Vision 2000 project, which was established as a collaborative effort between residents, business, and local government. Open public forums were held throughout the mid-1980s, and goals were set.

CHATTANOOGA COMMITTED TO
Sustainable Development
ECONOMY•ECOLOGY•EQUITY

**Chattanooga, Tennessee (cont'd)**

Forty specific goals were identified, one of which was reduced dependence on the personal automobile through reliance on clean public transportation (electric buses). Others fostered the development of multi-purpose facilities and affordable housing. Cleaning up the Tennessee River and developing the waterfront for recreational purposes was also on the list.

Perhaps the most visible component of the revitalization effort has been the freshwater aquarium. Standing as the cornerstone of the Riverwalk district, it has been a major tourist attraction. Its presence has been the catalyst for the construction of new residential apartments, businesses and recreational facilities.

There is no doubt that Chattanooga is a vibrant and far more pleasant city than it was twenty years ago.

Critics, however, argue that in the push for economic revitalization and environmental restoration, some social aspects have been disregarded. The effort has profited the middle class far more than the working class and minorities.

**Components of EIP design**

EIPs have a rich menu of design options, including site design, park infrastructure, individual facilities, and shared support services.

**Natural Systems** – An industrial park should fit into its natural setting in a way that minimizes environmental impacts while cutting operating costs.

*Example*: The Herman Miller design plant in Phoenix illustrates the use of native plant reforestation and the creation of wetlands to minimize landscape maintenance, purify storm water run-off, and provide climate protection for the building.

*Example*: Use of local solar and/or wind energy

**Energy** – More efficient use of energy is a major strategy for cutting costs and reducing burdens on the environment.

*Example*: Steam or heated water flowing from one plant to another (energy cascading), or to homes in the area.

**Material Flows** – In an eco-park, companies perceive wastes as lost opportunities that ideally are potential products to be re-used internally or marketed to someone else.

The park infrastructure may include the means for moving by-products from one plant to another, warehousing by-products for shipment to external customers, and common toxic waste processing facilities. One emerging strategy for EIP planning involves anchoring the park around resource recovery companies that are recruited to the location or started from scratch.

*Example*: Brewery, mushroom farming, pig raising and vegetable farming in Fiji

**Water Flows** – Processed water from one plant may be re-used by another (water cascading), passing through a pre-treatment plant as needed. The park infrastructure may include mains for several grades of water (depending on the needs of the companies) and provisions for collecting and using storm water run off.

**Park Management and Support Services** – Management supports the exchange of by-products among companies and helps them adapt to changes in the mix of companies (such as a supplier or customer moving out) through its recruitment responsibility. It may maintain links into regional by-product exchanges and a site-wide telecommunications system.

The park may also include shared support services such as a training center, cafeteria, day care center, office for purchasing common supplies, or a transportation logistics office.

**Benefits of Eco-Industrial Parks**

1. *Monetary benefits to companies*:

↓ Production costs (purchasing unwanted by-products form others at bargain prices; selling its own by-products)
↓ Energy consumption (less transportation)
↓ Waste management (on-site, or even being able to sell what would otherwise be waste)
↓ Costs of compliance
↓ Cost of some R&D (shared with other companies)

2. *Environmental benefits*:

↓ Demand on natural resources
↓ Waste (in all forms:
solid waste, air emissions, wastewater)
↓ Chances of accidents in transportation
(pipes instead of trucks)


3. *Societal benefits*:

Better economy → more jobs
Cheap heating (in both park and residential neighborhoods)
Cleaner air, cleaner water → better health
↓ Demand on sewer system, landfill *etc*.