Industrial Ecology is the Discipline Driving the Practice of Eco-Industrial Development

IE concepts can be applied on different scales.

Within Firm
- design for environment
- pollution prevention
- eco-efficiency
- green accounting
- green chemistry
- clean production

Across Firms
- industrial symbiosis
- product life-cycles
- byproduct synergies
- inter-firm closed-loop production
- greening supply-chains
- sharing facilities

Regional/Global
- balanced ecological budgets and cycles
- system-wide materials, energy and water flows
- interface with ecological systems
- resource efficient value-chains
Eco-Industrial Development is about the most efficient industrial facilities and processes that:

- Systemically optimize material, energy, and water flows throughout industrial supply chains.
- Maximize productive use of input resources and by-products, waste is non-productive.
- Minimize impacts on the environment by moving toward zero waste and emissions.
- Integrate sustainable design in facilities and sites.
- Utilize clean production and eco-efficient technologies and processes.
- Maximize use of renewable energy systems and sustainably produced feedstocks.
- Establish the business relationships to share amenities and facilities.
A True Eco-Industrial Development Applies Advanced Environmental Strategies

- Industrial symbiosis and byproduct exchanges
- Eco-industrial parks or clusters
- Renewable-based energy and feed stocks
- Closed loop production and waste recovery systems
- Green manufacturing and eco-efficiency
- Green chemistry and product design for the environment
- Zero waste and emissions
- Greening supply chains
- Eco-enterprises and commercialization of clean technologies
- Sustainable design methods
EID Integrates Ecological Design into Industrial Development

- Requires a proactive approach applied in early stages of industrial development projects.
- Provides a way to integrate industrial ecology concepts and methods to create eco-industrial facilities and parks.
- Conducting EID is complex and linked to larger community development efforts in the region supporting the industrial development.
What is an Eco-Industrial Park?

“A community or network of companies and other organizations, in a physical park, who choose to interact by exchanging and making use of byproducts and energy in a way that provides one or more… benefits over traditional, non-linked operations."

Benefits can include:

• Reduced natural resource inputs
• Reduced pollution - energy use – wastes
• Increases in value of non-product outputs

Extrapolated from Gertler 1995
US Eco-Industrial Development Examples

**ENERGY-BASED**
- Red Hills Ecoplex
  Choctow County, MS
- Hillman Industrial Park
  Hillman, MI
- Spiritwood Station,
  North Dakota

**ENVIRO TECH**
- Chicago Center for Green Tech
  Chicago, IL
- Cabazon Resource Park
  Indio, CA

**HYBRIDS**
- Riverside Eco-Park
  Burlington, VT
- Fort Devens
  Devens, MA

**ECO-PARKS**
- Silver Bay,
  MN
- ReVenture Park
  Charlotte, NC
- Londonderry Eco-Park
  Londonderry, NH
Benefits to Environment

- Less waste, emissions, and pollution.
- More efficient use of energy and resources results in higher levels of clean production.
- Superior performance, goes beyond regulatory thresholds, and can help streamline regulatory processes.
- Replacement of fossil based energy and materials.
- Increased use of renewable energy and sustainable materials.
- Industrial system and supply-chain pollution prevention versus facility-based approach.
Benefits to Business

- Greater resource efficiency equals decreased operating costs.
- Enhanced competitiveness and potential for revenue generation.
- Increased return on capital investments and asset value.
- Energy security and independence.
- Stronger connections with suppliers, customers, and community.
- Reduced future costs to business and community such as clean-up liabilities.
Benefits to Community

- More sustainable industrial operations and local prosperity creation.
- Can strengthen existing business base and enhance recruiting.
- Reduced long-term infrastructure and operations costs.
- Reduced emissions resulting in improved community health.
- Improved community industry relations, quality job creation, and workforce attraction.
- Enhanced community identity through eco-branding.
- Strengthens local economy through regionally produced feed stocks, products, and services.
Eco-Industrial Park
Planning – Design – Development
General Steps to Develop Eco-Industrial Parks

- Organize project and undertake initial planning.
- Conduct baseline analyses.
- Evaluate current environmental conditions and socio-economic impacts.
- Account for present and future costs.
- Determine technology needs and process to validate new technologies.
- Initiate EIP feasibility process.
Begin with Project Organization

- Identify EID goals and principles, establish a vision.

- Determine how EID goals align with community values and strategies.

- Develop EID project scope and general plan.

- Develop oversight team to lead project and establish communication approaches, including community representatives and developers.

- Determine project partners and resources; financial, technical, human.
**Baseline Analyses**

- Conduct energy profiles; supply systems, local commercial and industrial users, types and amounts.

- Quantify available waste streams including management methods, recycling efforts, industrial by-products.

- Assess existing regulatory and policy framework; national, state, local.

- Inventory site, community and regional assets and existing infrastructure.

- Identify underutilized facilities, land, and equipment.

- Uncover symbiosis opportunities between facilities and operations.
Baseline Analyses Continued

- Assess current industrial activity including material, energy, and water use profiles from local industries.
- Profile current supply-chain relationships.
- Analyze current market conditions.
- Analyze local and regional flows of raw materials, energy, water, goods, and services.
- Infrastructure mapping; facilities, utilities (use GIS models).
- Assess current transportation systems and improvement options.
Determine From Baseline Analyses

- Local conditions and assets; strengths, weaknesses, opportunities, threats.
- Current industrial activity and scenarios for eco-industrial development.
- Infrastructure and capital investment needs.
- How to identify, qualify, and educate on the benefits.
- Leverage points and opportunities to achieve superior performance in operations.
- Barriers and strategies to overcome, short and long-term.
Eco-Industrial Park Feasibility Process

• Conceptualize proposed industrial facilities and specific EIP scenarios.

• Identify and profile actual and prospective anchor and ancillary enterprises.

• Conduct feasibility studies for eco-industrial park or cluster.

• Determine structure of networks for anchor and ancillary enterprises.

• Conduct supply chain analysis including market applications.
Eco-Industrial Park Feasibility Process

- Determine the alternatives for renewable energy generation.
- Create conceptual site designs including type and scale of facilities.
- Identify sustainable design guidelines for site and buildings.
- Determine opportunities for natural and engineered green infrastructure.
Identify champions, existing anchor enterprises and entrepreneurs

- potential core tenant eco-enterprises
- potential local business expansions
- independent entrepreneurs

Begin recruitment dialogue with interested parties

- emphasize eco-industrial advantages
- align local incentives and controls
- apply external incentives available

Integrate external stakeholders into recruitment dialogue

- state agencies and federal agencies
- local commercial banks and investors

Select anchor enterprises and market development program to support recruitment

- develop plan to address infrastructure needs
- review workforce requirements for anchor enterprises
- coordinate raw material supply systems
Identify existing ancillary enterprises and entrepreneurs
- qualify anchor tenants’ interest in ancillary enterprise development
- supply chain vendors
- independent entrepreneurs

Same recruitment process as anchor
- development parameters dependent on anchor businesses
Establish Incentives and Local Controls

Local Incentives

Identify incentives and align with EID program
- Tax incentives
- Resource efficiency
- Umbrella permitting for superior performance
- Access to community-based renewable energy
- Educational eco-efficiency business assistance

Local Controls

Identify local controls for EID
- Changes to building, zoning codes
- Codes and covenants attached to properties
- Changes to community comprehensive plan
- Explore potential for innovation in applicable state and local regulations
- Mandate superior performance guidelines for facilities and industrial processes
Develop Governing By-Laws

The By-Laws build upon the sustainability goals and objectives set forth in community comprehensive plan.

The principles of sustainability are woven into the By-Laws through:

- zoning, density, dimensional requirements
- floodplain, water resource, historic district
- signage and wetland protection provisions
Determine Role and Structure of EIP Administration

Managerial
  • enforce covenants, decide on new companies, collect rents and assure taxes and charges are paid, responsible for maintenance and order on the estate

Technical
  • responsible for common facilities, training and technical services

Financial
  • oversees loans to estate tenants, arrange for cooperative purchasing agreements for materials
EIP Management Tools

Codes & Covenants
  • Standard operating procedure for EID in USA

Design Guidelines
  • Drive down operating costs & environmental impacts
  • Protect businesses’ investment in their facility

Environmental Impact Assessment

Continuous Improvement models
EIP Management Tools

Financial Decision-making Tools
  • Project financing, Return on Investment, Discounted Cash Flow, Return on Assets/Equity, Full Cost Accounting

Recognize & engage local resources
  • Tenant firms & parent companies
  • Government agencies
  • Universities

Market-based Standards
Develop Guidelines for Eco-park

Assess existing local environmental conditions and issues.

Develop environmental management performance objectives.

Develop plan for environmental management systems and projects.

Implement environmental management projects.

- EIP initiatives
- Bilateral initiatives
- Company initiatives (internal)
Develop Plan for Operations

Base environmental management system on ISO 14001 or similar standards for facility operations.

Form a tenants’ association or other coordinative mechanism to oversee the EMS on two different levels:

- The parks’ environmental impact
- Cooperative links between individual firms to encourage EMS application
Key Lessons

- Eco-Industrial Development takes time and requires a paradigm shift in the way we currently approach industrial development.

- New planning, design, business, and community development models and approaches are necessary.

- Opportunities are emerging and communities are exploring EID via green industrial parks, green manufacturing, and other green economy initiatives.

- There must be a continuum lead by champions followed by early adopters.

- Barriers abound; institutional, existing policies, human resistance to change, lack of resources, and main stream business drivers.

- It takes cross-jurisdictional collaboration to be successful.

- Resources from multiple public and private organizations are necessary.