Eco-industrial Park Performance Standards and Indicators and the Circular Economy

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Eco-industrial parks

“A community of businesses that cooperate with each other and with the local community to efficiently share resources (information, materials, water, energy, infrastructure and the local habitat) leading to economic gains, gains in environmental quality, and equitable enhancement of human resources for the business and local community.” (PCSD, 1996)

Some key characteristics:
- planning with the ecological capacity of the area in mind;
- energy production based increasingly on renewable resources;
- buildings designed and built to optimize conservation of materials and energy;
- industries selected based in part on their compatibility for symbiosis;
- webs of businesses involving producers and consumers, scavengers and decomposers;
- redundancy in material sources built into the structure of the system;
- water and wastewater infrastructure that recovers and reuses;
- information management system which facilitates networking;

(Cote and Cohen-Rosenthal, 1997)
Are there different kinds of EIPs?

- Virtual eco-industrial parks?
- Regional industrial symbioses?
- Recycling business cluster?
- A park with environmentally friendly infrastructure?
Eco-industrial parks around the world
Eco-industrial park characteristics

- Efficient sharing of resources: symbiosis but what else?
- Economic gains: financial benefits to businesses, to local community?
- Gains in environmental quality: air quality, water use and reuse? Solid waste reduction and recycling?
- Equitable enhancement of human resources for business: risk reduction? employee engagement?
- Equitable enhancement of human resources for the community: long term jobs? education and training?
  - Based on Chertow, 2003
An industrial food web

Burnside Industrial Park: An Industrial “Food” Web

- Construction and Demolition Debris Recycling
- Renovators Resource
- Happy Harry's Used Building Materials
- Office Building
- Office Building
- Rental Unit
- Rental Unit
- Warehouse
- Warehouse
- Construction Company
- Construction Company
- Construction Company
- Construction Company
- Supplier
- Supplier
- Distributor
- Distributor
- Building Product Manufacturer
- Building Product Manufacturer
- Building Product Manufacturer
Ecosystem model: Circular economy?
Standards and indicators

- Standards, goals, criteria
  - nature of the performance expected

- Indicators, metrics, targets
  - status or level of performance
Performance standards and indicators

- Port of Cape Charles, Virginia
- Koenig’s criteria for Thai EIPs (proposed)
- Devens EcoStar criteria
- Chinese EIP standard
- LEED standard for new developments
Port of Cape Charles
Sustainability guidelines and criteria, 1996

- Basic requirements included noise limitations, waste management with 3Rs, energy efficiency, emergency preparedness, employee benefits.
- Additional social requirements included local residency of employees, support for vocational training, percentage of services from within region, percentage of input materials and products from within region, community service activities.
- Additional environmental requirements included inventory system for materials and wastes, percentage use of recycled materials or products, percentage use of by-products from other industries by a tenant, percentage use of a tenant’s by-products by other industries.
Koenig’s proposed criteria for Thai EIPs

- **Minimum criteria I** include an Environmental vision & policy; Compliance to standards/Regulations; Efficient resource use/Recycling cooperation with surrounding community; Preventive maintenance; Waste/Emission reduction

- **Minimum criteria II** include Emergency response Plan; Integrated waste water treatment central management of estate with Information center; Networking with stakeholders; Monitoring/Public Reporting

- **Advanced criteria** include Synergies (BPX, heat, wastewater, etc); Green Products & services; Transportation efficiencies; Educational eco-center; Green/Sustainable infrastructure design
Devens Regional Enterprise Zone (EIP)

The Devens Sustainability Framework addresses:

- Economic and business sustainability
- Social matters
- Governance
- Public health
- Transportation
- Natural resources
- Environmental quality

This framework is supported by a number of goals, and in turn the goals are supported by indicators.
Economic and Business Sustainability
(Economic gains)

This category has a number of goals:

- Attraction and retention of companies within the carrying capacity
- Maintain unemployment rate below Mass. Average
- Increase in number of jobs especially high paying jobs
- Increase in participation in EEC events
- Increase in firms that purchase collaboratively, share equipment or personnel
Devens indicators

- Attraction and retention: number of companies and non-profit organizations
- Unemployment: Rate compared to Mass. Average
- Jobs: number of jobs / employees; annual mean wage vs Mass. Average
- Participation: Percent of organizations involved with EEC
- Purchasing and sharing: Percent of firms that do joint purchasing or share.
Chinese EIP standard

➢ The Chinese standards were developed pursuant to a national guidance document released in 2003.
➢ The actual standards were promulgated in 2006.
Chinese EIP standard for resource recovery parks

The criteria include:

- Contribution of recovery and recycling industries to the total; added industrial value of the park (%)
- Total amount of treated wastes (tons/year)
- Recovery rate of appliance, vehicles, tires, plastics
- Disposal rate of hazardous wastes (%)
- Wastewater effluent per added industrial value (tons/10000Y)
- Provision of common treatment facilities
- Area of park in green space
- Information platform
- Release of environmental report

Note that the criteria for sector and integrated sector parks focus much more on eco-efficiency eg reductions per unit of production or GDP.
LEED Standard for Neighborhood Development

Location
Ecological community conservation
Wetland and waterbody conservation
Floodplain avoidance
Brownfield remediation
Reduced parking footprint
Access to public transit
Housing proximity
Compact development
Connected community

Access to public space
Community outreach
Energy use reduction
Water use reduction
Pollution prevention
Stormwater management
District heating and cooling
Solid waste management
Assessment

1) Practitioners and researchers have some options to work with.
2) Standards and indicators have been confused in some instances.
3) The majority of the “standards” are more or less comprehensive, involving much more than symbiosis. Several are quite specific.
4) Some of the sets of indicators address environmental, economic and social aspects as one might expect when discussing sustainability.
5) The majority of “standards” and indicators target the individual tenant rather than the park or development as a whole.
Assessment

6) Many of the indicators are designed for quantification.

7) Other than the LEED standard, none have developed any international acceptance.

8) One set, the Cape Charles criteria has never been implemented although it has some very interesting but challenging characteristics.

9) The Chinese standard has the potential to be applied to a large number of parks, but at this time only in China. Arguably they are largely eco-efficiency oriented.
Performance standards (eco-criteria)

- Energy efficiency
- Renewable energy sources
- Waste management
- Water management
- Material / chemical flow
- Biodiversity
- Mobility, transportation
- Land use
- Air pollution prevention
- Noise prevention
- Environmental management systems
- Cultural, social, health and safety

Massard et al., 2014
Performance standards

Other “criteria” might include:

- Governance
- Information sharing
- Diversity
- Connectance
- etc?
### Examples of indicators from the literature

- Long term vision
- Ecological capacity and ecological footprint

- Water and land carrying capacity
- Wastewater treatment capacity
- Green transportation design
- Energy consumption per unit of production value

- Environmental reporting
- Environmental management systems
- Job creation

- Industrial value added per unit area
- Solid waste reuse ratio

- Recycling rate of industrial wastewater
- Waste and by-product utilization

- Connectance
- Emergy index
Where do we go from here?

- There is confusion in the research and practice communities regarding the definition of EIPs and whether a standard is needed.
- Ecological aspects should predominate but include economic and social aspects.
- Circularity of materials and energy should be an important aspect of an EIP.
- The community of industrial ecologists could be helpful in coming forward with an international standard that would assist in defining an eco-industrial park.
- A group composed of representatives from several interested countries could be brought together, perhaps under the auspices of the ISIE.
- The group should include several disciplines including planners, designers, engineers, ecologists.
Some questions to consider

Given the diversity of reported eco-industrial parks, would a standard or set of criteria be helpful?

- If yes, should these be minimum or comprehensive standards?
- Should standards be supported by indicators?
- If yes, should a suite of indicators be developed allowing for national flexibility?
- What do you think?
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Bibliography and References


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