

Eco-Efficiency in Eco-Industrial Parks

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Basic concepts

- Eco-efficiency
 - Environmental impact per unit of value created
- Eco-industrial parks
 - geographical proximate companies
 - interconnected via integrated use of by-product/waste material or energy
 - forming a synergistic industrial network

Indicators for EIP

- indicators on environmental management
- indicators on economical benefits
- indicators on resource and energy consumption
- indicators on environmental impact

Chinese EE-oriented EIP standards

- Chinese State Environmental Protection Agency, June 2006
 - criteria
 - indicators
 - requirements
- Example: Standard for sector-integrated Eco-industrial Parks

Items	Indicators	Unit	Required value
Economic development	industrial value added	ten thousand yuan/person	≥ 15
	increased rate of added industrial value		$\geq 25\%$
Material reduction and recycling	total energy consumption per unit of industrial added value	ton of tce/ten thousand yuan	≤ 0.5
	fresh water consumption per unit of industrial added value	m ³ /ten thousand yuan	≤ 9
	waste water production per unit of industrial added value	t/ten thousand yuan	≤ 8
	solid waste production per unit of industrial added value	t/ten thousand yuan	≤ 0.1
	repeated using rate of industrial water		$\geq 75\%$
	integrated use of solid industrial wastes		$\geq 85\%$
	the rate of reused water		$\geq 40\%$
Pollution control	COD and SO ₂ output per unit of industrial added value		≤ 1
	output per unit of industrial added value		≤ 1
	Rate of dangerous waste treatment		100%
	Concentrate disposal rate of domestic wastewater		$\geq 70\%$
		

Evaluation of the EE of EIPs in literature

- energy analysis, AHP and linear weighting
 - evaluation system, including index, weights and formula
- carrying capacity analysis
 - eco-efficiency of EIP and its sustainable development
- energy value-MFA
 - EE evaluation method and modeling and indicators, the EE's "up on the multi-peak" in EIPs development
- TOPSIS (Technique for Order Preference by Similarity

EIP development is still at an early stage

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- Netherlands

- only a limited number of local projects actually designed to bring about symbiosis and utility sharing

- USA

- key features of EIPs, like inter-firm networking and collaboration of materials and energy absent or at early planning stage

- South Korea

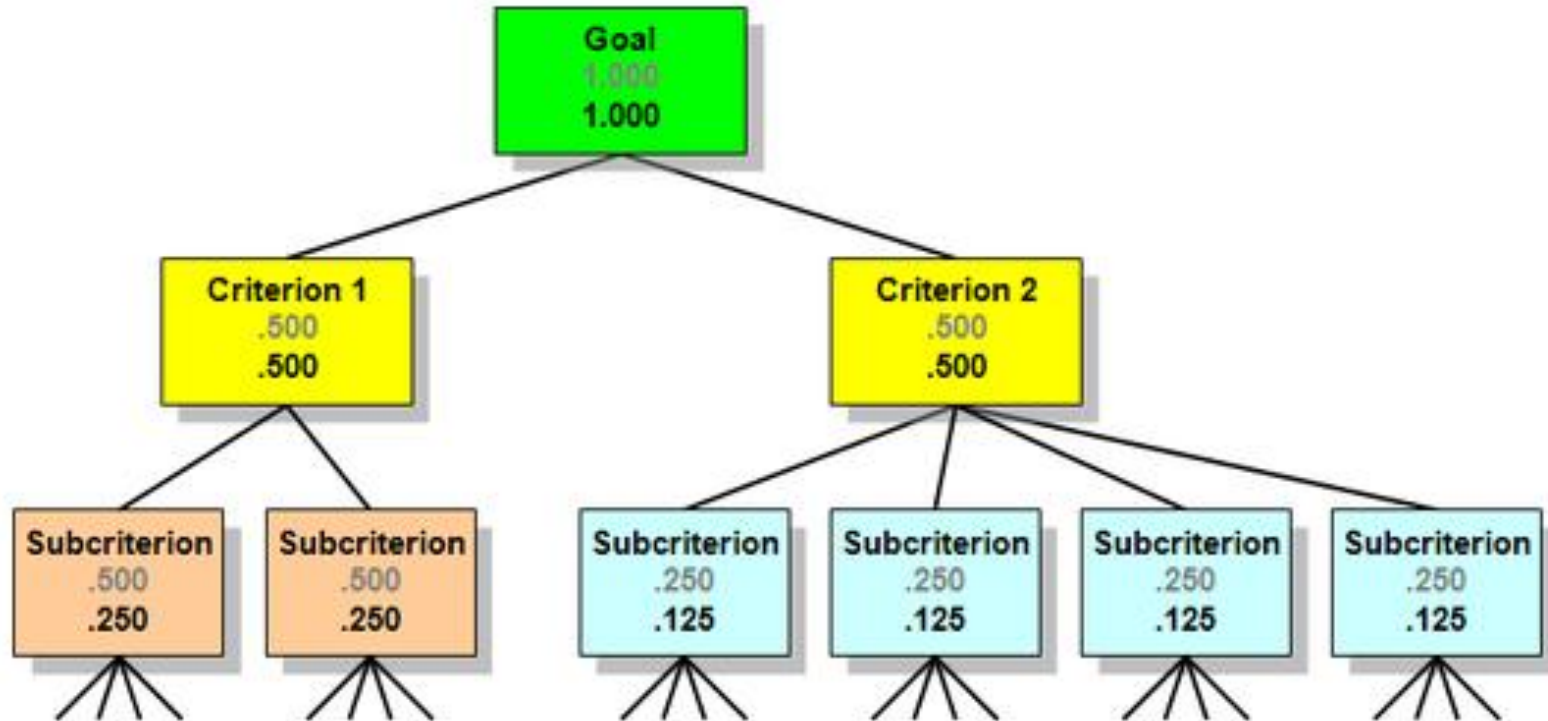
- project unsuccessfully deals with the needs of the stakeholders because of obstacles and insufficient public support

- ...

Analysis of key features of EIP

- What are the key feature of successful EIP?
- Analytic Hierarchy Process (AHP)
 - AHP is a structured technique for dealing with complex decisions
 - Rather than prescribing a "correct" decision, the AHP helps the decision makers find the one that best suits their needs and their understanding of the problem

Hierarchy of criteria in AHP



Scoring of criteria in AHP

The Fundamental Scale for Pairwise Comparisons		
Intensity of Importance	Definition	Explanation
1	Equal importance	Two elements contribute equally to the objective
3	Moderate importance	Experience and judgment slightly favor one element over another
5	Strong importance	Experience and judgment strongly favor one element over another
7	Very strong importance	One element is favored very strongly over another; its dominance is demonstrated in practice
9	Extreme importance	The evidence favoring one element over another is of the highest possible order of affirmation
Intensities of 2, 4, 6, and 8 can be used to express intermediate values. Intensities 1.1, 1.2, 1.3, etc. can be used for elements that are very close in importance.		

Analysis of performance of EIPs

- EE is just one aspect
- life cycle perspective
- role of LCA, LCC, MFA, ...
- global vs. local impacts
- value created vs. other economic impacts
- social impacts
- stability

Stability of EIP

- We should not go to extremes to pursue EE in developing industrial ecosystems but also consider the stability (or resilience) of the system
- This could be enhanced by diversity, and flexibility and reserve capacity although this sometimes may be inefficient
- There is a conflict between EE and stable EIP

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- please check at cml.leiden.edu