Industrial Symbiosis
(Eco Industrial Cluster)

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Industrial symbioses (ISs) and eco-industrial parks (EIPs) are key concepts of industrial ecology (IE).
Concept of an Eco-Industrial Park

Protection of Environment Through Pollution Reduction

Increase Business Success
Shift in Thinking...

- We think, the earth is a source of infinite resources
- We think, the earth has an excellent digestion system
- We think, the earth can assimilate anything and everything that we throw
- But, we need to look at the environment as an exhaustible resource and at the earth as a self-organizing system

The solution lies in

- Better positioning ourselves in nature’s supply chain
- Transforming our industrial systems and processes to adopt sustainable patterns
- Shifting our cultures and values towards sustainable development
Sustainable Manufacturing Systems Approach

**Cleaner Production**

**Industrial Ecology**

**MICRO** → **MACRO**
Industrial Symbiosis

• Industrial symbiosis is the sharing of services, utility, and by-product resources among industries.

• Industrial symbiosis focuses on material and energy exchange for resource efficiency in a closed cycle.

• Eco-industrial cluster development is one of the practical case of industrial symbiosis.

• Some common features of industrial cluster are;
  • centralized waste and wastewater treatment plant
  • Waste exchange (one industry’s by-product residual is another industry’s resource/raw material/energy source)
Eco Industrial Cluster for Upstream Resource Efficiency

- Eco-Industrial Cluster formation is one of the strategies to implement the concept of industrial ecology by inter-company collaboration.
- Waste of one company can be utilized by another company to increase the resource conservation which results in “Upstream Resource Efficiency” and “better environmental performance.”
- Inter-firm connectedness works collectively to fight the pollution through waste exchange, technology sharing, or common waste treatment plants, etc.

Introducing new industries and developing eco-industrial clusters will generate environment, social and economic benefits.
What are Industry Clusters?

- Industry clusters are more than a group of companies in the same industry.
- It's a geographical proximate group of interconnected companies with associated institutions in a particular specialization - all linked by networks.

- Most well known clusters
  - Movie makers of Hollywood
  - Computer Makers of Silicon Valley
  - Financial Services in Switzerland
  - Car Manufacturers of Detroit
  - California Wine Cluster
How Clusters Form?

• Clusters form around inputs and outputs - where these items involve transportation costs, then locating in close proximity reduces costs.

• Example, Detroit car manufacturing was based on the proximity to US steel mills plus the availability of cheap electricity.
How Clusters Form?

- Clusters can also form around proximity to information. Where companies deal in the same type of knowledge, they can maximize their access to that knowledge base by locating in the same city.
Movie Makers of Hollywood
Movie Makers of Hollywood

- CBS Studio Center
- Universal Studios
- Warner Bros
- Disney Studios
- NBC Universal Inc
- Directors Guild of America
- International Alliance of Theatrical Stage Employees (IATSE)
- Creative Artists Agency
- Writers Guild of America, West
- Paramount Pictures
- Sony Pictures Entertainment
- Screen Actors Guild
- Twentieth Century Fox Film Corporation
High-Tech Manufacturing In Silicon Valley

- It is home to many of the world's largest technology corporations as well as thousands of small startups.
- Term originally referred to the region's large number of silicon chip innovators and manufacturers.
- Biggest high-tech manufacturing center in the United States
Computer Makers of Silicon Valley
California Wine Cluster

Grape Making Companies

Wine Making Companies

California Wine Cluster
California Wine Cluster

- Grape Stock
- Fertilizer, Pesticides, Herbicides
- Grape Harvesting Equipment
- Irrigation Technology
- California Agricultural Cluster

Growsers/Vineyards

State Government Agencies (Select Committee on Wine Production and Economy)

Wineries Processing Facilities

Educational, Research & Trade Organizations

- Wine Making Equipment
- Barrels
- Bottles
- Caps and Corks
- Labels
- Public Relations and Advertising
- Specialized Publications (Trade Journals)

- Tourism Cluster

- Food Cluster
## Eco Industrial Cluster Approach to Dealing with Pollution

<table>
<thead>
<tr>
<th>Individual firm approach to pollution control</th>
<th>Industrial Cluster approach to pollution control</th>
</tr>
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<tbody>
<tr>
<td>• Pollution volume is less and the tendency of ignorance is higher.</td>
<td>• Larger pollution volume hence ignorance is not possible. Pollution control measures are deployed.</td>
</tr>
<tr>
<td>• Pollution abatement is done to comply with administrative requirements. Minimum pollution standards are met; hence there are no opportunities for innovation and furthering zero waste policies.</td>
<td>• Pollution abatement is practiced beyond the level necessary to meet national pollution standards; innovations are put into practice to achieve zero waste policies.</td>
</tr>
<tr>
<td>• End of Pipe (EoP) is practiced to deal with waste already produced.</td>
<td>• Upstream resource utilization is targeted to reduce pollution output. 3R and CPs are the strategies applied.</td>
</tr>
<tr>
<td>• Cost of pollution abatement is higher as only one industry is responsible for investing in equipment and technologies. Thus the chances of buying low cost and low efficiency equipment are high.</td>
<td>• Cost of pollution abatement is shared among the clusters and hence the cost becomes lower. Innovative and high-tech equipment can be installed favoring technology advancement.</td>
</tr>
<tr>
<td>• Small and scattered industries make it difficult for the national/local administration difficult to monitor the pollution control activities; hence it acts as a loophole, whereby industries try to avoid environmental compliance.</td>
<td>• Clusters make it easy for the policy control administration to monitor environmental performance compliance.</td>
</tr>
</tbody>
</table>
Chronological Developments

1960
Tisso water

1961
Asnæs Power Station

1961
Municipality of Kalundborg

1961
Veedol Refinery

1962
Gyproc, Novo Industries

1972
Cement Industry

1972
Fish farm

1972
Statoil refinery

1976
Gyproc, Novo Industries

1979
Veedol Refinery

1980
Farm

1982
Cement Industry

1982
Fish farm

1982
Statoil refinery

1983
Gyproc, Novo Industries

1989
Farm

1990
Statoil refinery

1993
Pig farm

1993
Fertilizer Industry

1993
Wastewater Treatment

1993
Reuse Basin

1995
Solitren

1996
Recovery of Nickel and vanadium

1996
Collaboration with Noveren

1998
Soilrem

1998
Recovery of Nickel and vanadium

1998
Purification of water

2000
Collaboration with Noveren

2004
Statoil refinery

2004
Purification of water

1962
Asnæs Power Station

1979
Veedol Refinery

1982
Gyproc, Novo Industries

1983
Farm

1993
Wastewater Treatment

1993
Reuse Basin

1995
Solitren

1998
Soilrem

2000
Collaboration with Noveren

2004
Purification of water

The Symbiosis Institute

Courtesy: Jørgen Christensen

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named "Industrial Symbiosis"

C. Visvanathan

Industrial Symbiosis
Eco-towns for Downstream Waste Recycling

- Eco Towns are usually a cluster of material recycling and waste treatment industries
- The goal of the “Eco-Town Project” is to create a recycling-orientated society
- Also called as “Recycling park”
Eco-Towns in Japan

- Asia’s International Material Recycling and Environmental Industrial Base

- Approved by Central government in 1997

- First stage: FY1997–2002: focus on RECYCLE
Kitakyushu Eco-town
Policy Measures for Industrial Symbiosis

- Policy is the most important tool for improving environmental performance

- Industrial Symbiosis has direct relevance to a broad policy agenda covering innovation, green growth and economic development, in addition to the ‘traditional’ resource efficiency

- Policies insisting the development of inter-firm networks material, product and by product exchanges

- Government should act as a major promoter and stakeholder bringing together industry clusters
Key features of Successful Industrial Symbiosis

• Strong legislation, shifting the market towards a sound material-cycle society

• Increasing product research and development - in both public and private sectors, including universities

• Large and rapidly expanding eco-business market, domestically and internationally

• Strong focus on environmental technologies and ESTs, and innovative/cutting-edge solutions to solve environmental problems

• Focus on energy conservation, material development and integrated waste management
Planning Eco Industrial Cluster

- Policy amendments
- Introduction of new technologies
- Formalizing the informal sector activities
- Investment capital
- Remove end-of-pipe mentality
- Trust among industrial partners
- Inter-firm network, commitment and geographical proximity

4 major sources of productivity gains from eco-industrial clusters

(i) the effective use of raw and waste materials
(ii) access to knowledge and technology
(iii) employment generation
(iv) complementary eco-product development

…. influence the EIC formation and transformation

✓ Government and industries should take the leadership for EIC formation
✓ Other stakeholders like academia, researches, policy makers, public, etc. should also work together
Conclusion

• Networking is important - what, where, when, how
• No generic rule - depends on the context
• Industrial symbiosis occurs usually in 2 forms
  o Eco Industrial Cluster/Park: in the upstream production
  o Eco-Town: in the downstream waste handling sector/ recycling Based Industries.
• Synergy/Inter-firm network/business proximity - is a key to success of industrial symbiosis
• Geographical Proximity is another factor for successful industrial symbiosis
• Industrial Symbiosis ensures the “now and in the long-term” sustainability
Conclusion

Eco-Industrial Development is...

a journey ... not a Destination!
Thank You!