Planning Industrial Ecology:
Creation of a toolkit for the implementation of sustainable business practices in Greenville County, SC

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Outline

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• Industrial Ecology in Practice
• Research Aims and Methods
• Study Area: Greenville County
• Case Studies
• Case Study Analysis
• Applying the Knowledge to Greenville
• Regional Implications
The Problem

- Waste accumulation
- Energy consumption
- Pollution (water, air, etc…)
- Site development practices
- Linear production process
What is Industrial Ecology?

- Frosch and Gallopoulos (Scientific American 1989)
  “Create the least damage within industrial and ecological systems through the optimal circulation of materials and wastes”

- Updated definition of Industrial Ecology (Lowe)
  “Industrial Ecology is a dynamic systems-based framework that enables management of human activity on a sustainable basis by:
  - Minimizing energy and materials usage
  - Ensuring acceptable quality of life for people
  - Minimizing the ecological impact of human activity to levels natural systems can sustain
  - Conserving and restoring ecosystem health and maintaining biodiversity
  - Maintaining the economic viability of systems for industry, trade and commerce”
Industrial Ecology in Practice

• Common applications
  o Eco-industrial parks
  o Regional networks
  o Intra-firm strategies

• Examples around the world
  o Europe
  o Asia
  o Australia
  o North America
Industrial Ecology Benefits

• Provided by Ernest Lowe on his Indigo Development consulting webpage

  o Creation of common ground for all community stakeholders to plan effective change
  o Increased efficiency of energy and resource use
  o Increased competitiveness for businesses
  o Ability to target highest risks and opportunities for greatest improvement
  o Decreased pollution and damage to the health of citizens and the environment
  o Opening of new local businesses and job development opportunities
  o Revitalization of existing industries
  o Improvements in the efficiency and extension of the life of municipal infrastructure systems
  o Restoration of the viability of local ecosystems
Research Aims and Methods

• Research Questions

1. Why is industrial ecology pursued at the regional level? (motivation)
2. Who are the relevant stakeholders and how do they contribute to industrial ecology? (stakeholder and function)
3. How is networking between stakeholders accomplished? (relationship)
4. How are industrial ecology efforts measured and assessed? (assessment)

• These questions drove the case study data collection and formation of the Greenville County toolkit
Research Aims and Methods

• Research and data collection
  o Case study data sheet – incorporation of embedded units of analysis
  o Data collection through print, web, and interview

• Evaluation and comparative analysis
  o Trend analysis and pattern matching
  o Incorporation of qualitative data
  o Scoping for Greenville County and existing market analysis
Study Area: Greenville County

WHY?

- Existing sustainability efforts
- Diverse business market
- Leading position in the regional economy
- Existing business leaders
- Preference for strong central government structure
- Need for pollution prevention and best practices
Case Studies

- Pearson Eco-Business Zone (Toronto, Ontario, CAN)
- Devens Eco-Industrial Development (Devens, MA)
- Kansas City By-Product Synergy Project
- Ohio By-Product Synergy Project (Columbus, OH)
Pearson Eco-Business Zone

- Program is managed by Partners in Project Green
- Key motivations were cost savings, relationship building, sustainability, and business development
- Strong project management and diverse stakeholder involvement has strengthened impact
- Functions are managed through divisional allocation
- Assessment and Evaluation is playing a growing role in maturation and marketing
Pearson Eco-Business Zone

• Projects and Applications
  o Building performance program and Sustainable Energy Plan
  o Seminars and education
  o Green Parking Lot and Employment Land Planting programs
  o Expert assistance and training programs
  o By-product networking
Devens Eco-Industrial Development

- Project is overseen by DEC and MassDevelopment
- Key motivations were sustainable development, resource conservation, economic development, and quality of life
- Project has secured strong business investment and commitment to sustainability regulations
- Functions are supported by the Eco-efficiency Center
- EcoStar program provides business assessment
Devens Eco-Industrial Development

• Projects and Applications
  o Unified development permit
  o R&D partnerships
  o Ecostar program and EcoStar Achiever status
  o Devens recycling center
  o Low impact development
Kansas City By-Product Synergy

- Project is managed by Bridging the Gap with assistance from USBCSD and Franklin Associates
- Key motivations were cost savings, resource conservation, waste management, and sustainability
- Project has secured strong business partners
- New software development has aided LCA tracking

**Stakeholders**

The charter member of the KC BPS project:

- City of Kansas City, MO
- Cook Composites and Polymers (CCP)
- Gerdau Ameristeel
- Hallmark Cards, Inc
- Harley-Davidson Motor Company
- Jackson County, MO
- Johnson County, KS
- Kansas Power and Light
- Lafarge Corp Cement Group
- Little Blue Valley Sewage District
- Missouri Organic Recycling
- Systech Corporation
Kansas City By-Product Synergy

• Projects and Applications
  o By-product synergy relationships
  o Mitigation Statistics
Ohio By-Product Synergy

- Project is managed by The OSU Center for Resilience with assistance from USBCSD and MORPC
- Key motivations were cost savings, resource conservation, waste management, and sustainability
- Project has strong early partners
- Innovation is spearheaded by OSU analysis

Stakeholders

The current participants of the Ohio BPS project:

- Honda of America Manufacturing
- Marathon Oil
- Barnes Nursery
- Battelle
- Belden Brick Company
- Cemex
- City of Columbus
- Cytec Industries
- Fairmount Minerals
- Imperial Aluminum
- Kurtz Bros.
- Kahiki
- Proctor & Gamble
- The OSU University
- United McGill
- Veolia Environmental Services
- Worthington Industries
Ohio City By-Product Synergy

- Projects and Applications
  - By-product synergy relationships
  - Eco-LCA Assessment Tool
  - T-21 Ohio
Case Study Analysis

• Analysis was organized based on the units of analysis from the Research Questions
  1. Why is industrial ecology pursued at the regional level? (motivation)
  2. Who are the relevant stakeholders and how do they contribute to industrial ecology? (stakeholder and function)
  3. How is networking between stakeholders accomplished? (relationship)
  4. How are industrial ecology efforts measured and assessed? (assessment)

• Patterns and trends from the case studies were extracted in order to formulate answers to the questions
• These findings were applied to Greenville County
Case Study Analysis

• Motivation
  o Economics
  o Resource Management
  o Sustainability
  o Environment
  o Energy Conservation

• Barrier Mitigation
  o Well Documented Work
  o Clear and Available Communication Pathways
  o Multi-Stakeholder Involvement
  o Strong Champion Stakeholders

• Stakeholder Involvement
  o Holistic Representation
  o Government Support
  o Strong Management
Case Study Analysis

• Functions
  o Resource and Waste Management
  o Buildings and Site Design
  o Transportation and Infrastructure
  o Communications
  o Energy Production and Distribution
  o Research and Development
  o Management and Marketing

• Relationships
  o Energy Cascade
  o Transportation
  o Waste Processing
  o Material Exchange
  o R & D
  o Physical (co-location)
  o Virtual (data, IT)
  o Shipping and Distribution
  o Purchasing and Financial
  o Knowledge
Case Study Analysis

• Assessment and Evaluation

Diagram:
- Dynamic Process
- Project or Initiative
- Data Collection
- Application to new Analysis and Presentation
Applying the Knowledge to Greenville

- Motivation and Project Startup
- Stakeholder Involvement
- Functions and Relationships
- Assessment and Evaluation
- Projects and Applications
Motivation

• Sustainability
• Economic
• Environmental
• Resource Management
• Energy Conservation

Sustainability Motivations
1. Development of a “Green” image and marketing campaign
2. Improved quality of life
3. Integrated long term planning and land use
4. New vehicle of change for continual integration and expansion of sustainable business practices
Project Startup

Step 1: Interest Building

Step 2: Feasibility Study

Step 3: Steering Committee

Step 4: Strategic Plan

Step 5: Member Recruitment
Stakeholder Involvement

• Key Stakeholder Groups
  o Businesses
  o Academia
  o Citizens
  o Developer/Construction
  o Economic Developer
  o Financial Institution
  o Non-Profits
  o Planner
  o Transportation Agency
  o Utilities
  o Government
  o Management Group

South Carolina State Departments
  • Department of Commerce
  • Department of Health and Environmental Control
  • Department of Natural Resources
  • Department of Transportation
  • Materials Management Office
  • SC Energy Office

Materials Management Office
The Materials Management Office demonstrates industrial ecology actions through their green purchasing initiative. Knowledge is made available to educate consumers as to the minimum material content and recipe for certain common items to be termed green and they have compiled a list of suggestions on how to spot fake green items. Even more, the office developed the environmental purchasing policy and a checklist guide to ensure that government entities are making smart purchasing decisions.
Stakeholder Involvement

• Other Key Stakeholder Groups
  o Designers/Engineers
  o Solid Waste Management
  o Consultants
  o Re-industries

Ever-Green Recycling is a commercial recycling service. They provide recycling program development and collection services to small and large companies. Their ability to coordinate with multiple firms and provide functions that attract interest across sectors alludes to a strong foundational partner for industrial ecology integration. This company’s approach devises an external plan for material cycling, and helps companies develop greener waste management plans and more sustainable practices.
Functions and Relationships

- **Functions**
  - Seven theme categories
- **Relationships**
  - Ten IE relationship classes

**Resource and Waste Management**

**Project Summary**
With a focus on local foods, Greenville County could launch a pilot program in a municipality or district to collect fruit and veggie waste from local restaurants and food stores. This waste would be placed in a central location for compost development with the intention of providing growth media for local community gardens. This type of pathway could also be implemented in an institutional setting, such as St. Francis Hospital.

**Stakeholder Groups**
- Restaurant/Food Store (Bus.)
- Chamber of Commerce (ED)
- Solid Waste Division (Govt.)
- Citizens
- Management
- Compost Facility
- St. Francis Hospital (Bus.)

**Networking Diagram**

[Diagram showing relationships and processes involving St. Francis Food Preparation, Chamber of Commerce, Solid Waste Division, Restaurants and Food Stores, In-House Compost Facility, Knowledge and Marketing, Data Collection and Funding, Compost Facility, Community Gardens, and Community Garden Participants.]
Functions and Relationships

Management and Marketing

Project Summary
One of the biggest responsibilities in management and marketing is relationship building and stakeholder interaction. One of the most common ways to stimulate interaction is to have a networking event. The networking event could be industry specific or more general, but the ultimate goal is to facilitate a synergistic environment. This example looks at more general networking event showing potential linkage opportunity.

Relationships
- Knowledge
- Research and Development
- Material Exchange
- Purchasing and Financial
- Virtual
- Shipping and Distribution

Stakeholder Groups
- Businesses
- Academia
- Management Stakeholder
- Economic Developer
- Utilities
- Government
- Consultants

Networking Diagram

[Image of networking diagram with nodes and arrows indicating relationships between different stakeholders such as Management, Stakeholder, Economic Developer, Government, Business, Utilities, Academic Institution, Knowledge and Providers, Consultants, Business, Energy Funding R & D, and Manufacturing.]
Assessment and Evaluation

• **Keys**
  - Summary of activities
  - List of project impacts
  - Analysis of current actions
  - Suggestions for future efforts

• **Methods**
  - Case studies
  - Software applications
  - Indicator-metric system
  - Social media
  - Annual report

**Other Indicator Systems**
- Compass Index on Sustainability
- FEEM Sustainability Index
- GRI Guide
- Eco-Efficiency Guide of the WBCSD
- EPA Report on the Environment
- The Balanced Scorecard
- The United Nations Commission for Sustainable Development Theme Indicator Framework
- Adapted version of Shannon-Weaver Index
Example Projects and Applications

**Small Manufacturing and Production Innovation Center**

**Project Summary**
This project has four main goals which are new business creation, product innovation, knowledge sharing, and building reuse/revitalization. The concept for this idea is derived from the NEXT Innovation center, but instead of focusing on service industries this incubator center would focus on innovative production, manufacturing, and research development. Multiple centers may be created and instead of building new, all developments would utilize existing or vacant facilities in the County.

**Short Term Objectives**
- Engage investors and entrepreneurs
- Investigate market to determine industry sector targets
- Recruit corporate partners from the region

The NEXT Innovation Center is working to facilitate high tech business and research development in Greenville. This project would work to facilitate creative professionals in developing, producing, marketing, and distributing tangible products. Different centers would take on a specific industry focus with some examples being food production, high tech manufacturing, biotech design, and biopharm production. In practice, these centers could build linkages to large corporations or academics through process partnerships.

**Mid Term Objectives**
- Select abandoned light industrial facility or vacant building(s)
- Determine areas of focus for industry sector(s)
- Put out a call for design and build new facility

From an economic and sustainable development standpoint, the use of vacant or abandoned facilities boost creative reuse efforts. Plus certain facilities may be inherently linked to certain business functions or sectors. A more urbanized building would work well for a food production incubator because of the potential for retail or display space. More than anything, the center(s) should invoke innovative design and be a show piece for the benefits of shared facilities, collaborative work environments, and creative class work ethic.

**Long Term Objectives**
- Develop marketing strategy
- Open facility under 1 and 2 year conditional leases
- Recruit businesses to build cluster effect and facilitate long term mixed use development

The NEXT Innovation Center has received accolades for its design, offerings, and partnerships, which would be remiss if not for effective marketing efforts. The website, market support, and publicity illustrate the advantages for business development and growth. Coupled with marketing is developing options and features that attract high quality tenants and continued business innovation. Even more, investors and designers need to envision the big picture and connect center functions to the surrounding spaces to grow as one.

**Motivations**
- Economics
- Sustainability
- Environment
- Resource Management
- Energy Conservation

**Stakeholder Groups**
- Management group
- Financial Institutions
- Government
- Businesses
- Non-profits
- Designers/Engineers
- Economic Developer
- Academia
- Developer/Construction

**Project Benefits**
- Business development
- Creative reuse of vacant and abandoned buildings
- Encourages sustainable design and development
- Innovative product creation
- Shared facilities – cost savings
- R&D partnerships

[Images of the NEXT Innovation Center showing various facilities and projects]
Example Projects and Applications

Sustainable Business Branding and Marketing Program

Project Summary
In practice, programs like this are being explored by the City of Greenville in order to increase energy conservation and recycling among businesses, which demonstrates one focus area of integration. In design, these branding programs work more effectively when they have a specific focus area that applies to a broad audience, however the program should also distinguish participants who are integrating sustainable practices across the board.

Short Term Objectives
- Evaluate market conditions to determine areas of greatest need for mitigation or support
- Partner with local businesses, who have regional, national, or international certification

Evaluating the existing market provides feedback into the type of focus areas that would be most effective or most needed based on market functions. Energy conservation, recycling, building design and construction, and environmental impact all represent viable focus areas for a branding system. With in the market, businesses have already gained acclaim for participating in programs like LEED and ISO 14000, so these businesses would be critical partners in the design of programs and the recruitment of project participants.

Mid Term Objectives
- Identify focus areas for pilot branding programs
- Identify candidate businesses
- Outline short term goals for recruitment and market impact
- Build evaluation measures

Working from the feasibility findings, certain focus areas were identified to be better suited for the Greenville County market. These focus areas will make up the pilot efforts. In designing the pilot programs, the local partners should be engaged to help identify businesses to launch and participate in the pilot programs. In parallel to the pilot actions, internal managers should be focused developing marketing strategies and incorporation of basic evaluation measures with a key attention to economic benefits.

Long Term Objectives
- Develop a marketing strategy for whole market participation
- Assess data and increase project efforts to support market needs
- Engage regional partners to increase marketing scope

After completing the pilot programs, successful efforts should be scaled, so as to engage the County business population. Moving dynamically with this expansion is the need for continuous evolution in project design and proposed offerings. The benefits of each program will help to illustrate which critical problem areas are not being addressed by the functional or organizational changes, so new designs can be adapted. In order to boost participation, regional expansion should be investigated so as to recruit strong regional leaders.

Motivations
- Sustainability
- Environment
- Economics
- Energy Conservation
- Resource Management

Stakeholder Groups
- Management group
- Designers/Engineers
- Government
- Businesses
- Non-profits
- Utilities
- Consultants
- Academia
- Citizens

Project Benefits
- Increased knowledge distribution and awareness of sustainability applications
- Mitigation of major environmental and health impacts
- Cost savings
- Energy usage reduction
- Green building and site design
Example Projects and Applications

**Six Application Groups**

- Solid waste and recycling
- Education and knowledge sharing
- Material and waste reuse
- Community relations and marketing
- Business development and workforce
- Material procurement

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**Industrial Ecology Cost Savings Booklet**

**Objectives and Summary**

- Inform local businesses of cost saving functions
- Display organizations, who have implemented cost saving industrial ecology applications
- Stress industrial ecology’s economic value

This application is geared toward the economically driven stakeholders, which some people may indicate as everyone; however, that statement would be brash. One of the largest motivations for industrial ecology participation is cost savings and marketing the pathways to saving and the functions that save the most money will really catch investors’ attention. Engaging the fiscal motivation is the best way to invoke more immediate action, and once stakeholders are acting then new directives and holistic aims may be further applied.

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**Sustainable Production Education**

**Objectives and Summary**

- Identify and partner with green producers and sustainable production companies in the market
- Create knowledge tools and pathways to better educate the larger market on sustainable production processes

So much of the initial work in creating industrial ecosystems depends on the spread of information and general saturation of knowledge. Understanding how industrial ecology or sustainability applies to a given sector and even more having the opportunity to see it in action is critical to developing a large dissemination of green practices. This application utilizes peer relationships in a non-competitive environment with the understanding that everyone is working to better the Greenville County market and their collective living environment.

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**Industrial Ecology Lecture Series**

**Objectives and Summary**

- Create regular educational and knowledge sharing events
- Infuse industrial ecology knowledge and application from other markets into Greenville County
- Exemplify expert processes

An industrial ecology lecture series represents a commitment toward change and a willingness to embrace the experience and knowledge of other organizations. Furman’s post-graduate sustainability programs represent a perfect sponsor or contact for a broader focus lecture series. Utilizing existing groups and meetings within the Commerce structure would provide pre-existing industry sector focus groups that could be combined to better engage a lecture series with more specific application. Overall, the goal is knowledge expansion and linkage.
Regional Implications

- Knowledge Dissemination
- Networking Events
- BPS Linkages
- “Building a Sustainable Upstate”
Conclusion

- Industrial ecology requires strong management representatives, significant government support, and diverse stakeholder involvement
- Planning professionals have the potential to serve a critical role in development and implementation
- Industrial ecology applications should have a long term goal of being business driven
- Industrial ecology is a viable concept for integration into Greenville County