

# Eco-Industrial Development

## The Minnesota Experience

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Minnesota Pollution Control Agency

# 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
- 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.

# Eco-Industrial Development

Applies Advanced Environmental Strategies

- Industrial symbiosis and byproduct exchanges
- Eco-parks or clusters
- Clean renewable energy and sustainable materials
- Closed loop water and waste recovery systems
- Clean production and eco-efficiency
- Green chemistry and design for the environment
- Zero waste and emissions
- Greening supply chains
- Eco-enterprises and 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.

Embraces  
Industrial  
Transformation

Rethinks  
development  
paradigms

Establishes  
intentional  
design

Applies  
industrial  
ecology models



# Eco-Industrial Development

## Can take many forms

- Network of co-located businesses
- Energy, technology, agricultural, other cluster drivers
- Brownfields or greenfields
- One or many facilities, can be a mix of commercial/industrial

## Inherently reflects local characteristics

- Resource base and material-energy-water flows
- Regional assets and socio-economic conditions
- Existing industrial and institutional activity
- Community goals for employment, environmental quality and growth

# Since 2001 the State of Minnesota has fostered Eco-Industrial Development initiatives.

The strategy has supported eco-industrial opportunities to:

- Achieve superior environmental performance
- Enhance community sustainability
- Gain a competitive edge in the green economy

The premise is that EID:

- Involves more integrated design of industrial facilities, complexes, and supply chains
- Can create more advanced, competitive, and cleaner industrial operations across production systems rather than just within an individual facility
- Provides the means to capture economic development including clean green enterprises



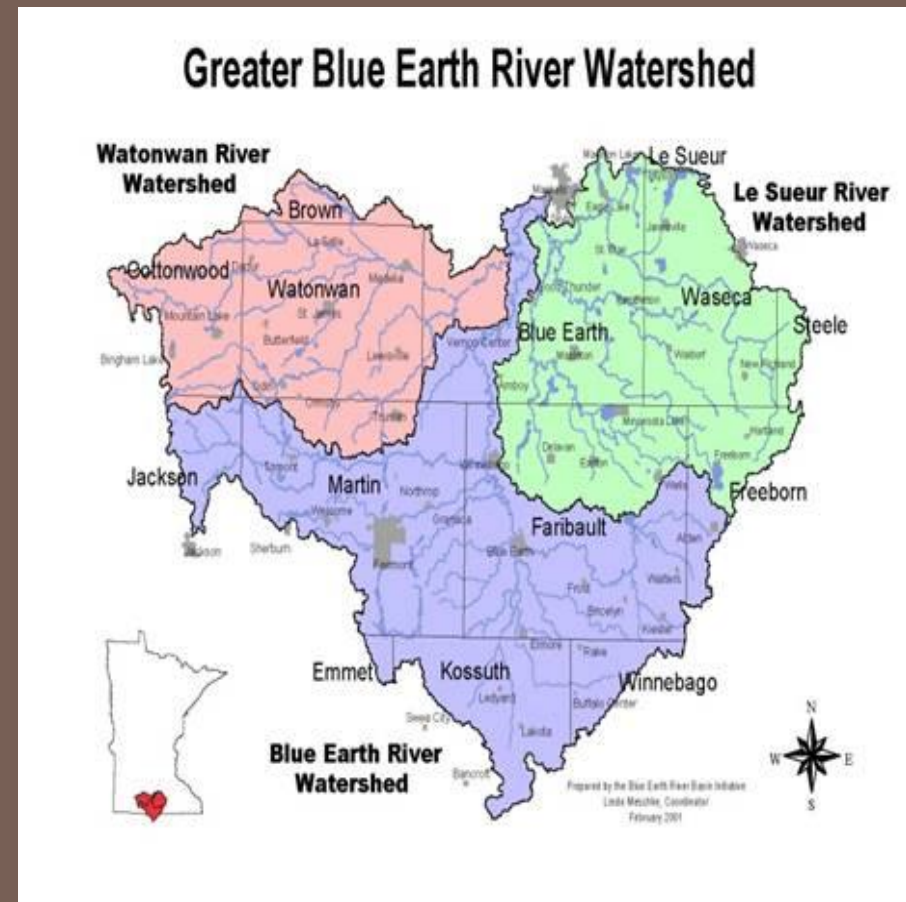


# Madelia Model for Eco-Industrial Development 2007

## Strategy to Address Regional Environmental Challenges and Create Economic and Community Value

Concept - build a replicable system of new enterprises, based on locally sourced agricultural biomass, to fuel a biomaterials conversion system.

Changes watershed paradigm by creating a market for alternative sustainably produced crops!



# Implementation of the Madelia Model 2011

A partnership between the Uof M, SynGas Technology LLC, Rural Advantage NGO and Prairie Skies Biomass Cooperative, proposes an R&D project that will lead to the competitive commercial production of biofuels and feedstocks for biobased products.

Prairie Skies Biomass Co-op is pursuing a facility to establish feedstock supply-chain, conduct a feasibility study, and raise equity for the first phase of a new facilities for an integrated bio-refinery. The full three phase project:

- A 300 tons/day torrefaction facility to convert sustainably managed perennial grass, corn stover, straw, willows and miscanthus
- Combined cycle power generation facility [high pressure gasifier]
- Bio-refinery to convert to gasoline, diesel fuel and ammonia

# Elkhorn Industries Proposed Eco-Park 2005

## Superior, Wisconsin

(project did not move forward)



- 50 acre site and reuse of old Georgia Pacific fiberboard mill
- Biofuels production and biomass gasification combined heat and power system
- Strategic supply chain and product development alliances
- Green product building materials & custom formulated chemicals
- Regional freight handling hub
- A place to grow green businesses



# Involves Facility Design Transformation



# The Greater Duluth Superior Area Eco-Industrial Development Initiative

Report to the John S. and James L. Knight Foundation 2007

The Duluth-Superior Area Eco-Industrial Development Initiative explored the circumstances, conditions, and readiness of the region to undertake eco-industrial development. Results demonstrated a comprehensive approach can unify many diverse interests under a common vision, and create a regional strategy for the future. The Mn Pollution Control Agency and multiple local partners:

- Provided technical assistance to advance the development of eco-industrial ventures.
- Initiated a regional baseline characterization to inform regional eco-industrial activities.
- Formed an Eco-Industrial Network as a resource for EID projects.
- Educated and supported local governments in their efforts to establish strategies and policies that enable eco-industrial development.
- Established the Coalition for Eco-Industrial Development as a means to build local capacity to undertake EID projects.

# Silver Bay Eco-Industrial Business Park Study 2009

## Mission Statement

To network businesses to work with each other and the Silver Bay Community in order to create and diversify living wage employment, by improving resource productivity, eliminating pollution and expanding markets through renewable sustainable energy development.





# Silver Bay Renewable Energy Facilities

## Engineered Green Infrastructure

A publicly owned utility service for the generation, production and distribution of renewable, sustainable combined heat and power system for the citizens and businesses of Silver Bay.

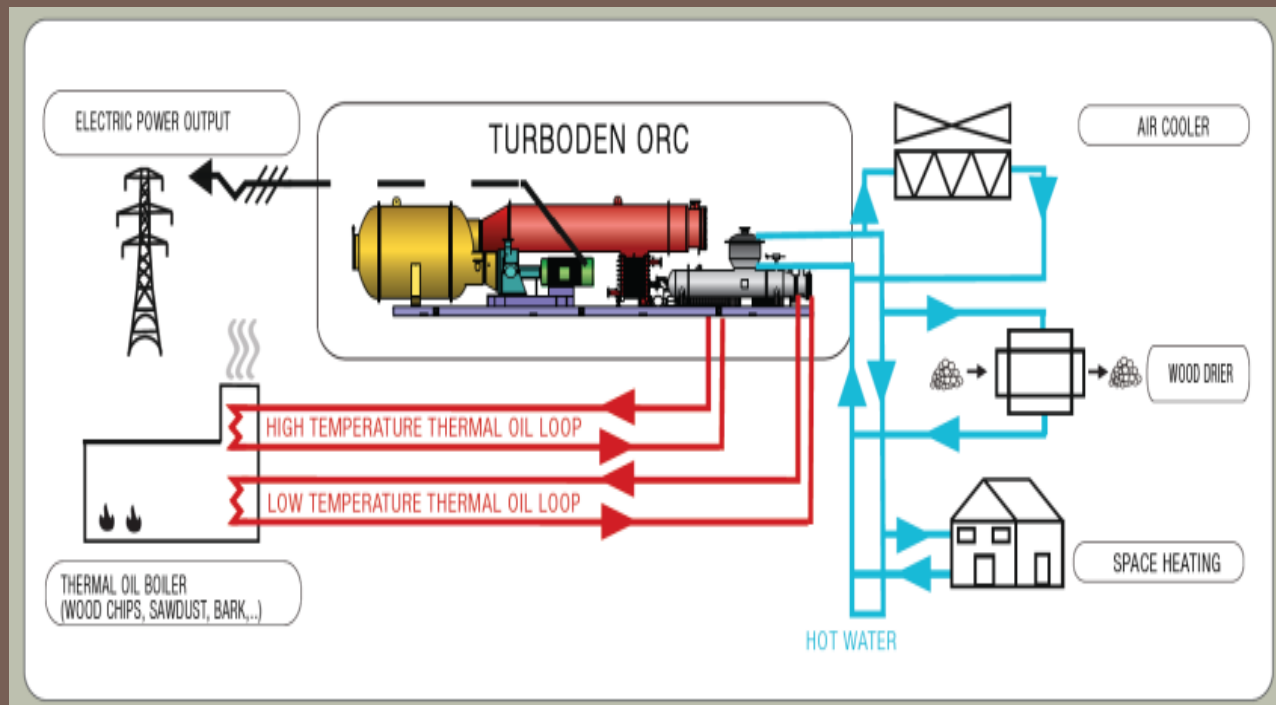




# Integrated Renewable-Based Energy System

## Three Forms of Energy Generation in Eco-Park

- Biomass Binary Combined Heat and Power
- Wind / Solar
- Biodiesel through Algal Growth

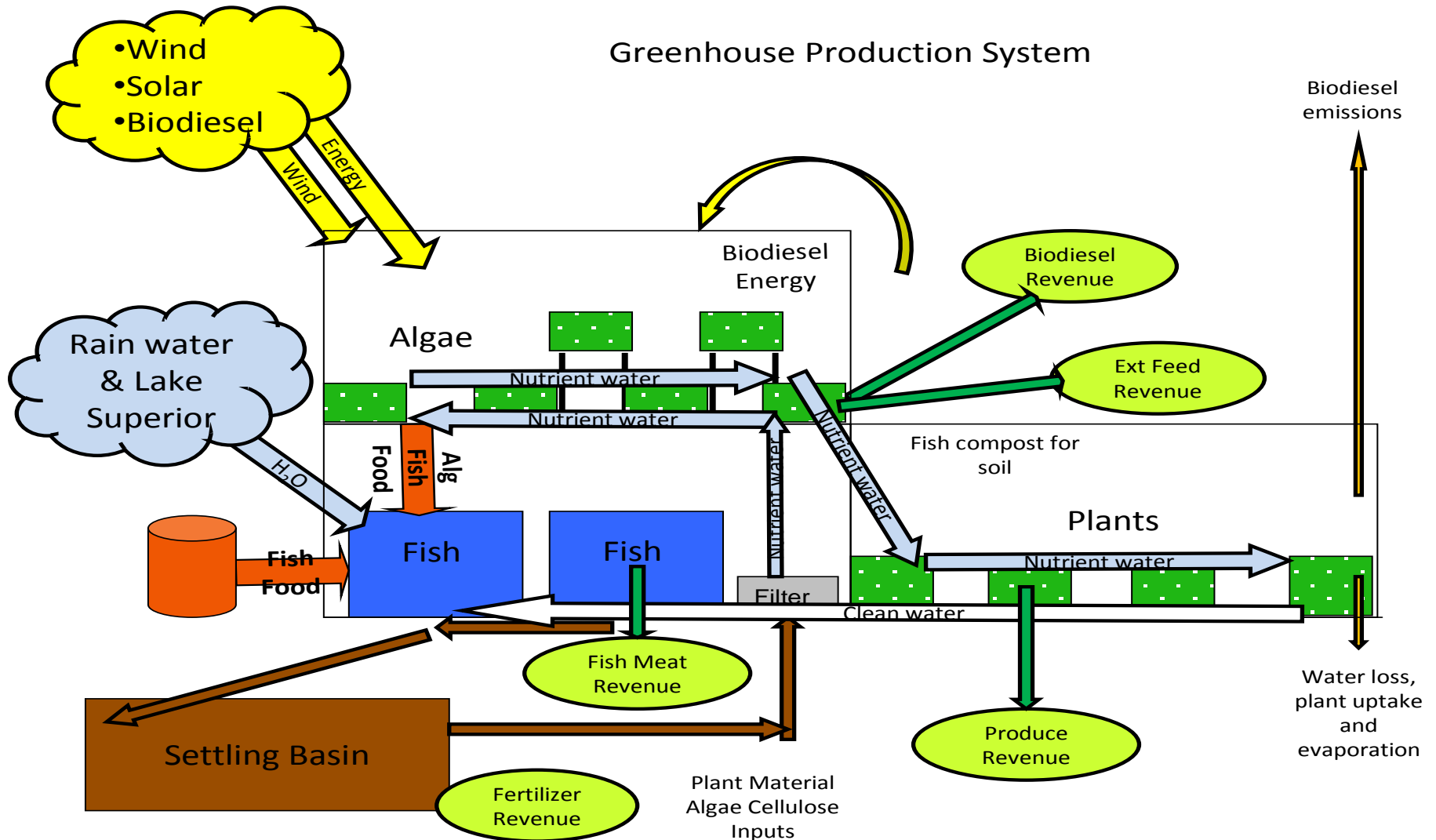


# Environmental and Economic Benefits

- The renewable CHP system will result in a minimal amount of waste and displace approximately 150,000 tpy CO<sub>2</sub> emissions
- It will increase fuel efficiency from about 37 percent, in utility sized coal fired electric power plants, to about 75 percent
- Complete system emissions at maximum potential to emit will be less than 235 tpy
- Utilization of 100,000 tpy of wood pellets, displacing a 50/50 mix of propane and fuel oil, yields a total of 127,500 tpy of CO<sub>2</sub> displaced
- Approximately forty (40) construction jobs, fifteen (15) permanent pellet plant operating and 6 logging jobs could be created

# Silver Bay Eco-Park Greenhouse Production

## Wind-Algae-Rain-Food Synergistic Systems



# Fish and Produce Production Facilities 2012

- Locally Grown Food Initiative “Food to Cafeteria” (Schools, Hospitals & Assist. Living)
- Sustainable Job Creation
- Better Quality & Lower Cost Production
- Food Security and Safety
- Works Synergistically with other System in the Greenhouse.
- Eliminates Transportation
  - Reduces Cost
  - Reduces Pollution
  - Resource Conservation



# Itasca Eco-Park Grand Rapids, MN 2011

- Proposed \$5 million redevelopment to transform 223 acre wood products mill site
- Integrated multi-tenant industrial park and incubator for renewable energy and other related businesses
- Opportunity to cluster synergistic businesses to reduce operating costs and maximizes competitive advantages
- 2011 U. S. EDA awarded \$1.75 million to advance the project.
- Expected to create 175 jobs and generate \$45 million in investment.





UMore Sustainable Community  
Eco-Industrial Park District  
Concept Master Plan January 2009





# Ford Site Green Manufacturing Reuse Study August 2009





# Roadmap to Sustainability Ford Site Saint Paul

## Sustainable Redevelopment Team Report May 2011

- High Level of Interest in Sustainable Redevelopment of the Ford Site
- Potential as a Demonstration and Legacy Project
- Bringing Sustainability and the Market Together

### Sustainability Categories and Objectives:

Operating Energy	Global Warming	Potable Water	Waste Water
Solid Waste	LC Materials Impacts	Soil	Environmental Quality
Vegetation	Habitat	Stormwater	Groundwater
Trans. Energy	Recreation	Human Health	Food
Night Sky Radiation		Employment	Urban Heat Island

Potential Implementation Strategies include integrated design process, zoning, policy and incentives, and eco-industrial systems.

# 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.