

# Laboratory for Sustainable Solutions

**Dr. Wally Peters**



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Photo by A. Wilson

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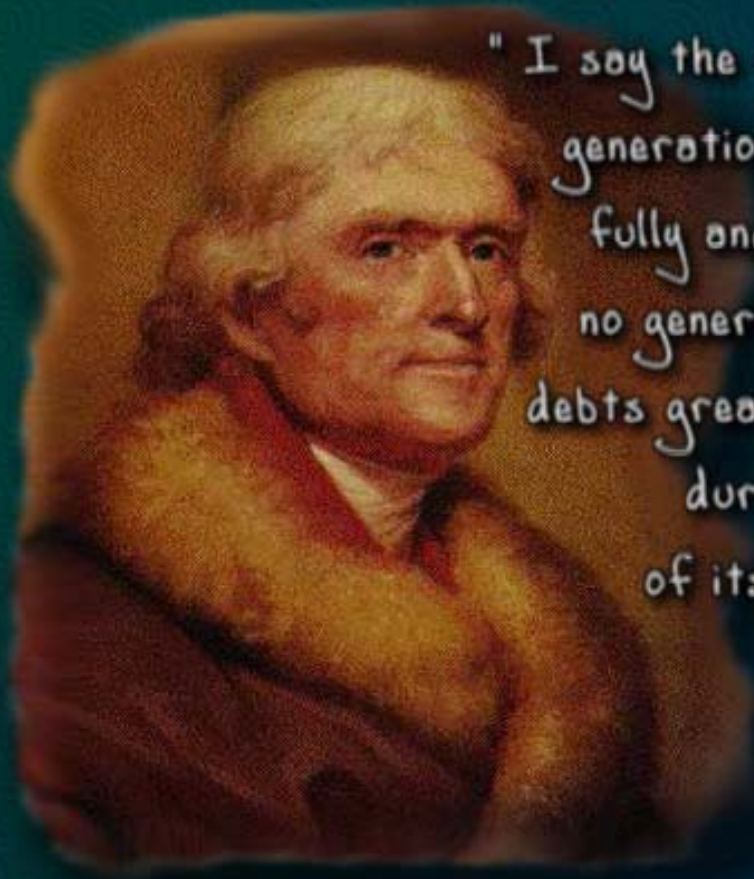
# SUSTAINABLE DESIGN AND DEVELOPMENT

## THE GOOD—THE BAD—THE UGLY

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# What is Sustainability?



" I say the earth belongs to each...  
generation during its course,  
fully and in its own right,  
no generation can contract  
debts greater than may be paid  
during the course  
of its own existence,"

Thomas Jefferson  
September 6, 1789

# What is Sustainable Development?

*Sustainable development is “development that meets the needs of the present without compromising the ability of future generations to meet their own needs”*

*-- “Our Common Future,” United Nations World Commission on Environment and Development 1987*

# Daly's Definition of Sustainable Development

*“SUSTAINABLE DEVELOPMENT” IS “DEVELOPMENT WITHOUT GROWTH IN THROUGHPUT BEYOND ENVIRONMENTAL REGENERATIVE AND ABSORPTIVE CAPACITY”*

Herman E. Daly, *Beyond Growth*, (Beacon Press, 1996), p.69.

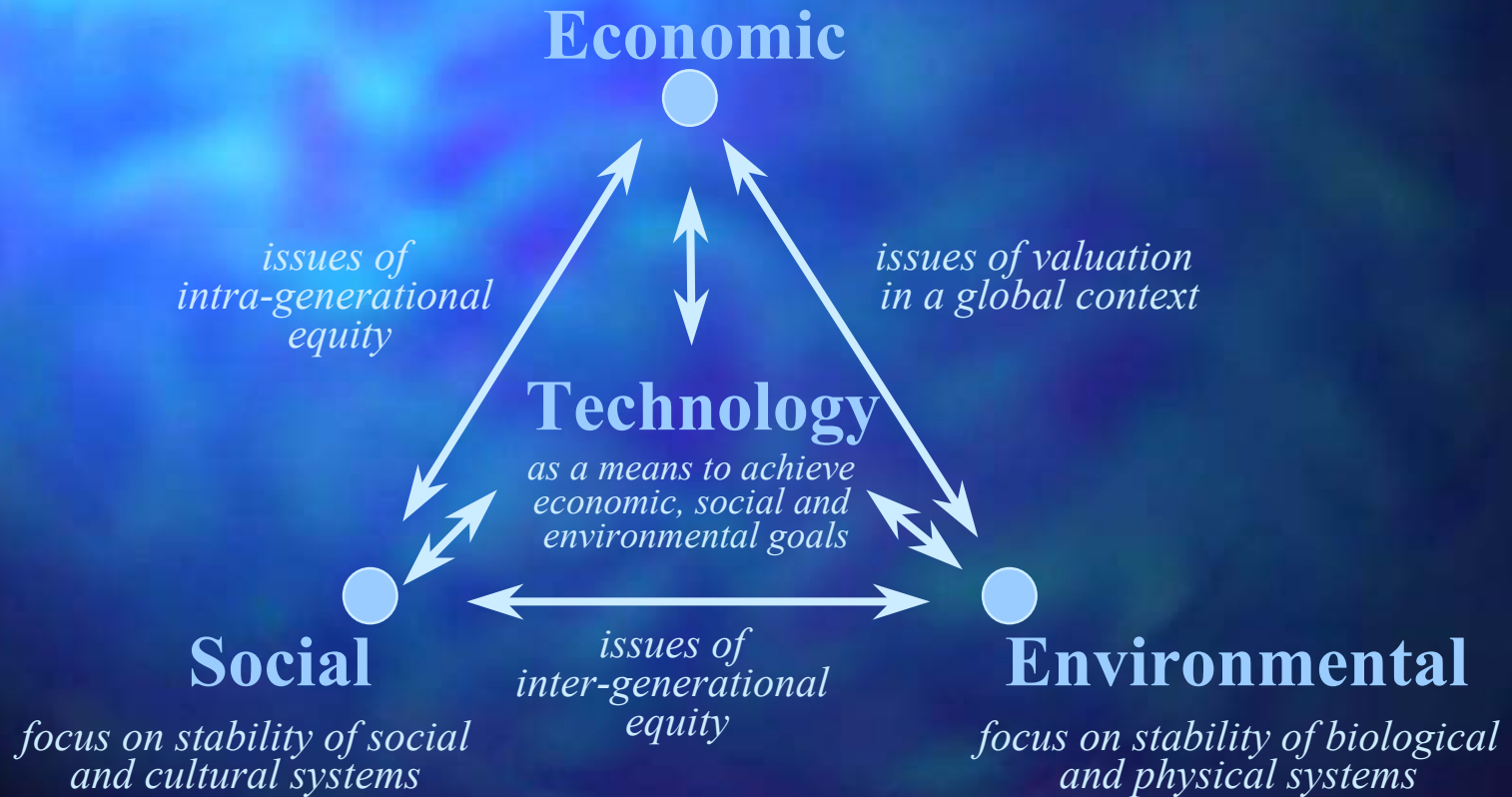
# Systems Analysis

## ■ Basic science

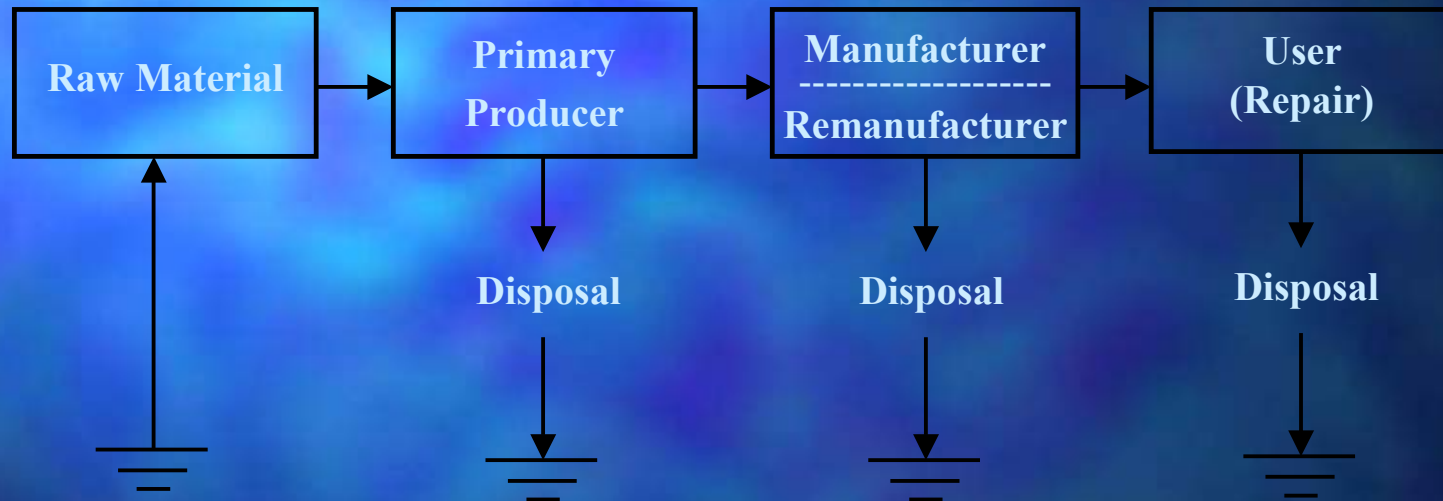
- Matter and energy cannot appear or disappear
- Matter and energy tend to spread spontaneously
- Material quality is concentration and structure of matter
- Material quality on earth is net produced only by sun-driven processes

# Dimensions of Sustainable Development

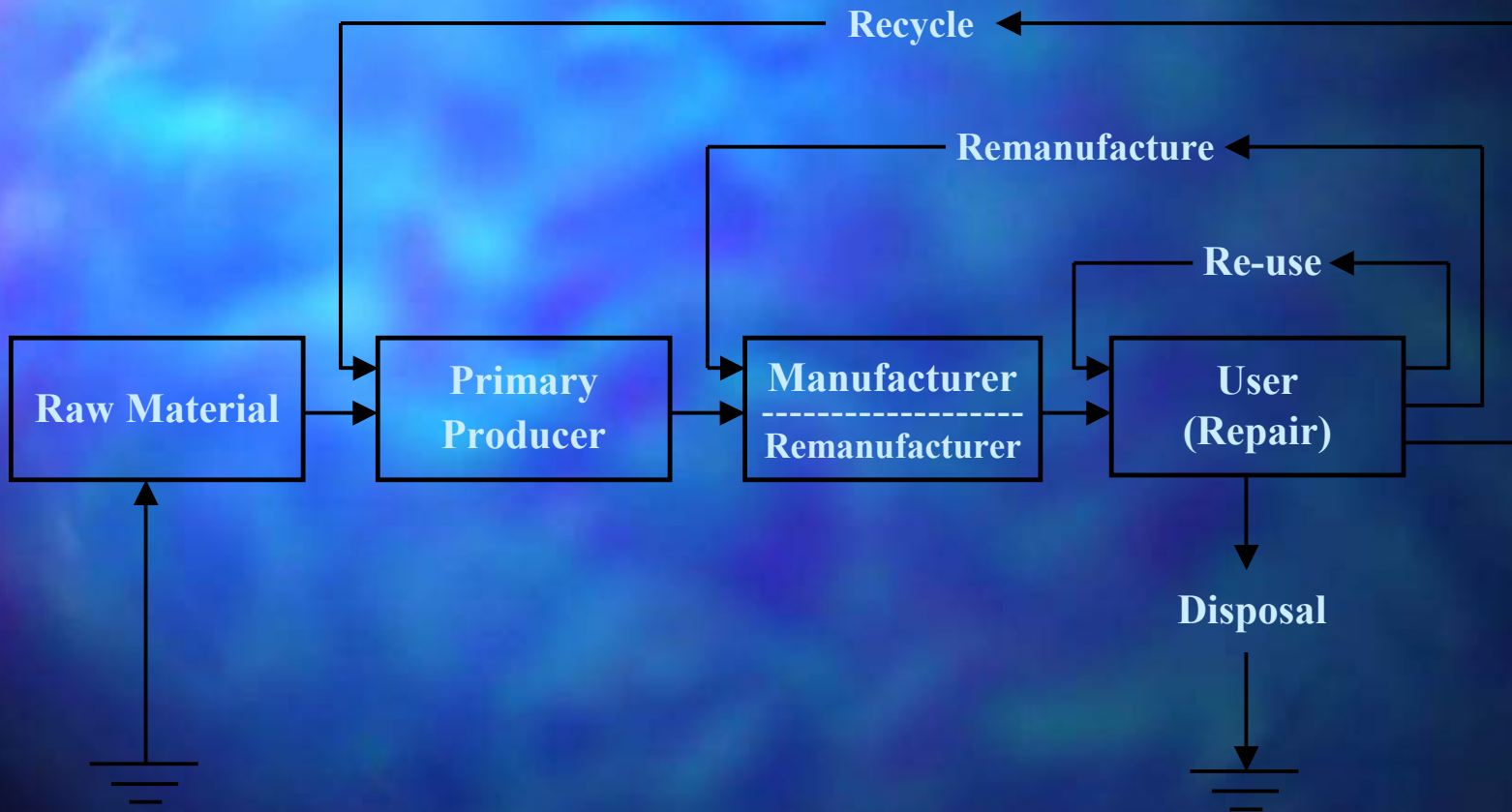
*focus on maximizing income while maintaining the stock of capital assets  
(human, natural and manufacturing capital)*



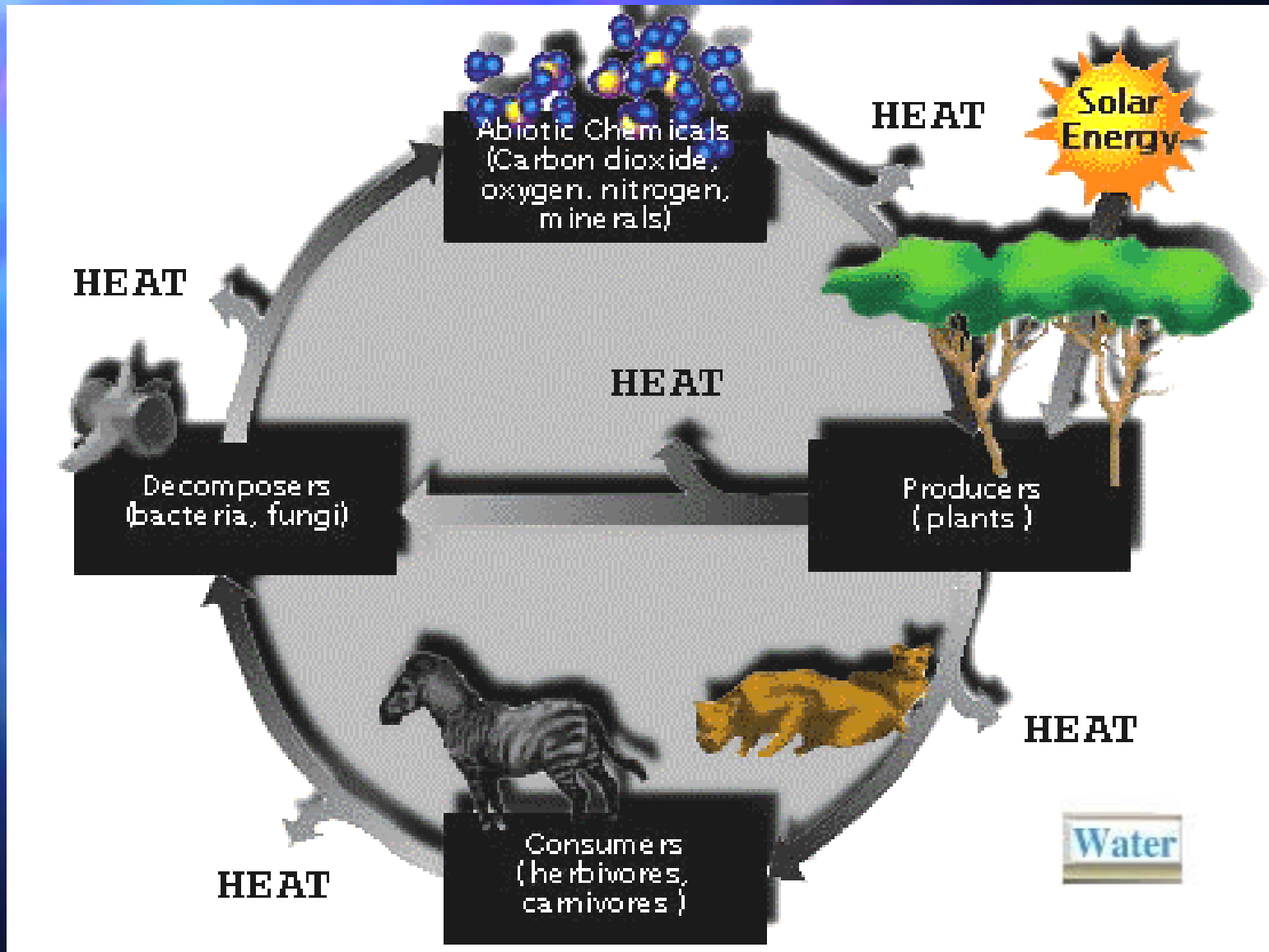
# First Industrial Revolution



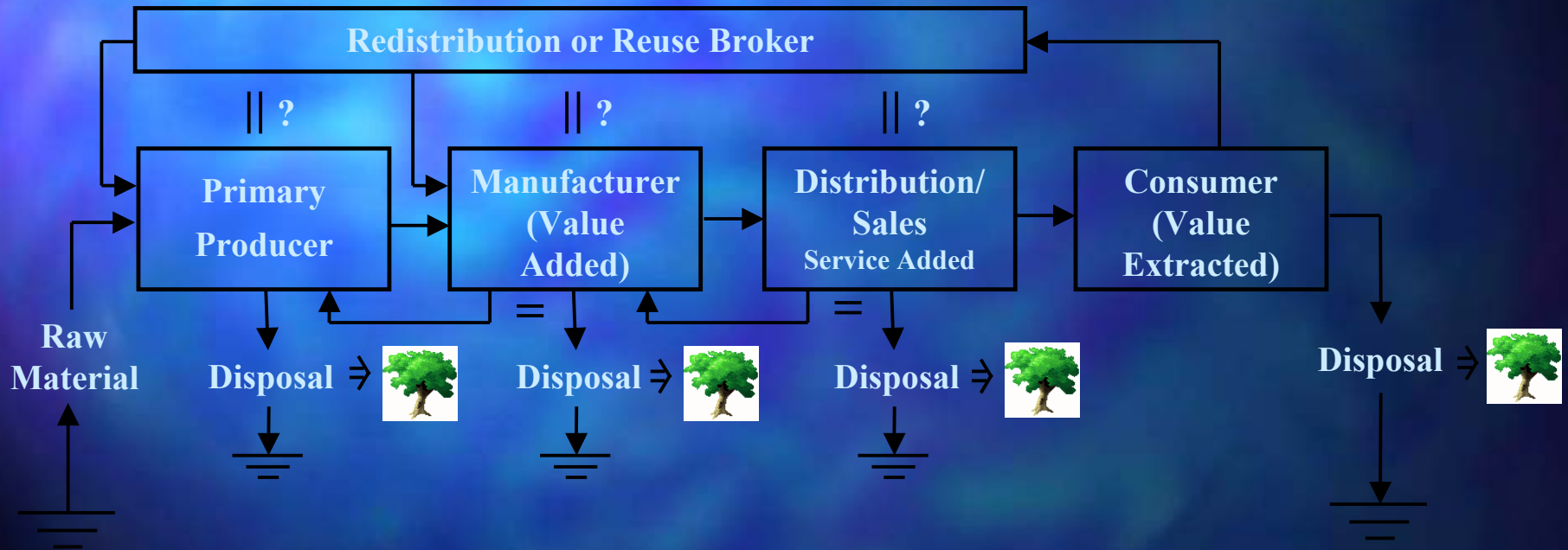
# "Recycle" Industrial Revolution



Source: Lund, Remanufacturing: The Experience of the U.S. and Implications for Developing Countries; World Bank, 1985.



# Sustainable (Responsible) Industrial Revolution



# Wise Investments/Shared Benefits: Development of a Sustainable Infrastructure Planning Model in a Coastal Region

- **Purpose: Develop a model public process and a set of suggested criteria for creating a local comprehensive infrastructure development plan.**
- **Apply a systems approach to predict performance of different scenarios of infrastructure development.**



## Project Partners:

- USC - Center for Environmental Policy
- NOAA Coastal Service Center
- South Carolina Sea Grant Consortium
- Lowcountry Regional Council of Governments
- SC Coastal Conservation League
- South Carolina Budget and Control Board

**A Practical Geographic  
Information Systems (GIS) Tool  
for Environmental Sustainability  
Analysis for Infrastructure  
Planning in Colleton, Jasper,  
Hampton, and Beaufort Counties  
of South Carolina**

**Thomas P. Wallace**

**MEERM**

**School of the Environment**

- **Density of Industrial Air Releases**
- **Density of Industrial Water Discharges**
- **Density of Underground Storage Contamination Sites**
- **Distance to Airports**
- **Distance to Endangered Species Sites**
- **Distance to Existing Industry**
- **Distance to Major Power Lines**
- **Distance to Public Water Wells**
- **Distance to Railroads**
- **Distance to Roads**

- **Distance to Superfund Sites**
- **Distance to Utility Generating Facilities**
- **Distance to Water and Sewer Lines**
- **Distance to Water and Sewer Treatment**
- **Location of Forestland**
- **Location of Hydrological Features**
- **Location of Real or Potential Farmland**
- **Location of Wetlands**
- **Relation to Industrial Siting**

**A Geographic Information  
System (GIS) Infrastructure  
Planning Application for the  
South Carolina Lowcountry  
Council of Governments (LCOG)**

**David B. Grigg**

**MEERM**

**School of the Environment**

**Community Infrastructure  
Planning As a Deterrent to  
Urban Sprawl:  
Assessing Regional Needs in  
Beaufort, Colleton, Hampton and  
Jasper Counties**

**Emily Peterson**

**M.A.**

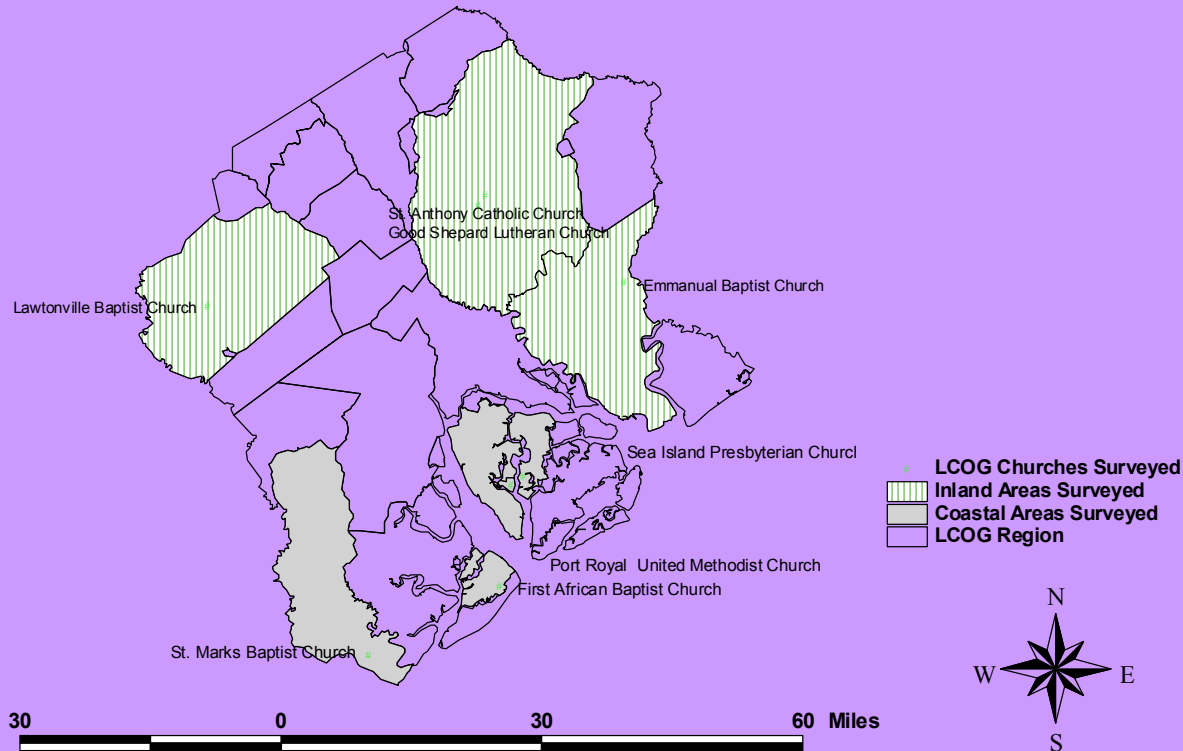
**Department of Geography**

# Results

- **Six Areas of Comparison**
  - **Coastal v. Inland**
  - **Urban v. Rural**
  - **Rural Coastal v. Rural Inland**
  - **Urban Coastal v. Urban Inland**
  - **Rural Coastal v. Urban Coastal**
  - **Rural Inland v. Urban Inland**

# Map of Coastal & Inland Areas

## Coastal and Inland Survey Areas



# Growth and Infrastructure

## Coastal residents

- No more growth
- Are satisfied with current infrastructure

## Inland residents

- More growth regardless of type
- Better infrastructure development

# Future Development

## ■ Coastal Resident

- More public transit
- Historic buildings
- Internet access
- Bike paths
- Pedestrian areas
- Tidal creeks & rivers preserved

## ■ Inland Resident

- Fast food restaurant
- Well-maintained roads
- Parks & recreation
- Proximity to natural resources

**WEB SURVEYING**

**SEE**

**[WWW.SMARTGROWTHSC.COM](http://WWW.SMARTGROWTHSC.COM)**



# What is Industrial Ecology?

- The Industrial Ecology concept is one in which the industrial system is viewed in concert with its surrounding systems, not in isolation from them. It involves a systems analysis seeking optimization of the total materials cycle from virgin material...to ultimate disposal.

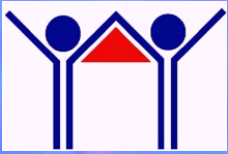
# Green Building



# Habitat for Humanity



- Sustainable Redesign of Habitat Home
- Interdisciplinary Student Team
- Community Involvement

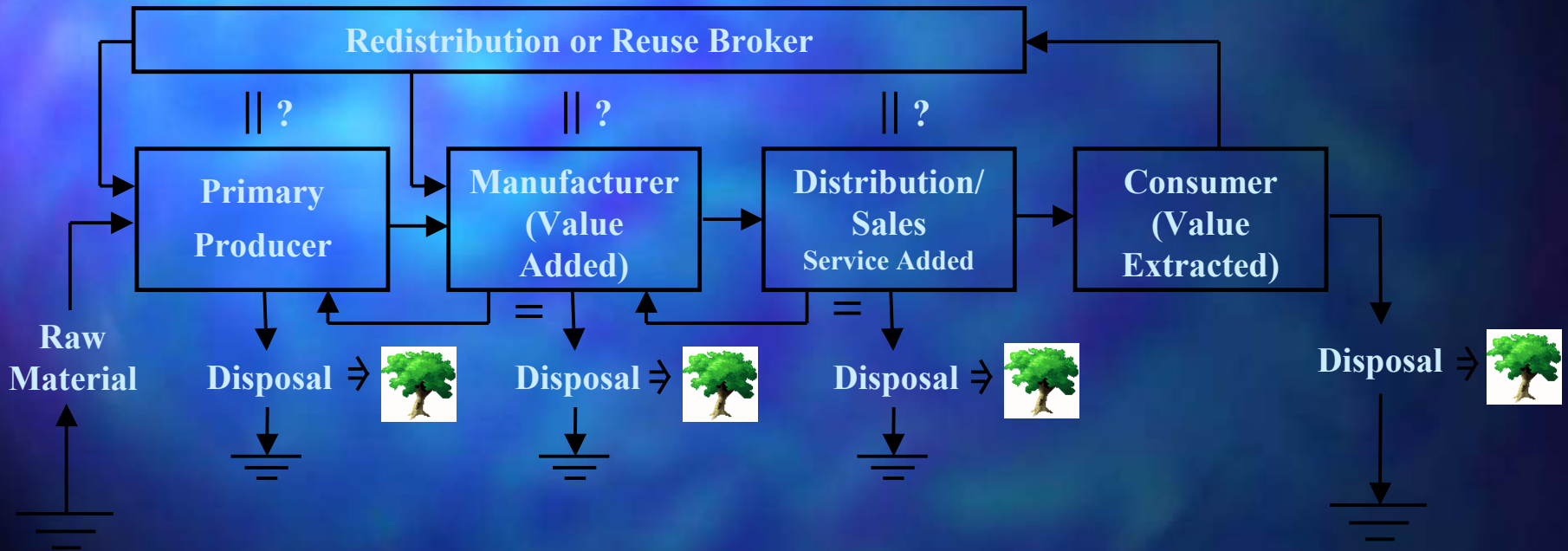


# CONCLUSION



- Survey and Analysis
- Researched and Selected Sustainable Building Materials
- Additional Design Changes
- Building Recommendations
- Community Model Design

# Sustainable (Responsible) Industrial Revolution



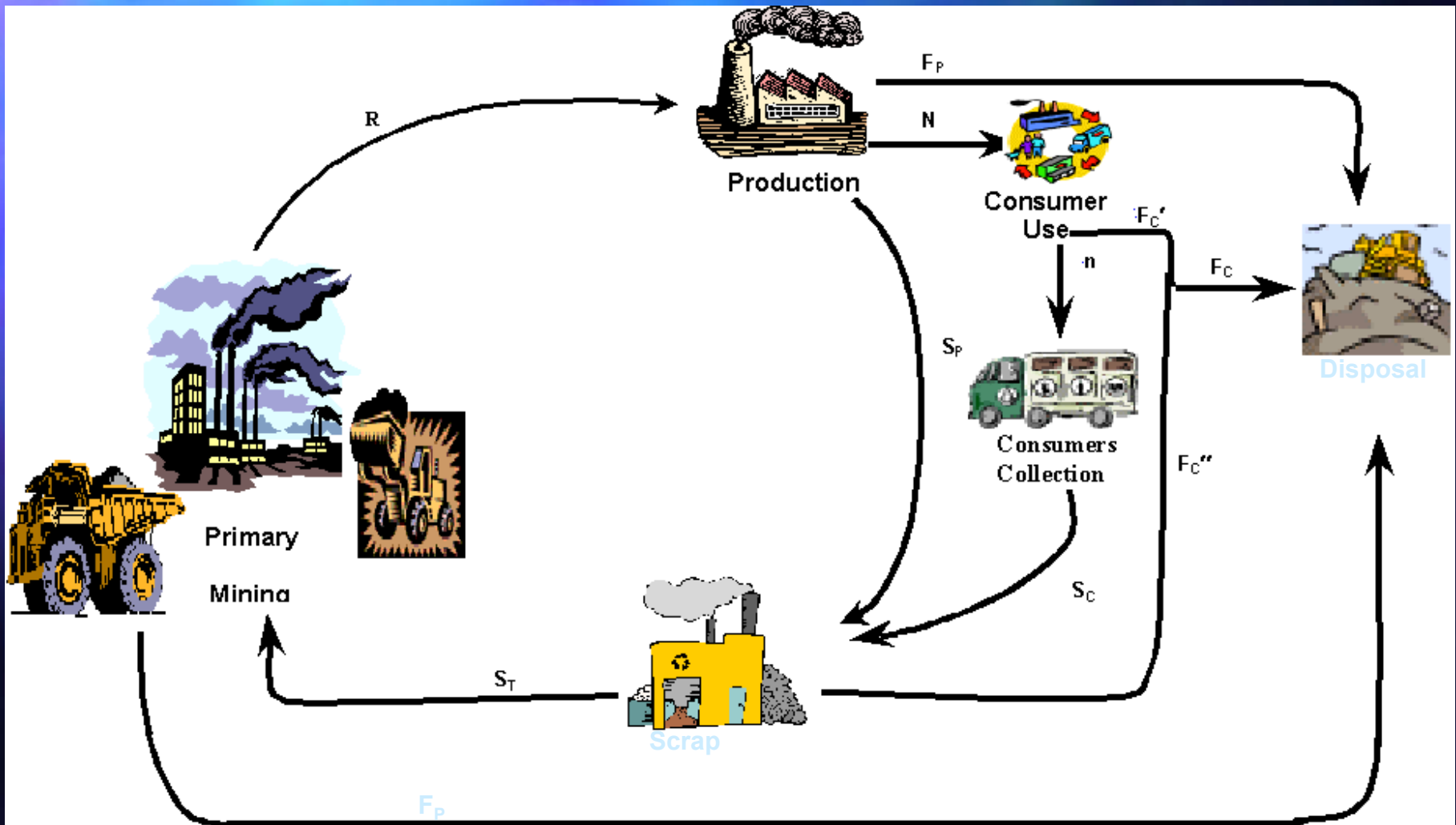
# A Sustainable Decision Support System for the Demanufacturing Process of Product Take-Back Based on Concepts of Industrial Ecology

Sirine A. Saleem

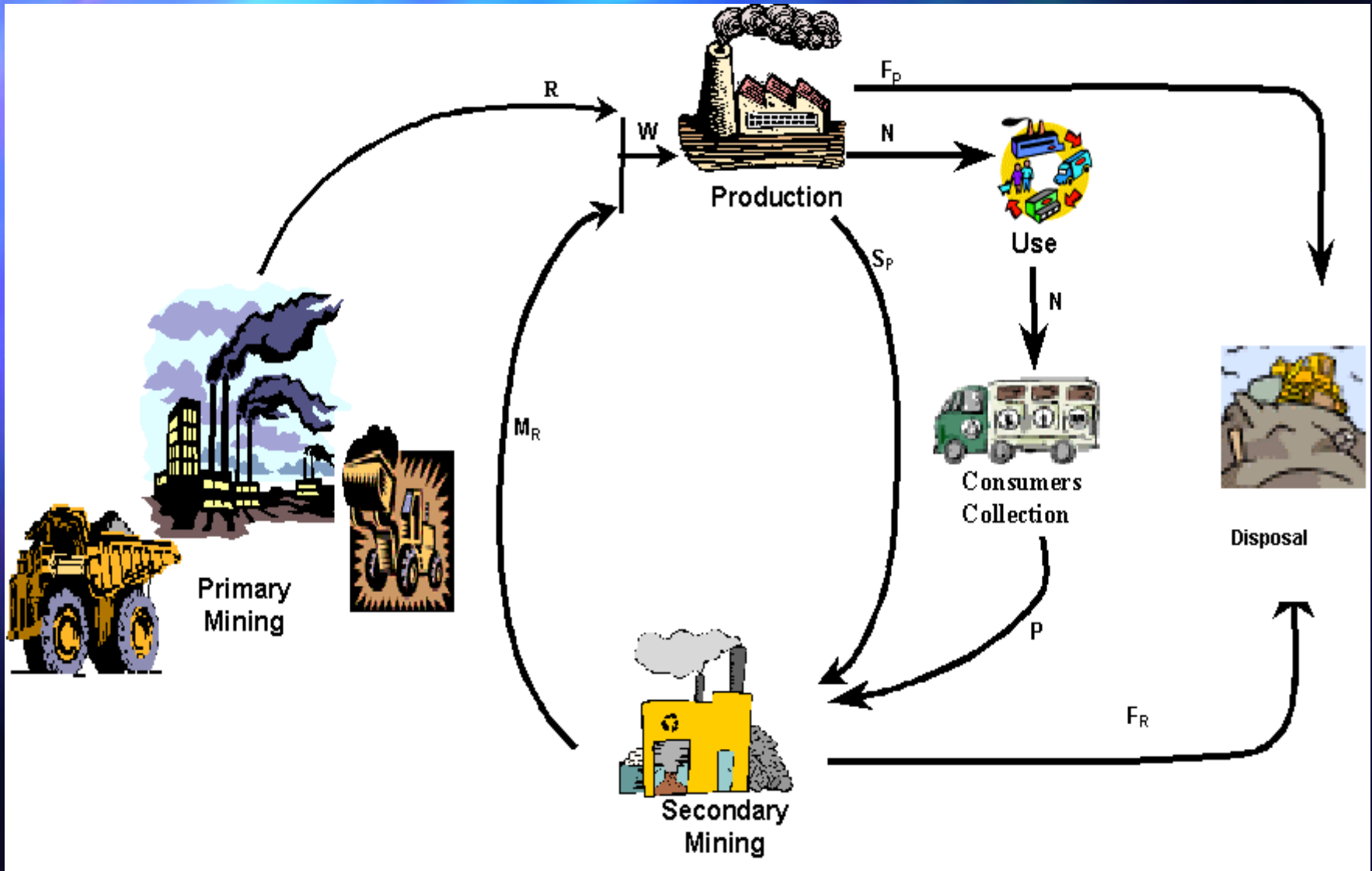
**M.S.**

**Laboratory for Sustainable Solutions  
Department of Mechanical Engineering  
University of South Carolina**

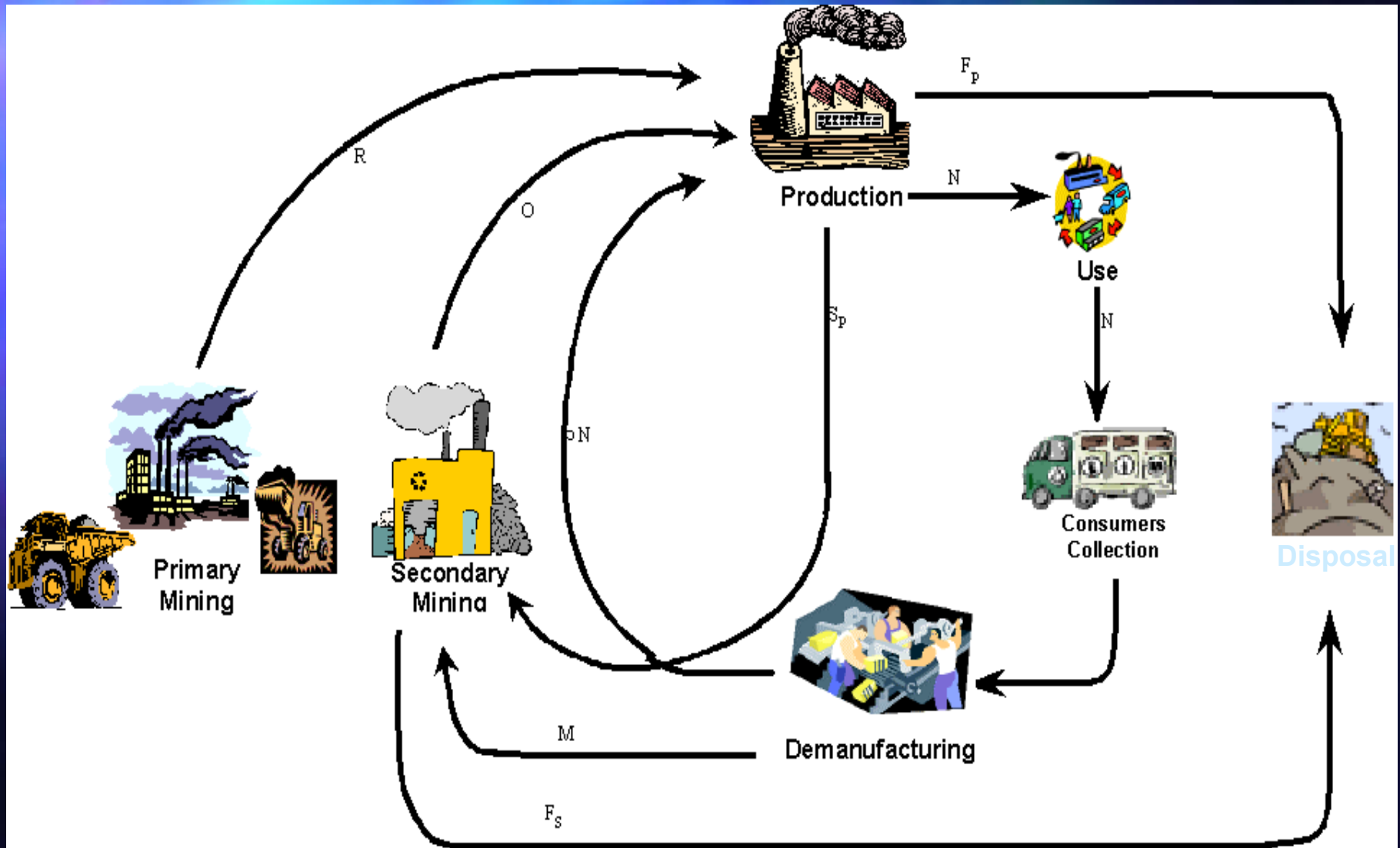
# The Primary Mining Scenario



# Secondary Mining Scenario



# The Demanufacturing Scenario



# Conclusions and Recommendations

- The demanufacturing process is the most sustainable process among the three alternatives studied.
- Disassembly impacts other areas in the production.
- Product Design
  - \*Sustainable Product Design
  - \*Design for Disassembly

# Cont...

- Consider internal reuse of scrap product.
- Offer a like-new warranty (instead of repair).
- Employ Total Quality Environmental Management (TQEM).

A Decision Support System for the  
Reverse Logistics of Product Take-Back  
using Geographic Information Systems  
and the Concepts of Sustainability

Beth Locklear

**Master of Earth and Environmental Resource  
Management**

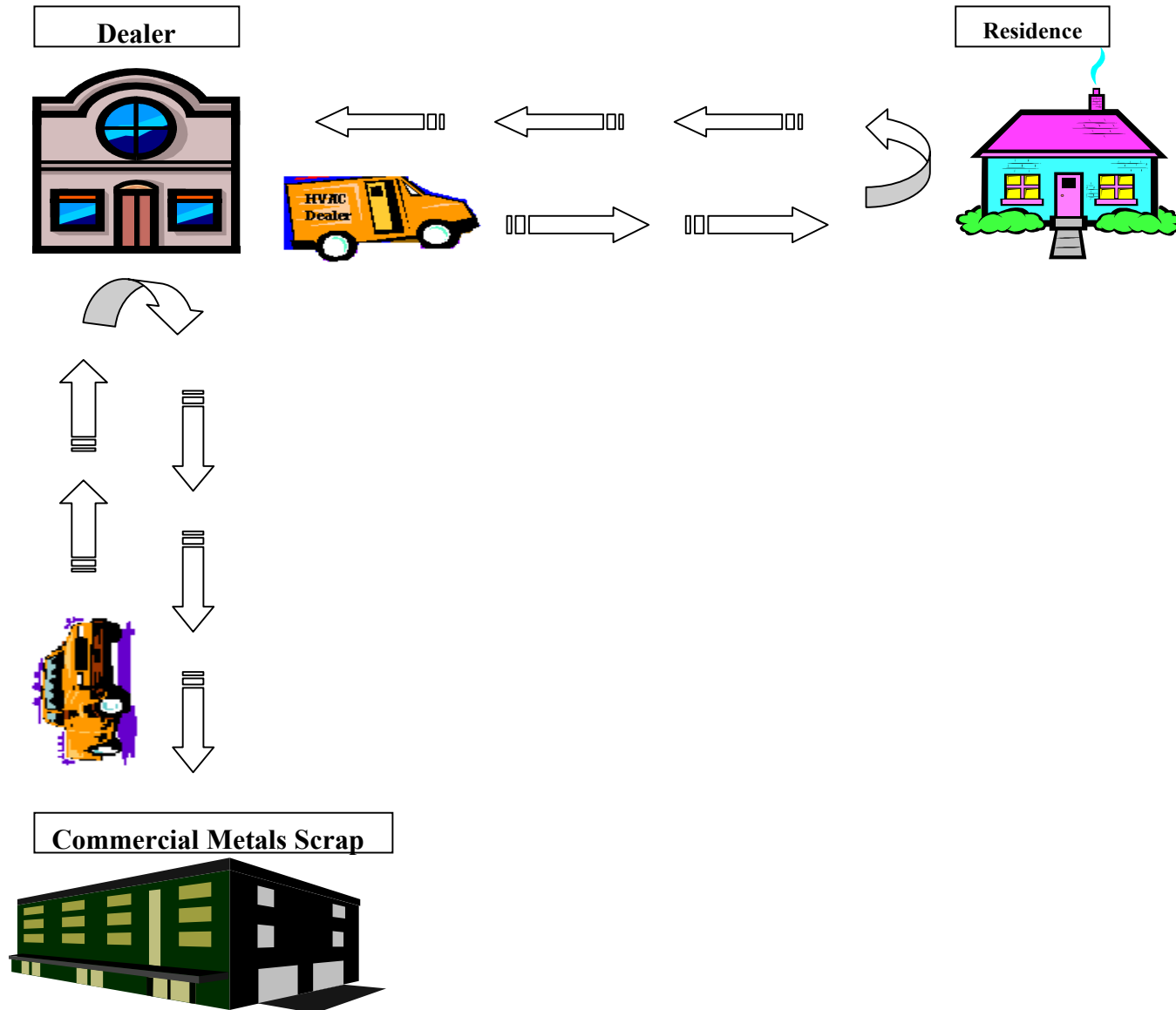
**School of the Environment**

# Methodology

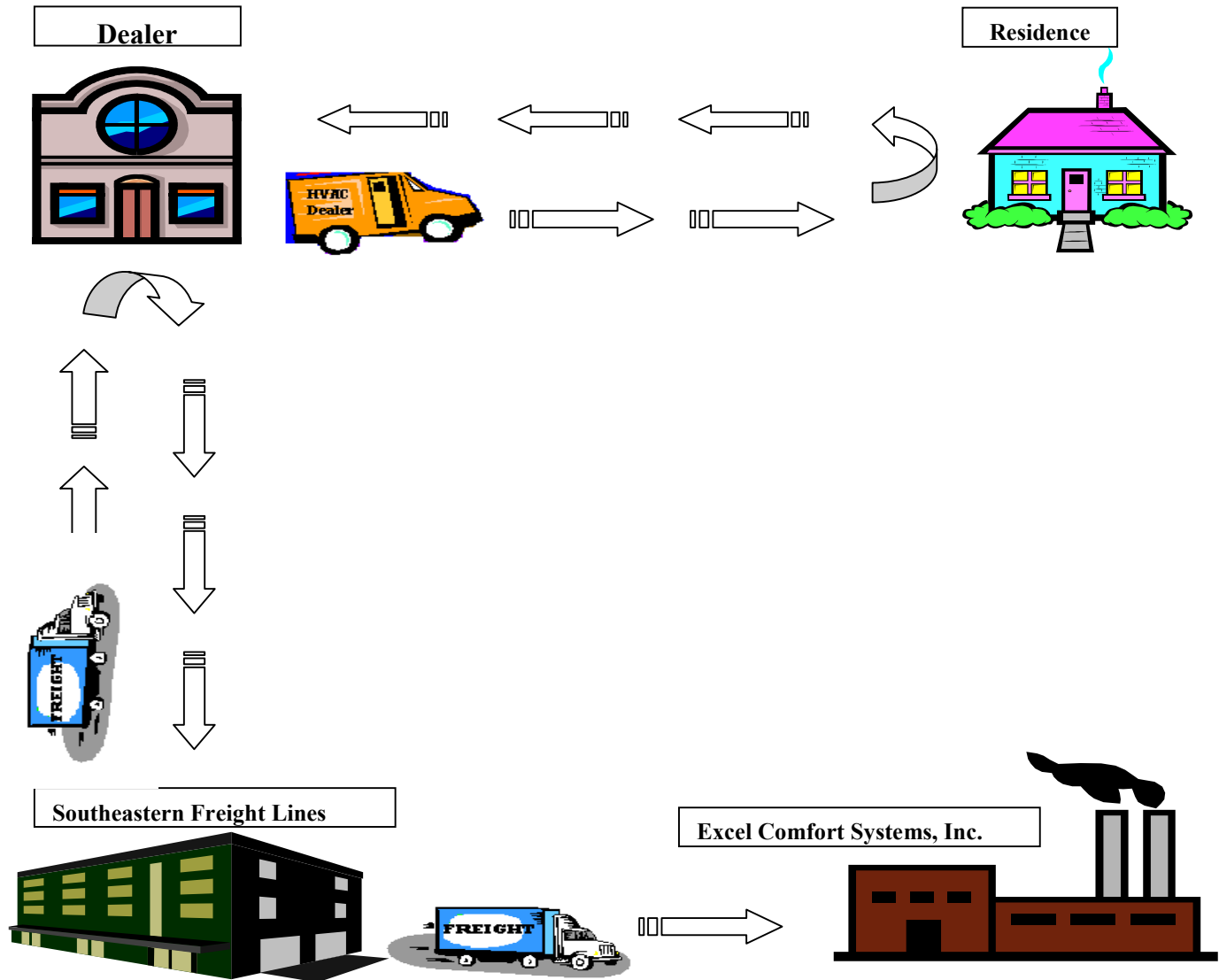
## Arc Logistics Route

**Optimizes routing and scheduling of fleet vehicles reducing total vehicle miles traveled**

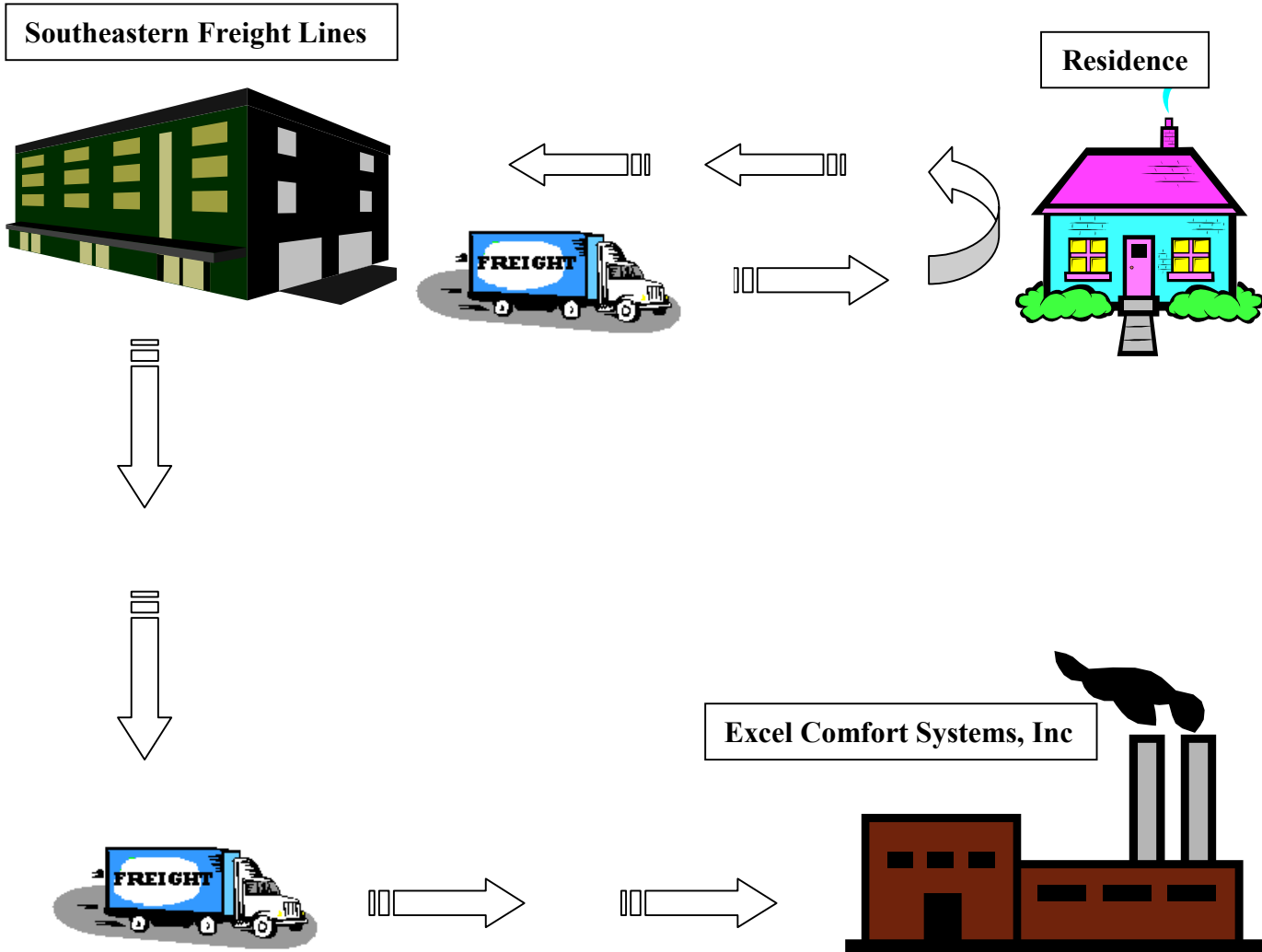
# The Status Quo



# The Milk Run



# The Scavenger



# Preferred Scenario

- **The Scavenger**
- **Disassembly-for-remanufacturing**

# What is Industrial Ecology and How Does it Related to ISO 14001?



UNIVERSITY OF  
SOUTH CAROLINA.

**LSS**



**Jamie Russell**  
**Ph. D. Candidate**  
**Laboratory for Sustainable Solutions**  
**Department of Mechanical**  
**Engineering**

# What is Industrial Ecology?

- **Industrial ecology is the means by which humanity can deliberately and rationally approach and maintain a desirable carrying capacity, given continued economic, cultural, and technological evolution. The concept requires that an industrial system be viewed not in isolation from its surrounding systems, but in concert with them. It is a systems view in which one seeks to optimize the total materials cycle from virgin material, to finished material, to component, to product, to obsolete product, and to ultimate disposal. Factors to be optimized include resources, energy, and capital.**
- **From Graedel and Allenby "Industrial Ecology"**

# What is an EMS?

## What Does ISO 14001 Require?

- *Use the Deming Cycle (continuous improvement) to establish and maintain an EMS including:*

<b>■ Policy Statement</b>	<b>■ Doc. Control</b>
<b>■ Legal Req.'s</b>	<b>■ Operation Control</b>
<b>■ Aspects Impacts</b>	<b>■ Emergency Prep.</b>
<b>■ Objectives Targets</b>	<b>■ Corrective Action</b>
<b>■ Training</b>	<b>■ Record Keeping</b>
<b>■ Audits</b>	<b>■ Management Rev.</b>

# ISO14001 Policy Statement

- Appropriate to nature, scale, and environmental impacts of activities, products, or services
- Include commitment to continual improvement and **prevention of pollution**
- Commitment to comply with environmental regulations (i.e. regulatory compliance)
- Framework for setting and reviewing environmental objectives and targets

# Connection of ISO with IE

- **Regulatory Requirements (EPA)**
  - Focus on outputs: end of pipe/command and control
- **Aspects (Inputs, Outputs, Processes)**
  - ISO focused on but not limited to local operation
  - IE broadens the focus to life cycle effects
- **Impacts (Interaction with Environment)**
  - ISO focus “controlling impacts on the environment”
  - IE coherence with earth systems

# Conclusions

- **ISO 14001 & Industrial Ecology are compatible**
- **Explain Industrial Ecology principles before beginning ISO 14001 implementation**
- **Start with the “big picture” and zoom in**
- **Don't get stuck in the process:**
  - Focus on big items first
  - Will get to the smaller using Deming cycle
- **The key interface between IE and ISO occurs when examining Aspects and Impacts**
- **Full Presentation Available on the Web**  
**[www.me.sc.edu/Research/Iss/](http://www.me.sc.edu/Research/Iss/)**

# C&D Debris Recycling



SDST Columbia Site

Construction Waste Recycling

## Summary

Material	Amount Recycled (yd <sup>3</sup> )	Amount Recycled (tons)	Recycling Costs	Recycling Transportation	Amount Landfilled (yd <sup>3</sup> )	Amount Landfilled (tons)	Landfill Costs	Landfill Transportation
Roofing/Gen	0	0.00	\$0.00	\$0.00	140	24.53	\$343.38	\$400.00
Gen. Waste	0	0.00	\$0.00	\$0.00	210	71.90	\$1,006.56	\$630.00
Cardboard	230	7.67	\$0.00	\$480.00	64	2.14	\$29.97	\$80.00
Wood	159.6	23.82	\$670.99	\$1,800.00	0	0.00	\$0.00	\$0.00
Masonry	240	256.80	\$600.00	\$960.00	8	8.54	\$119.61	\$80.00
Metals	0	0.00	\$0.00	\$0.00	0	0.00	\$0.00	\$0.00
Plastic	0	0.00	\$0.00	\$0.00	0	0.00	\$0.00	\$0.00
Gypsum	30	6.00	\$84.83	\$150.00	0	0.00	\$0.00	\$0.00
<b>Totals</b>	<b>659.6</b>	<b>294.29</b>	<b>\$1,355.82</b>	<b>\$3,390.00</b>	<b>422</b>	<b>107.11</b>	<b>\$1,499.52</b>	<b>\$1,190.00</b>
				Trans. costs if landfilled: \$1,860.01				
<b>Current Costs</b>		<b>\$7,435.34</b>			<b>Cost to Landfill all Materials (\$14/ton)</b>			<b>\$8,669.56</b>
				SDST Columbia Site	EPA RTP Project			
				Volume percentage of material recycled to total:	61.0%	NA		
				Weight percentage of material recycled to total:	73.3%	90%		

# **The Sustainable Systems Analysis Algorithm (SSAA)**

**S. Lynn Odom**

**Ph.D.**

**Laboratory for Sustainable Solutions**



# What is an Eco-Industrial Park?

- An Eco-Industrial Park (EIP) is a group of firms arranged around a primary raw material processor... which trade by-products with each other.

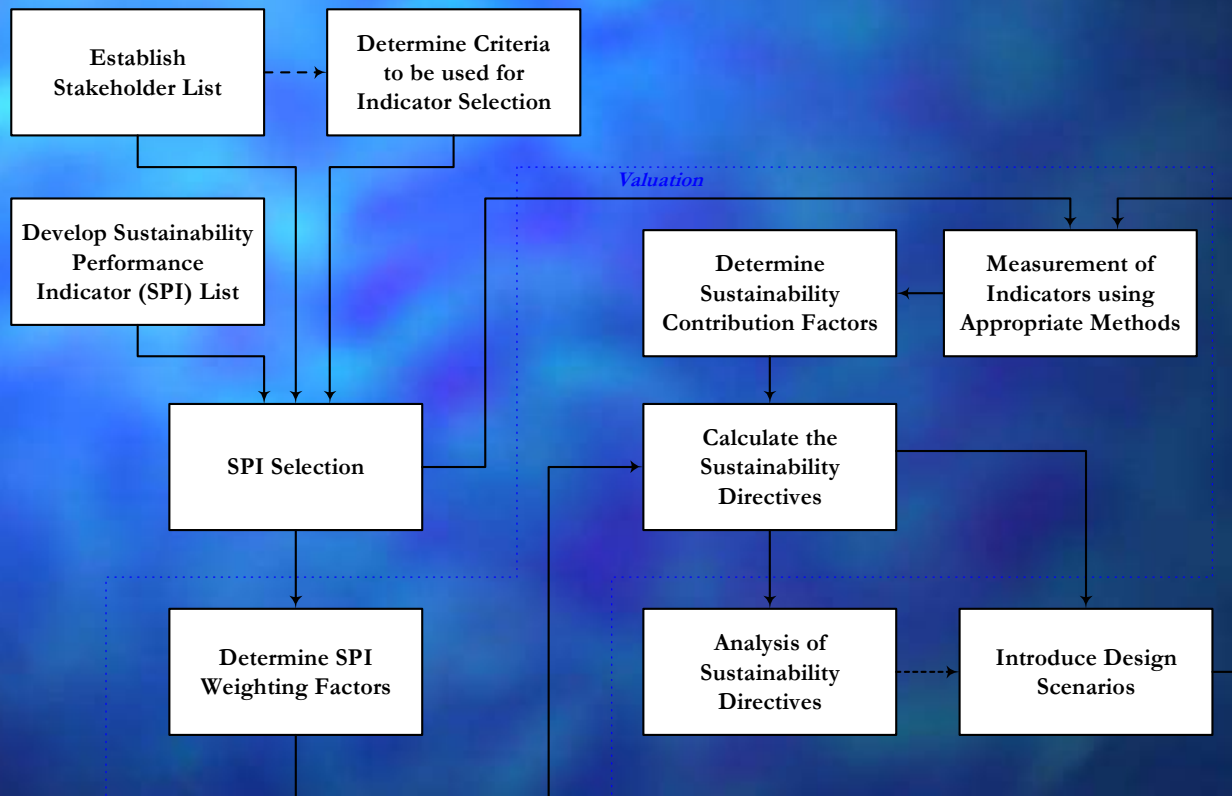
Ayres, Robert U. "Creating industrial ecosystems: a viable management strategy?," *Industry and Environment*. Vol. 19, No. 4, Oct. – Dec. 1996, pg. 9.



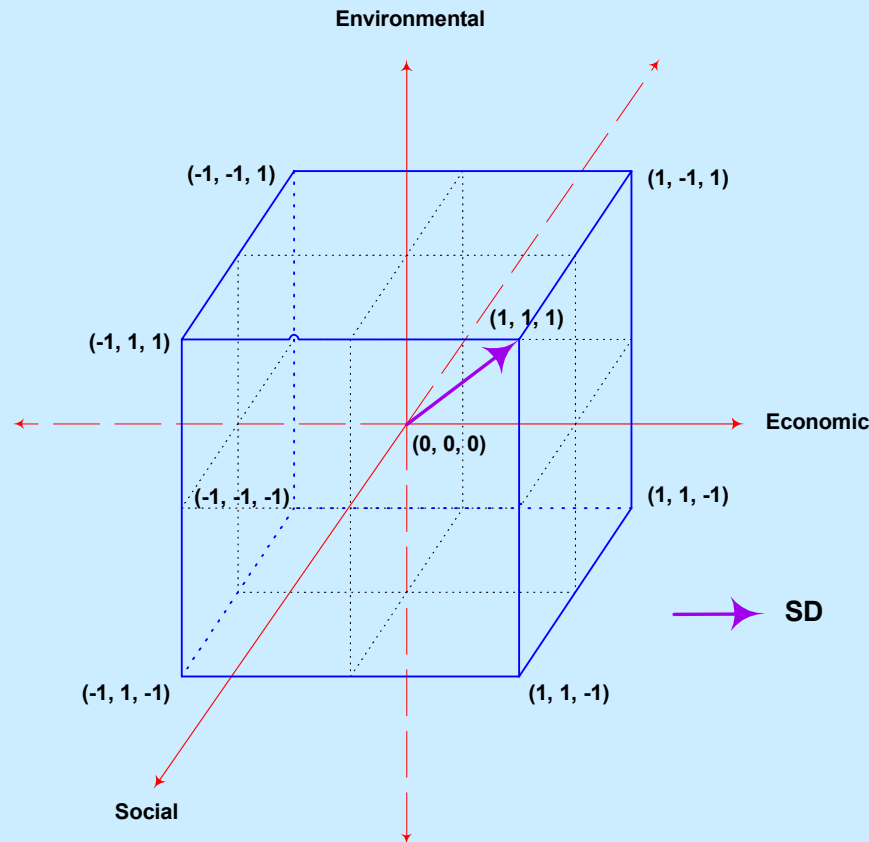
# Edisto River Basin (ERB) Eco-Industrial Park (EIP) Project Goal

- The principal goal of this project is to demonstrate that resource-based industrial development can be optimally planned and designed in such a way so as to balance the environmental, economic, and social aspects of sustainability within the Edisto River Basin using concurrent planning and a systems-based design approach.

# The Sustainable Systems Analysis Algorithm (SSAA)



# The Sustainability Directive: An Uncharted Directional Bearing



# **LEOPOLD'S LAND ETHIC**

**A THING IS RIGHT WHEN IT  
TENDS TO PRESERVE THE  
INTEGRITY, STABILITY, AND  
BEAUTY OF THE BIOTIC  
COMMUNITY. IT IS WRONG  
WHEN IT TENDS OTHERWISE.**

# **CALLICOTT'S MODIFIED LAND ETHIC**

**A THING IS RIGHT WHEN IT  
TENDS TO DISTURB THE  
BIOTIC COMMUNITY ONLY AT  
NORMAL SPATIAL AND  
TEMPORAL SCALES. IT IS  
WRONG WHEN IT TENDS  
OTHERWISE.**



“The world that we have created with our way of thinking has problems that cannot be solved thinking the way we do now.”

*Albert Einstein*



Photo by A. Wilson

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