

Constraints and Opportunities for Planning and Management in a Rapidly Changing Environment

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Stewardship in a Complex World

- Industrial Ecology
 - Analogic Base
 - Worldview
 - Management Implications

Stewardship in a Complex World

- Industrial Ecology
- Complexity Theory
 - Insights from Nature
 - Concepts and Tools
 - Management Implications

Stewardship in a Complex World

- Industrial Ecology
- Complexity Theory
- Complexity Management
 - Adaptation and Anticipation
 - Stakeholder Involvement
 - Illustrations

Stewardship in a Complex World

- Industrial Ecology
- Complexity Theory
- Complexity Management
- A Pragmatist's Agenda

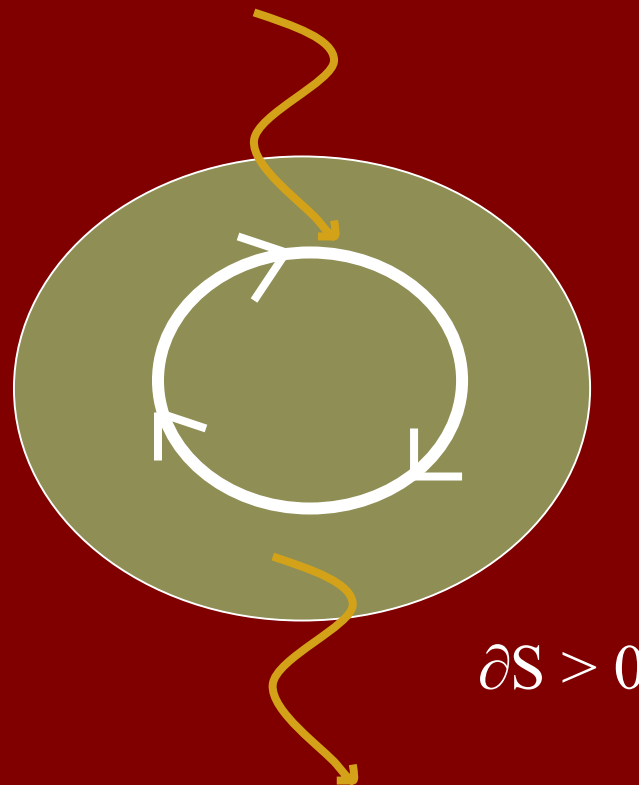
Industrial Ecology

- Analogic Base
- World View
- Management Implications

Industrial Ecology

Analagic Base

- Material Cycles and Energy Flows in Ecosystems



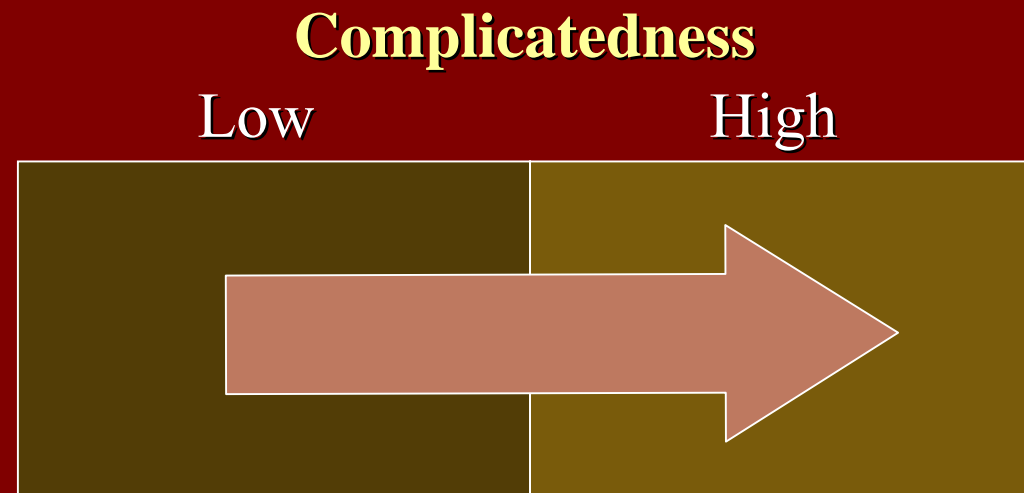
Industrial Ecology

Analogic Base

- Material Cycles and Energy Flows in Ecosystems
- Specialization and Diversification as Means to Promote Efficiency
- Gradualism and Reversibility

Industrial Ecology

World View



Industrial Ecology

World View

- Path Analysis
 - Given: System Input and Structure
 - Determine: System Output

Industrial Ecology

World View

- Path Analysis
 - Given: System Input and Structure
 - Determine: System Output
- Policy Analysis
 - Given: Structure and Desired Output
 - Determine: System Input

Industrial Ecology

Management Implications

Philosophy

Actors

Focus

Mind-set

Minimization

Specialists

End-of-Pipe

Reactive

Industrial Ecology

Management Implications

Philosophy

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Focus

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Specialists

End-of-Pipe

Reactive

Optimization

Managers

Process

Receptive

Industrial Ecology

Management Implications

<u><i>Philosophy</i></u>	<u><i>Actors</i></u>	<u><i>Focus</i></u>	<u><i>Mind-set</i></u>
Minimization	Specialists	End-of-Pipe	Reactive
Optimization	Managers	Process	Receptive
Diversification	Product/Process	Sector	Constructive

Industrial Ecology

Management Implications

<u><i>Philosophy</i></u>	<u><i>Actors</i></u>	<u><i>Focus</i></u>	<u><i>Mind-set</i></u>
Minimization	Specialists	End-of-Pipe	Reactive
Optimization	Managers	Process	Receptive
Diversification	Product/Process	Sector	Constructive
Vision	Society	Systems	Pro-active

Industrial Ecology

World View

- Path Analysis
 - Given: System Input and Structure
 - Determine: System Output
- Policy Analysis
 - Given: Structure and Desired Output
 - Determine: System Input

Industrial Ecology

World View

- Path Analysis
 - Given: System Input and Structure
 - Determine: System Output
- Policy Analysis
 - Given: Structure and Desired Output
 - Determine: System Input
- System Design
 - Given: Desired Output
 - Determine: Structure and Input

Complexity Theory

- Insights from Nature
- Concepts and Tools
- Management Implications

Complexity Theory

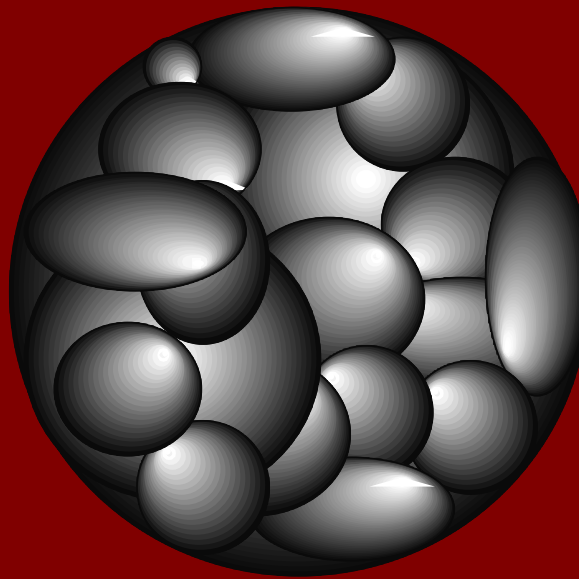
Insights from Nature

- Nonlinearities, Lags and Irreversibilities
- Bifurcations, Chaos, Catastrophies and Self-organized Criticality
- Fundamental Uncertainties and Surprise

Complexity Theory

Concepts and Tools

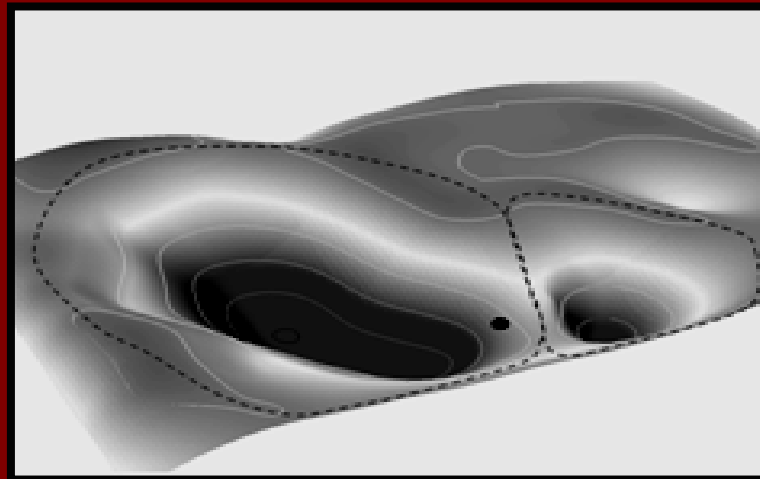
- Concepts
 - Nested Hierarchies



Complexity Theory

Concepts and Tools

- Concepts
 - Nested Hierarchies
 - Attractors, Resilience, Adaptability and Transformability



Complexity Theory

Concepts and Tools

- Concepts
 - Nested Hierarchies
 - Attractors, Resilience, Adaptability and Transformability
- Dynamic Modeling
 - Data Collection and Organization
 - Identification of Causal Relationships
 - Simulation and Scenario Development
 - Information Exchange and Knowledge Generation

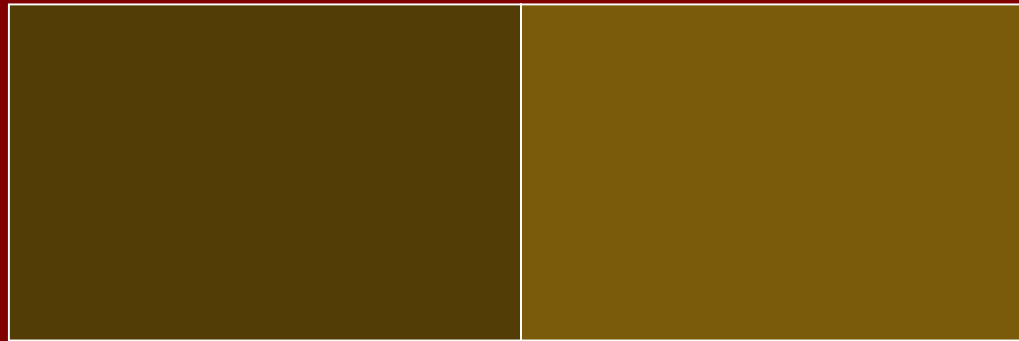
Complexity Theory

Management Implications

Complexity

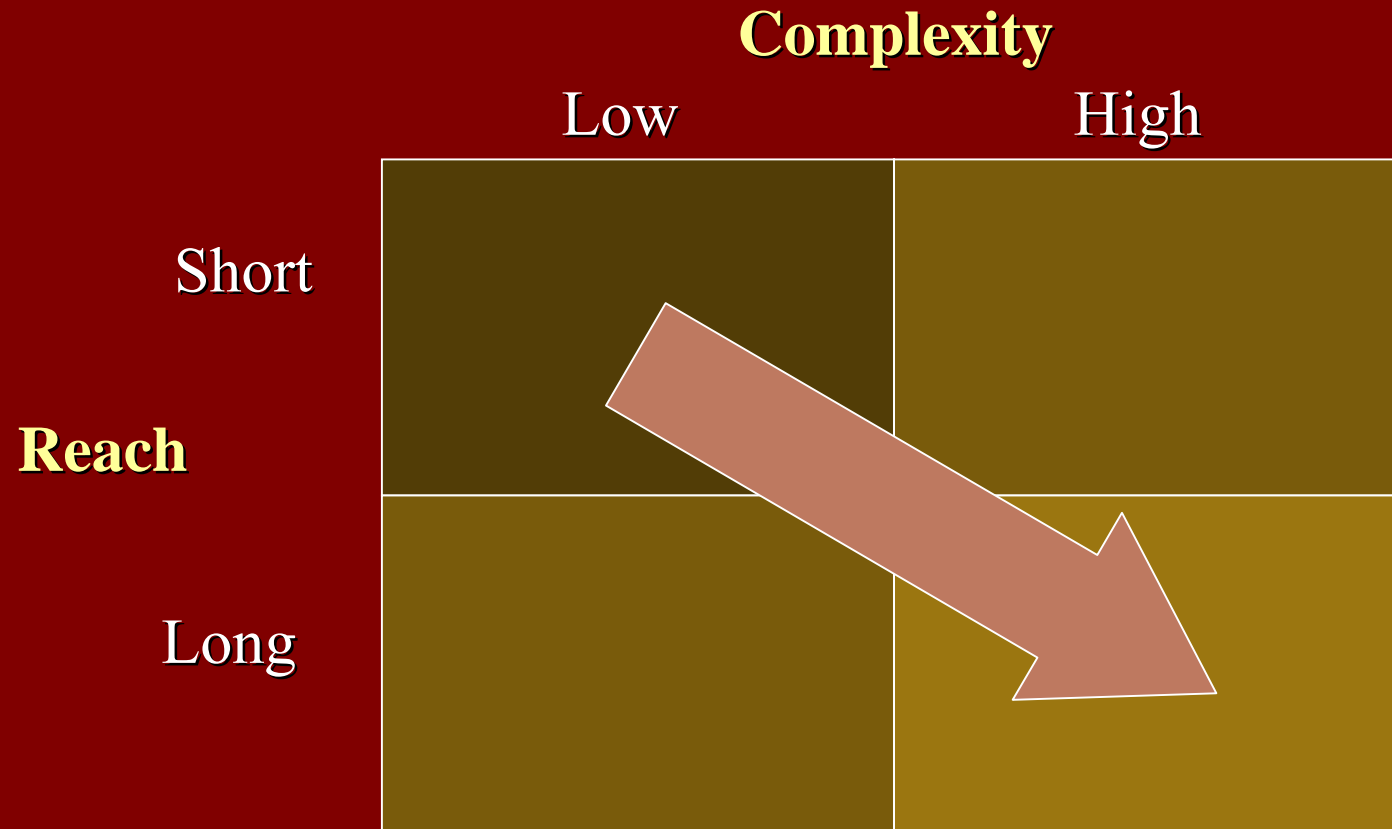
Low

High



Complexity Theory

Management Implications



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Complexity Management

- Dynamic Modeling for Decision Support

Complexity Management

- Dynamic Modeling for Decision Support
- Stakeholder Involvement

Complexity Management

- Dynamic Modeling for Decision Support
- Stakeholder Involvement
- Adaptive and Anticipatory Management
 - Passive Adaptation
 - Active Adaptation
 - Anticipation

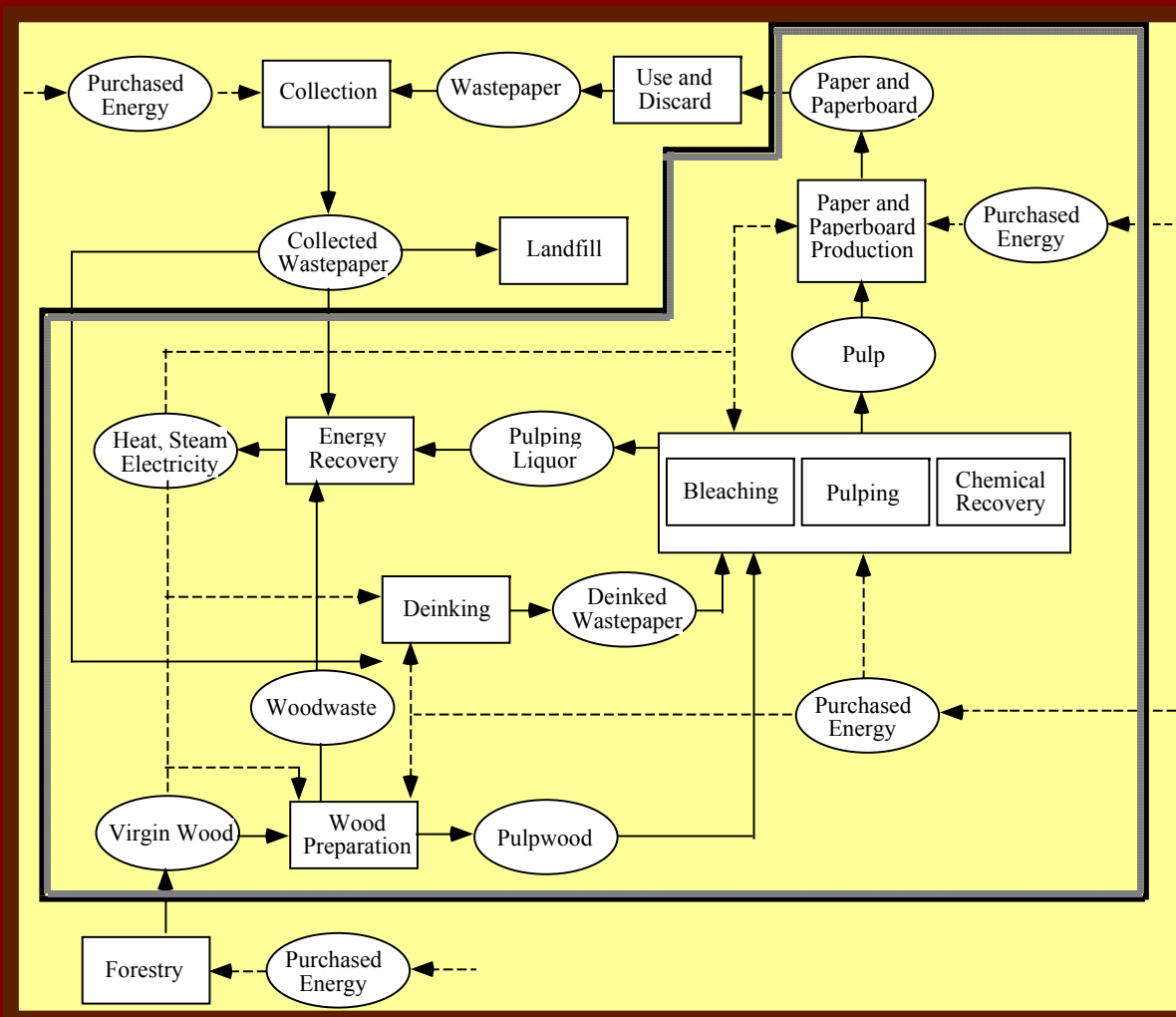
Complexity Management

- Dynamic Modeling for Decision Support
- Stakeholder Involvement
- Adaptive and Anticipatory Management
- Illustrations

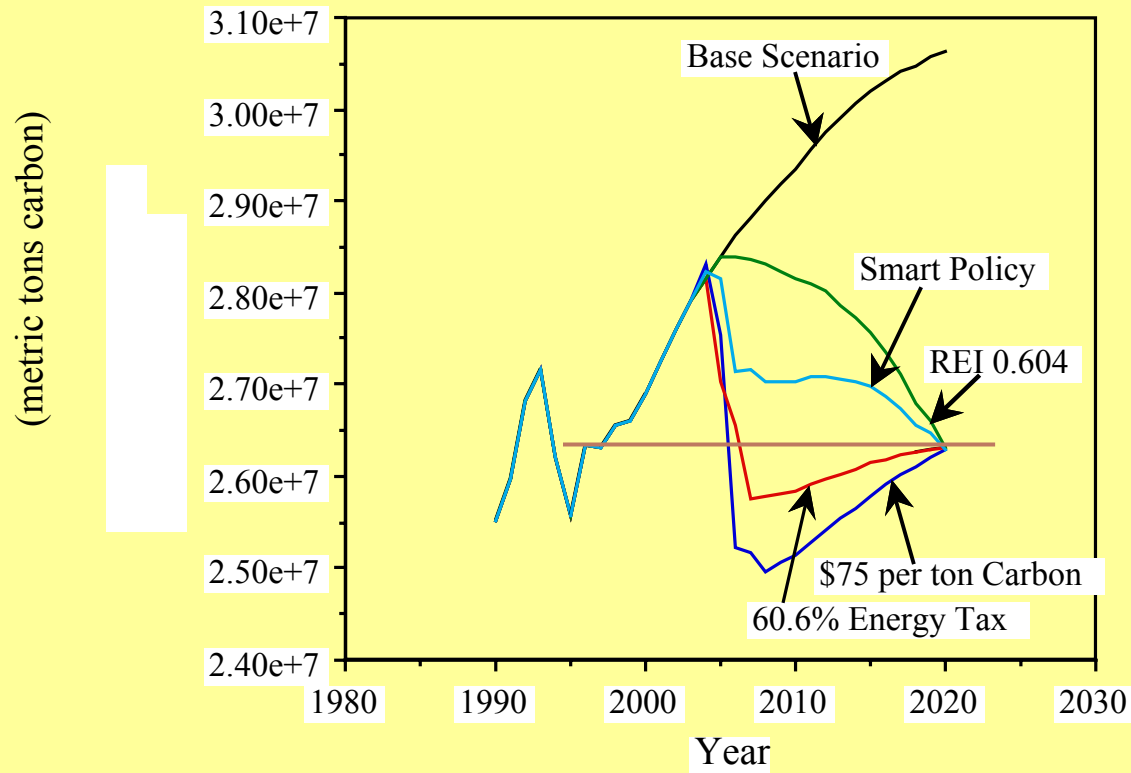
Illustrations

- US Pulp and Paper Industry
- Urban Infrastructure

US Pulp and Paper

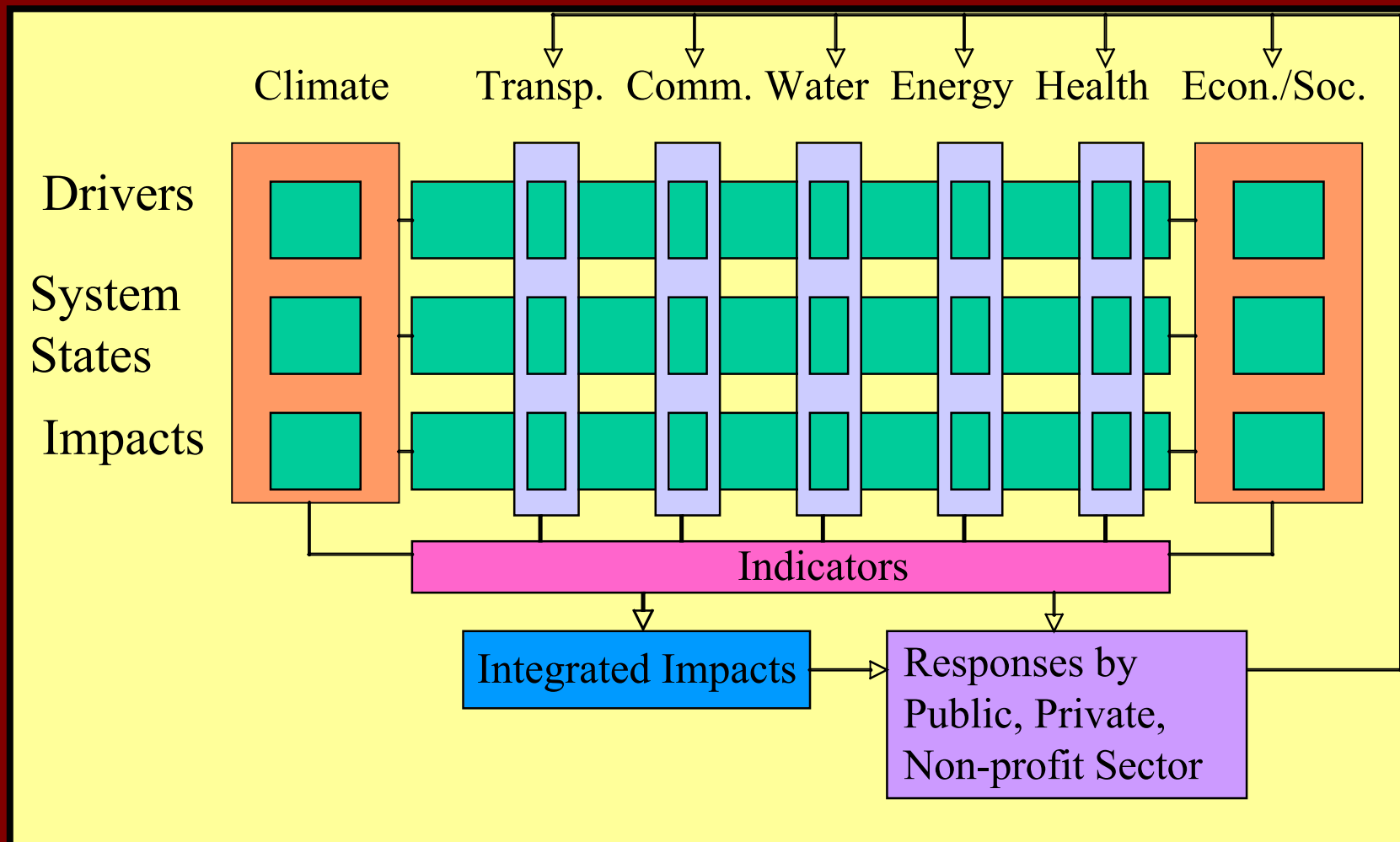


Identification of Investment and Policy Portfolios

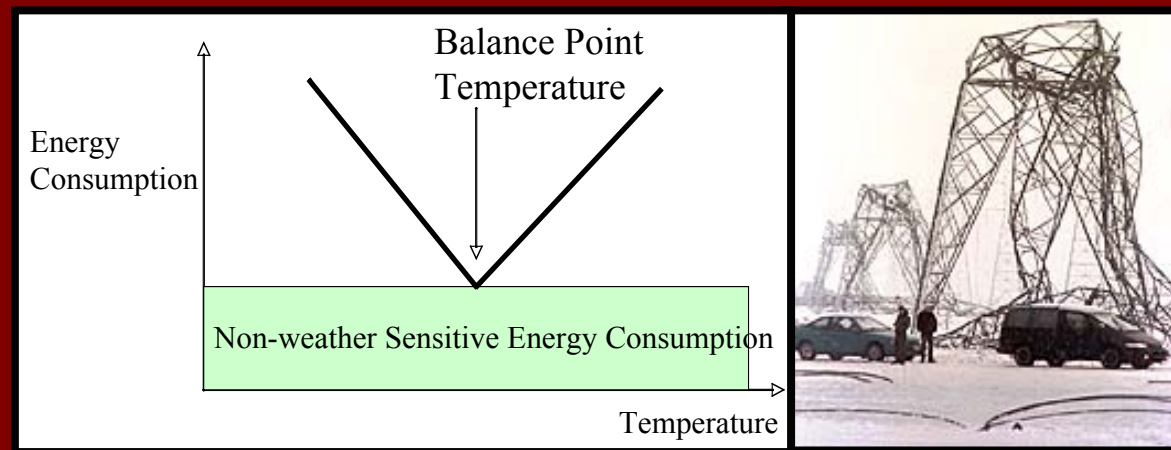


Illustrations

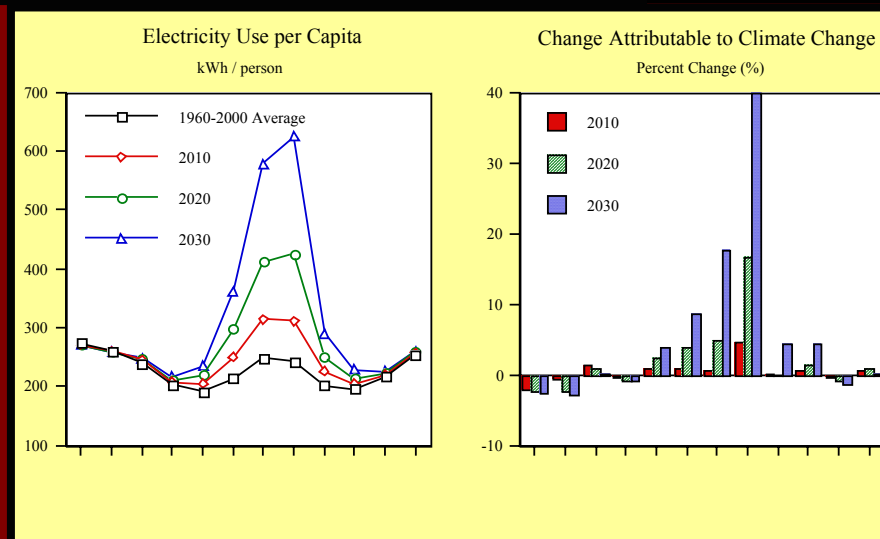
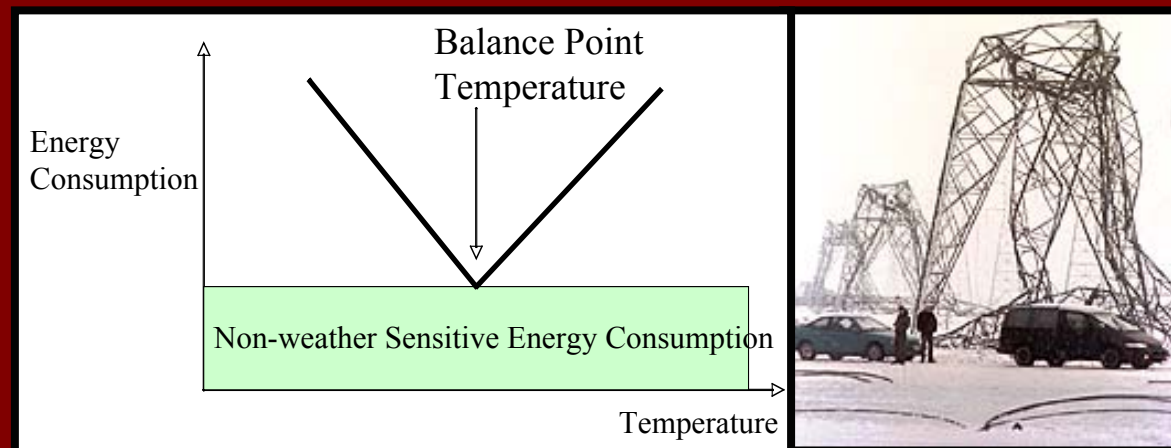
Urban Infrastructure



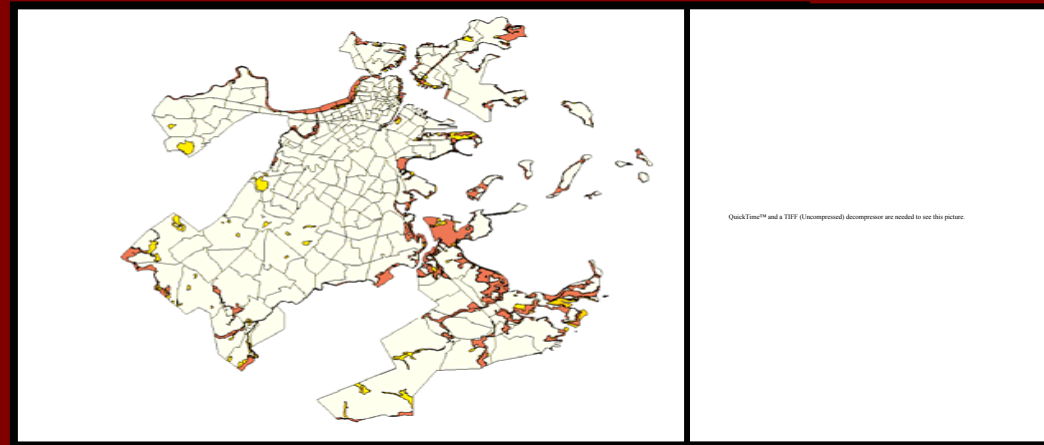
Climate's Long-term Impacts on Energy Systems



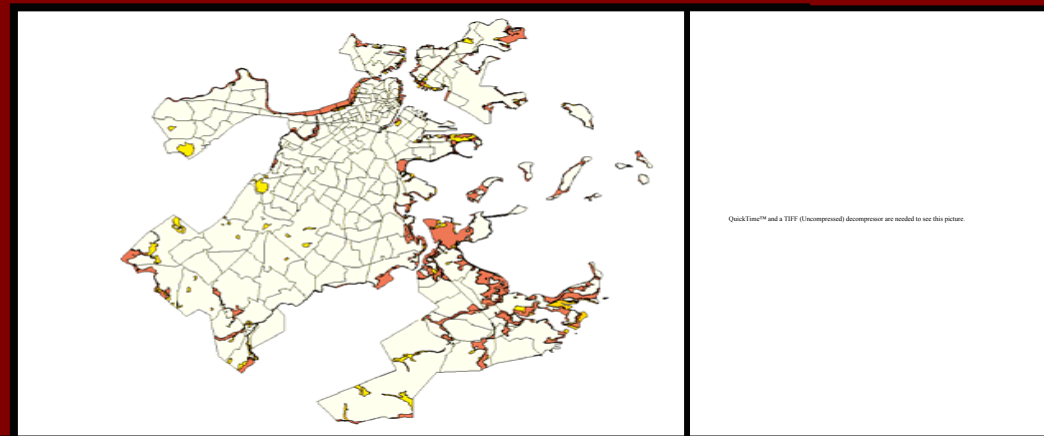
Climate's Long-term Impacts on Energy Systems



Climate's Long-term Impacts on Transportation Infrastructure



Climate's Long-term Impacts on Transportation Infrastructure



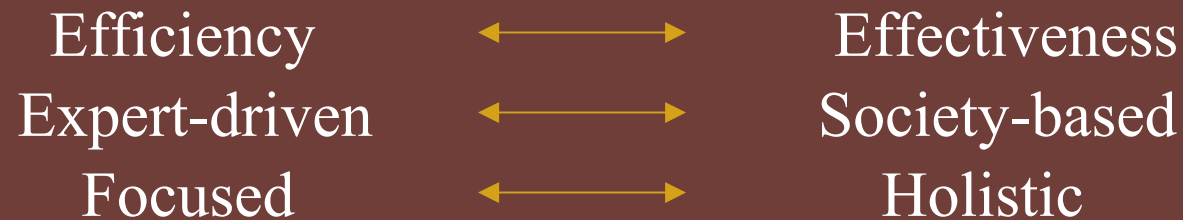
Year	No Change	Subsidence	Subsidence and CC
2000 - 2025	100	100	71.4
2025 – 2050	67.5	67.5	25.2
2051 – 2075	80.6	48.0	7.1
2076 - 2100	92.5	38.4	3.7

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A Pragmatist's Agenda for Planning and Management in a Rapidly Changing Environment

1. Taking Complexity Seriously



A Pragmatist's Agenda for Planning and Management in a Rapidly Changing Environment

1. Taking Complexity Seriously
2. Promoting Anticipatory Management
 - Forward-looking Design Criteria and Standards
 - Incentives for Cross-institutional Collaboration
 - Encouragement of Profit-seeking without a Socialization of Associated Cost

A Pragmatist's Agenda for Planning and Management in a Rapidly Changing Environment

1. Taking Complexity Seriously
2. Promoting Anticipatory Management
3. Establishing Dialog for Investment and Policy-relevant Research

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