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SUSTAINABLE MATERIALS MANAGEMENT

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*The content of this presentation reflects the views of the author and does not represent the policies or position of the U.S. EPA.

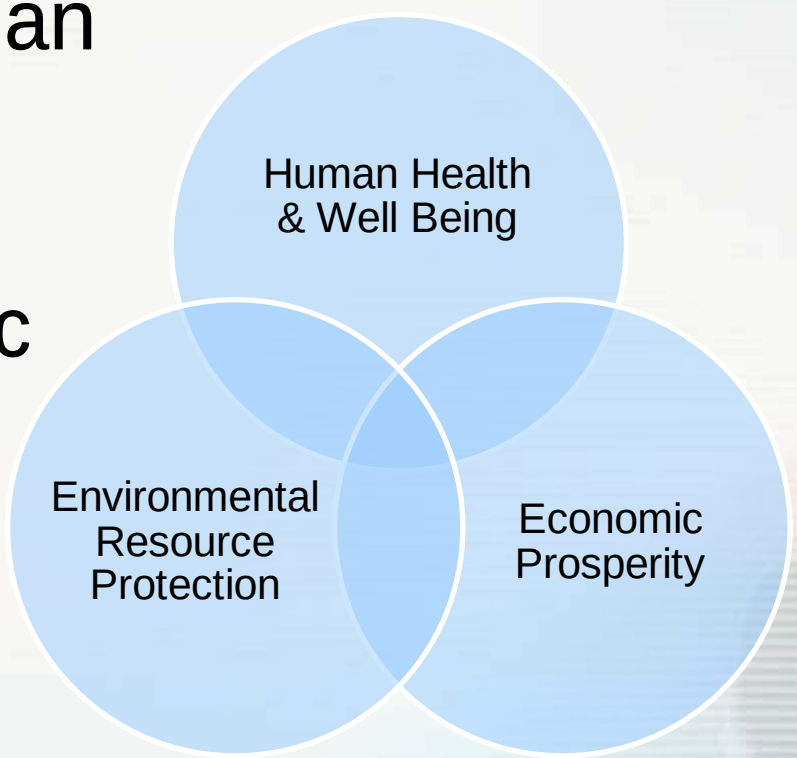
What is Sustainability?

Development that meets the needs of the present without compromising the ability of future generations to meet their own needs

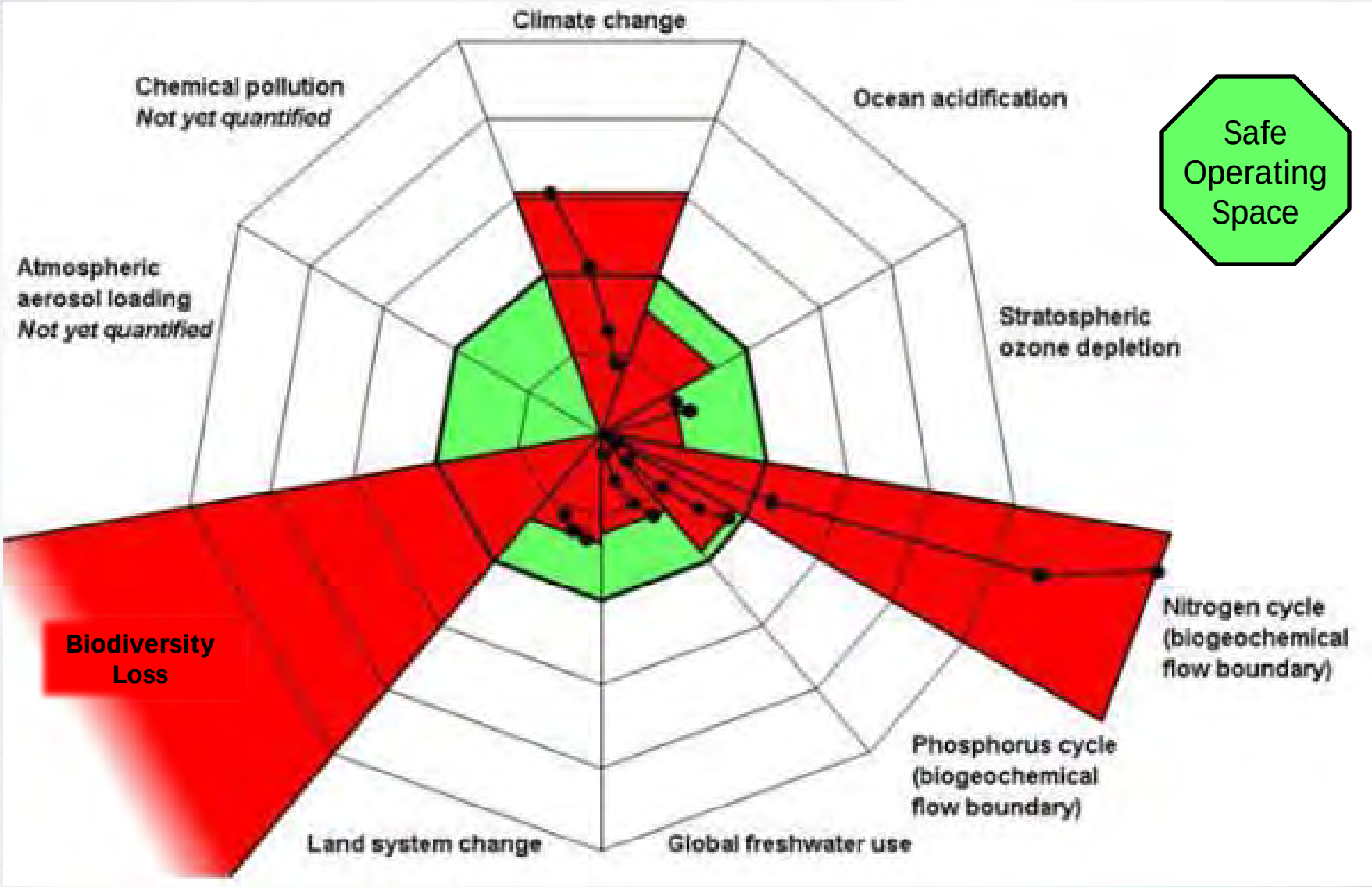
Brundtland Commission, 1987

What is Sustainability?
A more explicit definition…

The continuation of human health and well being, environmental resource protection, and economic prosperity—now and for generations to come



Exceeding Planetary Boundaries



Source: Stockholm Resilience Centre, 2009

Sustainable Development

"Meeting the needs of the present without compromising the ability of future generations to meet their own needs"

- World Commission on Environment & Development, 1987

Challenges

- **Global warming, melting ice, rising oceans**
- **Ecosystem degradation, biodiversity loss**
- **Resource scarcity (water, land, minerals)**
- **Infectious diseases (viral, bacterial)**
- **Urbanization, social disintegration**
- **Income gaps (rich vs. poor)**
- **Population growth**

The Kaya Identity

Total carbon burden

= population (\$GDP/capita) 

(resources/\$GDP) 

(burden/resource unit) 

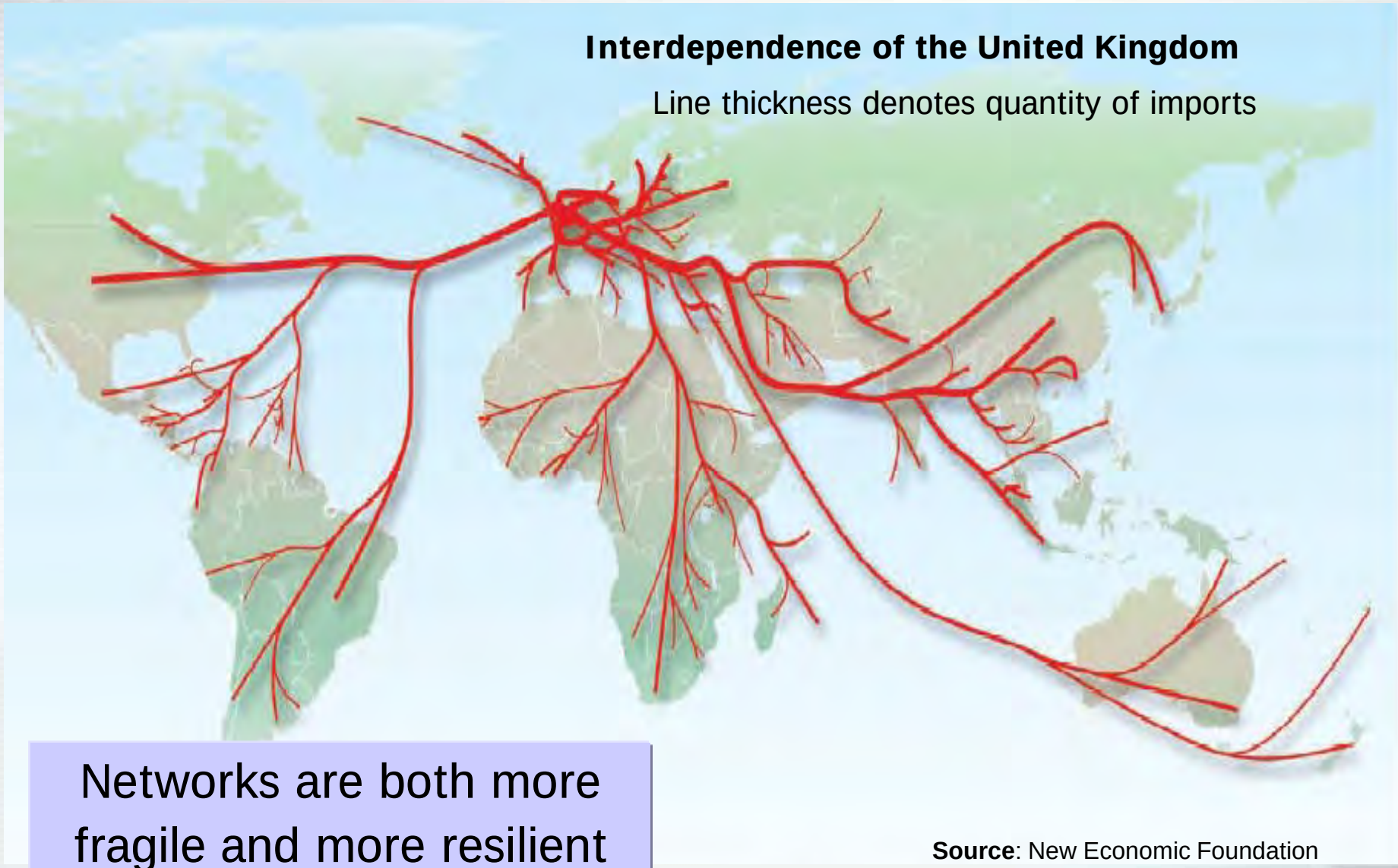
Global challenge:
Decouple resource consumption from economic growth

Sustainable Materials Management

"SMM is an approach to promote sustainable materials use, integrating actions targeted at reducing negative environmental impacts and preserving natural capital throughout the life-cycle of materials, taking into account economic efficiency and social equity."

Working Group on Waste Prevention and Recycling

Global Supply Chains

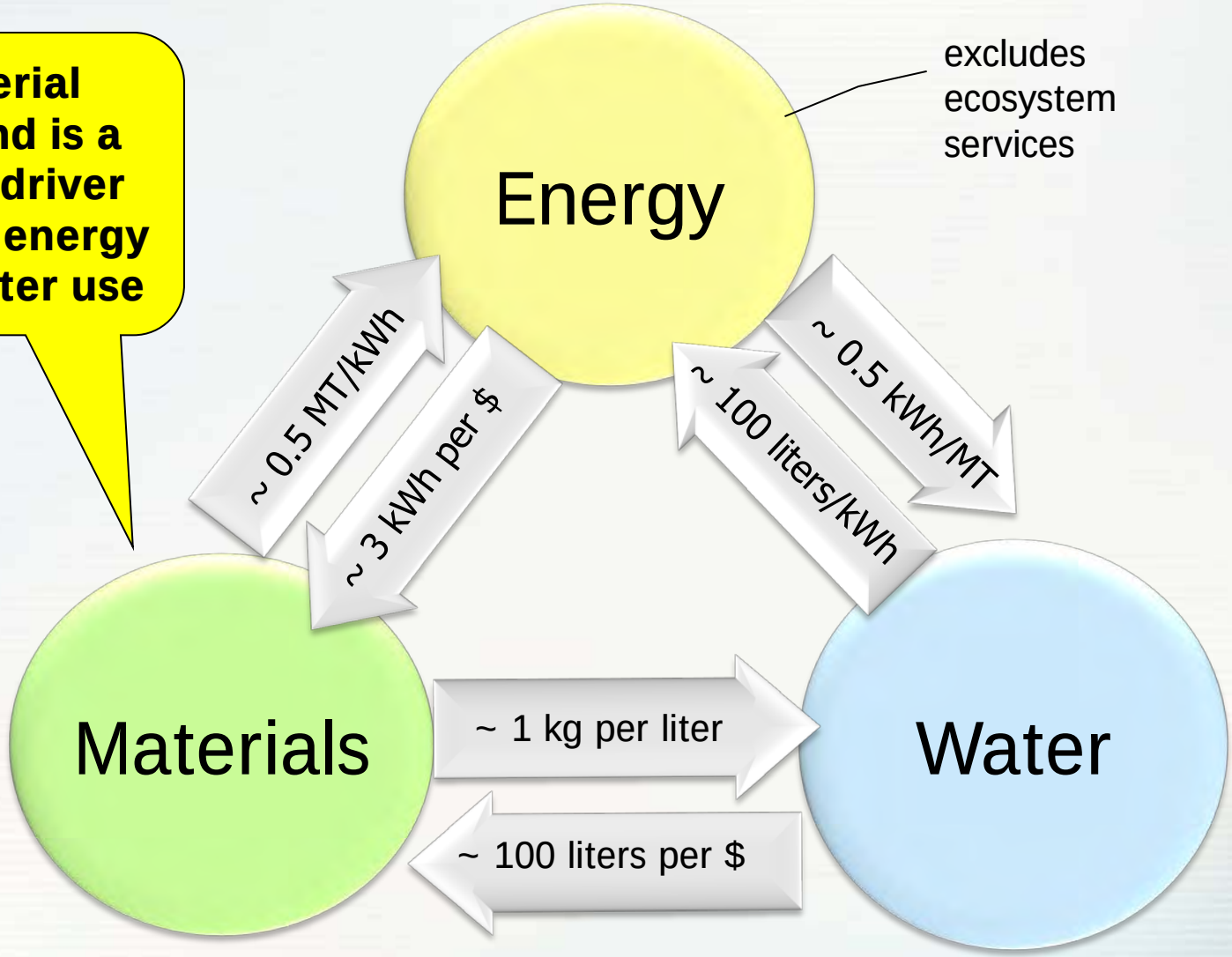


Networks are both more fragile and more resilient than isolated systems

Source: New Economic Foundation

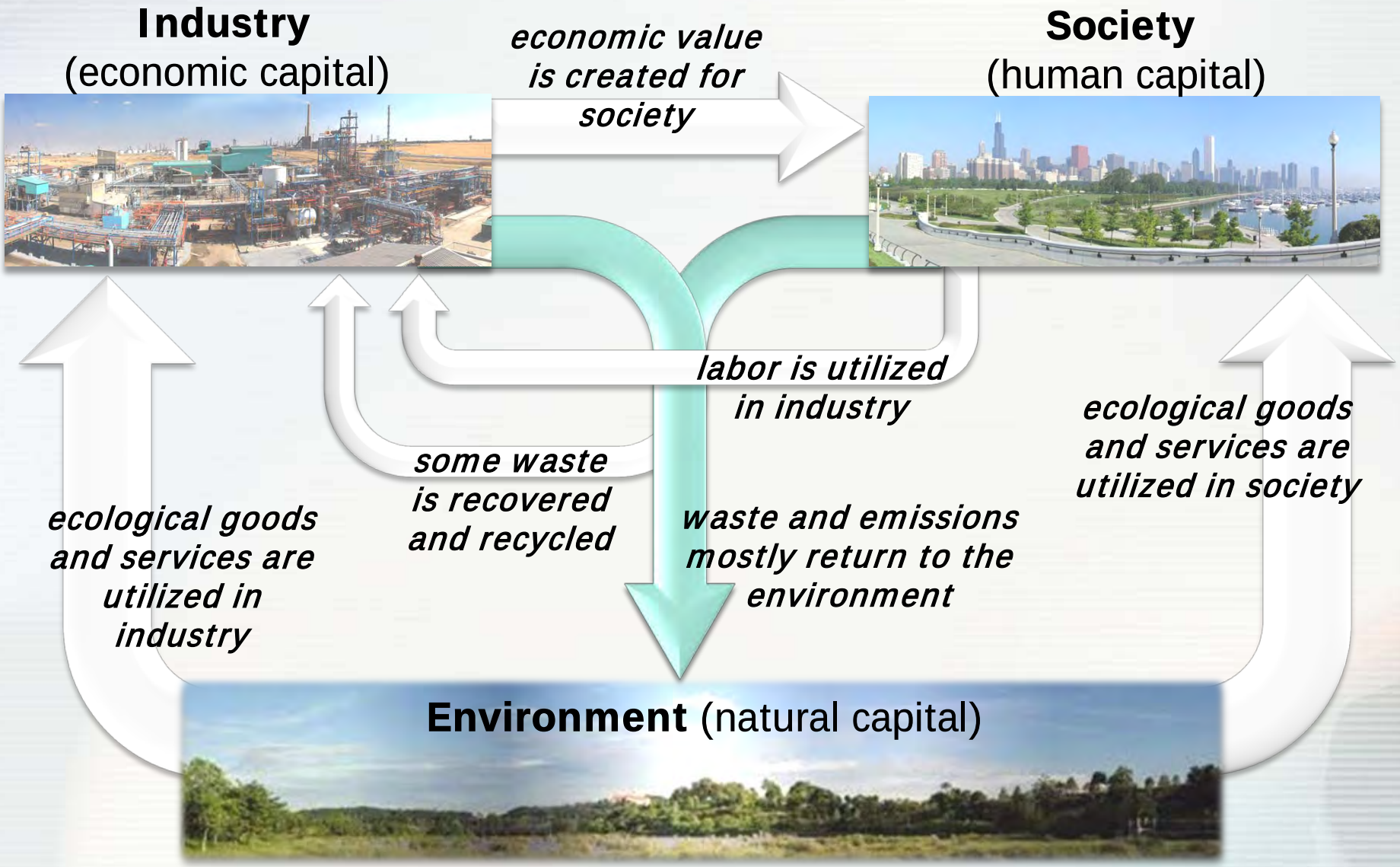
The Material-Energy-Water Nexus

Material demand is a major driver of both energy and water use



Source: J. Fiksel, "Evaluating Supply Chain Sustainability," *Chemical Engineering Progress*, May 2010.

Systems View of Material Flows



Adapted from: J. Fiksel, A Framework for Sustainable Materials Management, *Journal of Materials,* August 2006.

SMM Policy Intervention Options

Principle 3 - Use the full suite of policy instruments

collaborate

educate

evaluate

eliminate

Principle 2 – Adopt a life cycle perspective

Principle 4 - Engage all parts of society

facilitate

innovate

regulate

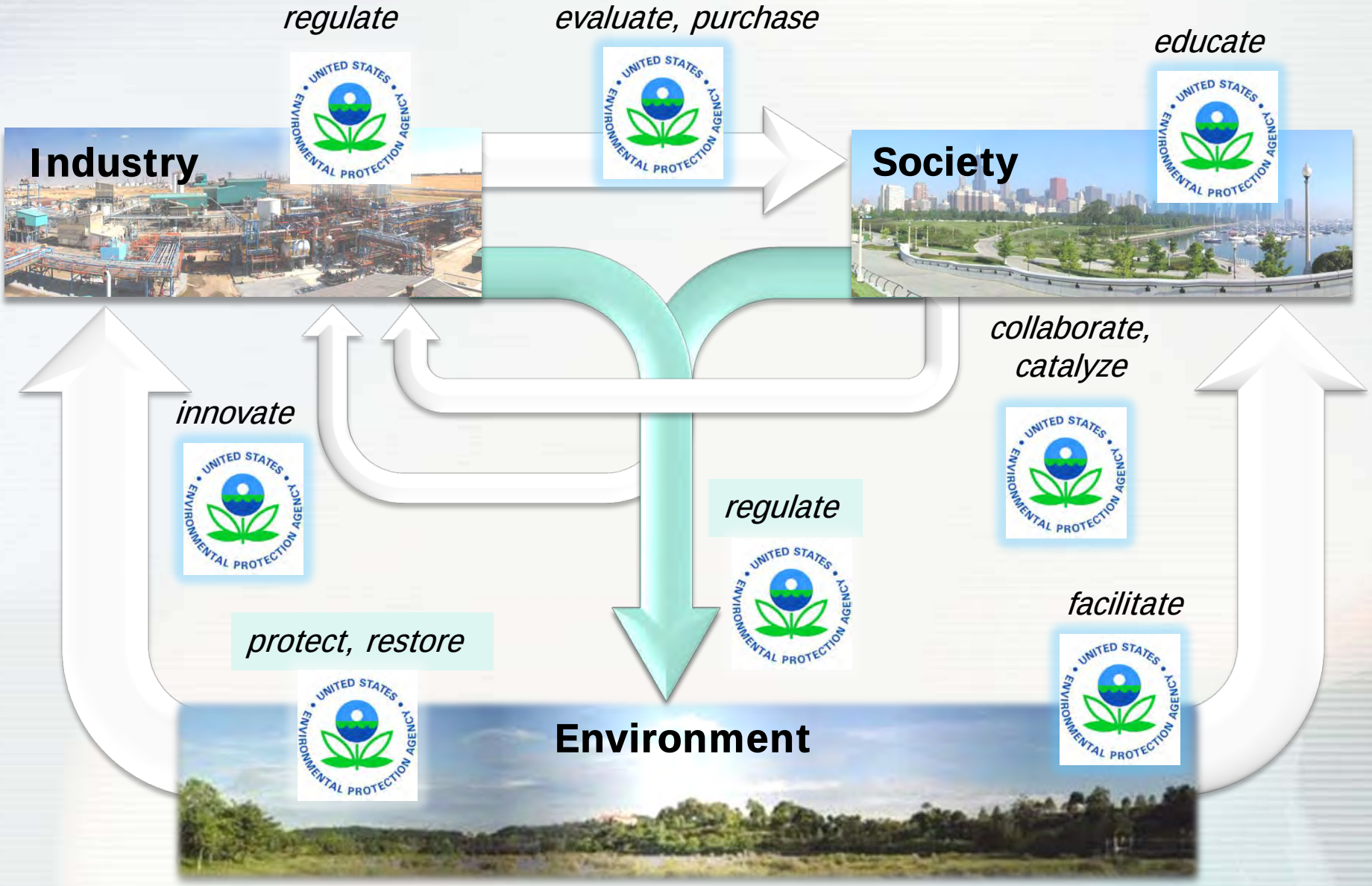
motivate

Principle 1 - Preserve natural capital

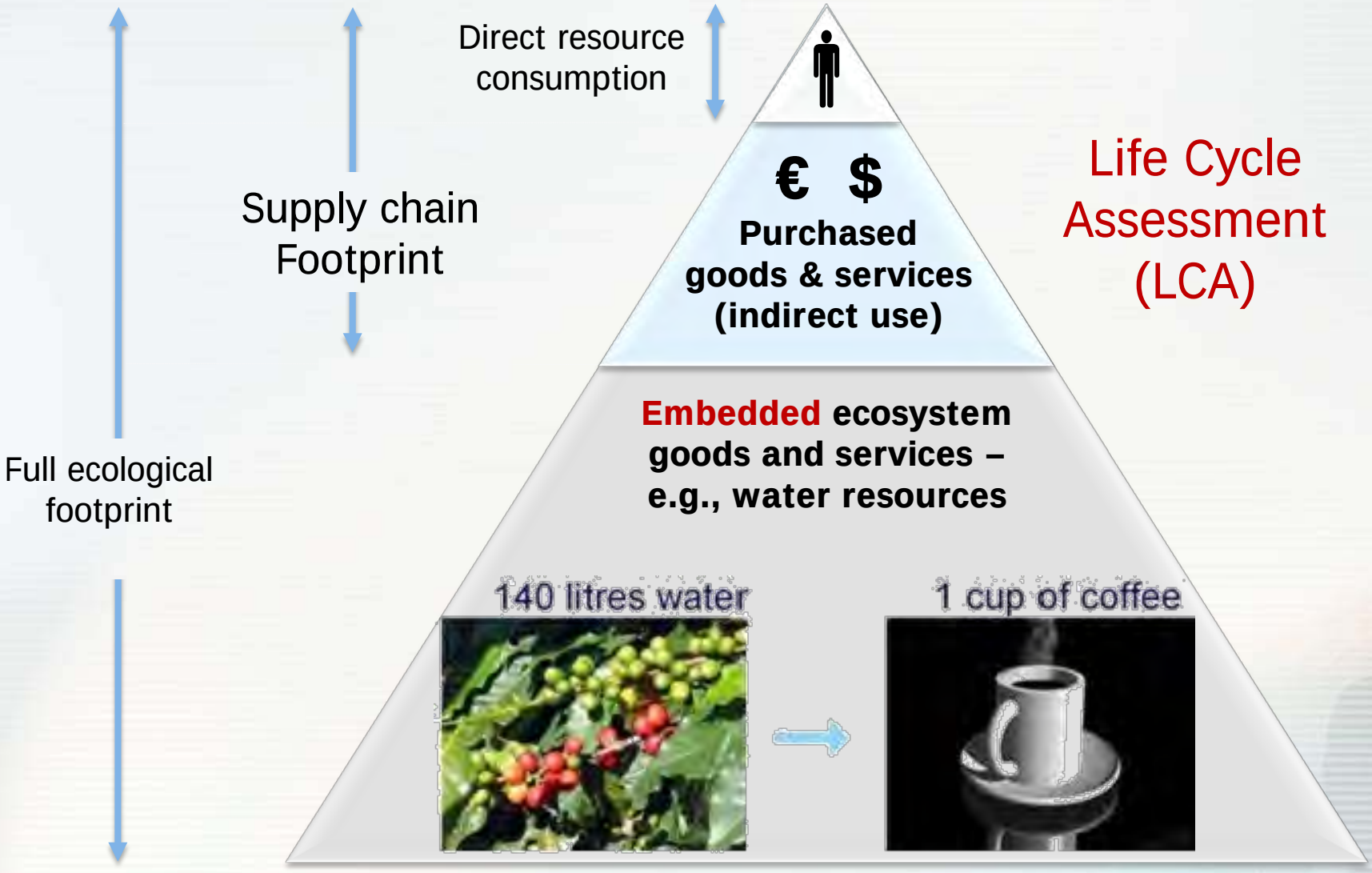
mitigate

ameliorate

Potential EPA Interventions



Preserving Natural Capital

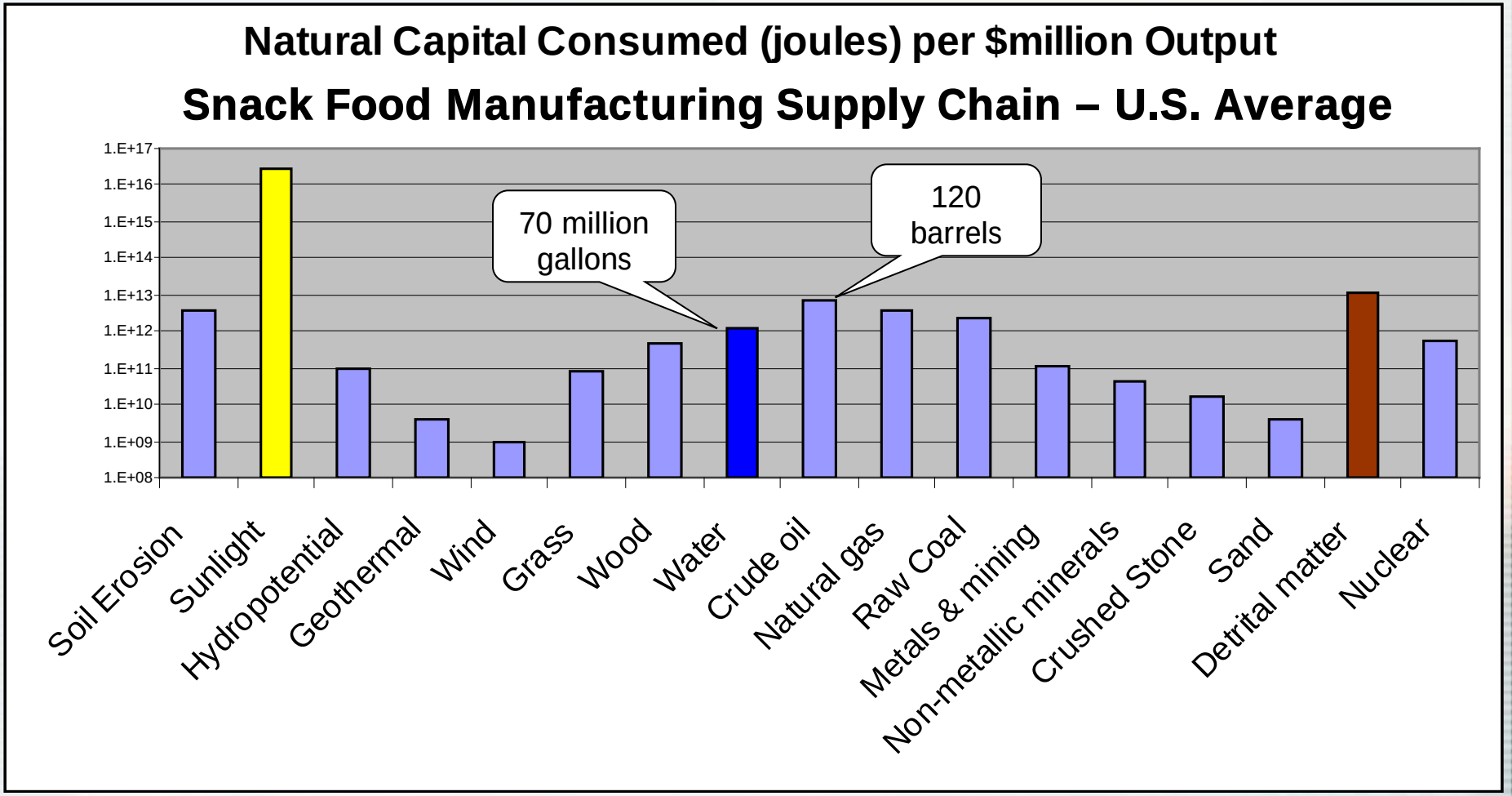


Life Cycle Assessment (LCA)

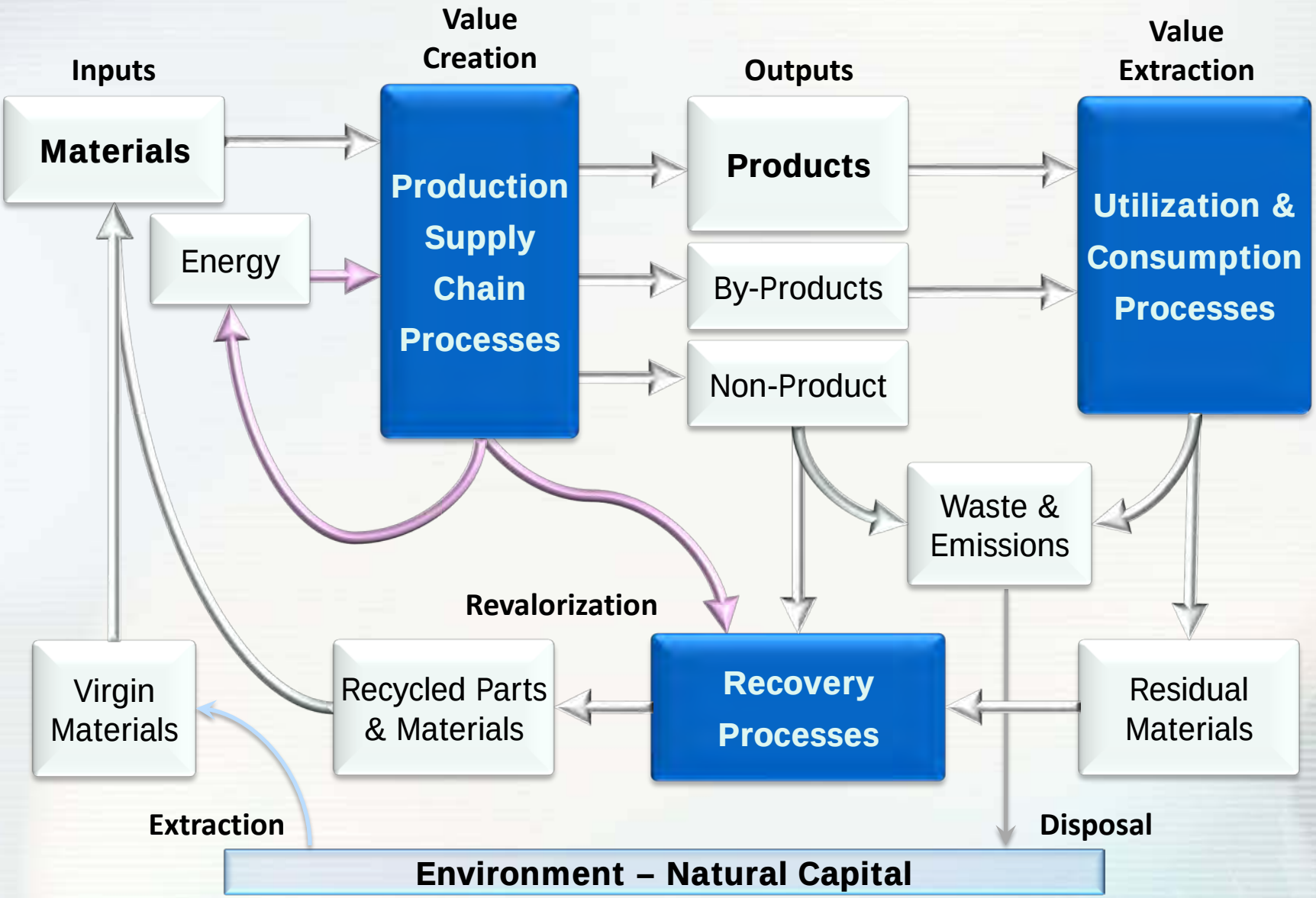
Example: Snack Food Industry

"Embedded" natural capital for a typical U.S. food supply chain, converted into energy equivalents

Source: OSU Center for Resilience



Life Cycle of Materials



Example: Aluminum Industry

Recycling uses 5% of energy & material flows vs. primary

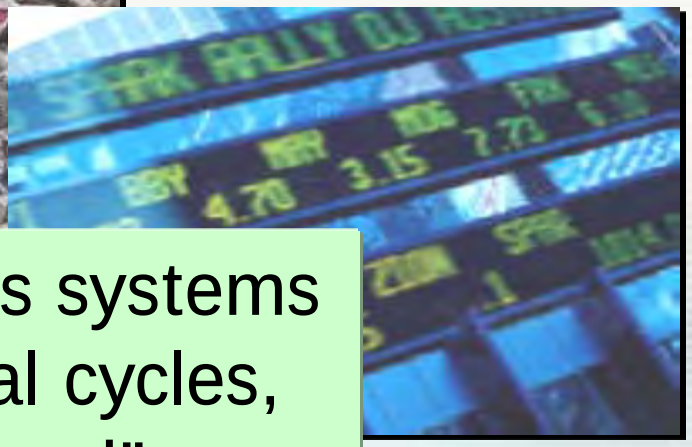
Source: Alcan

Industrial Ecology

Waste = Food

= Value

= Profit

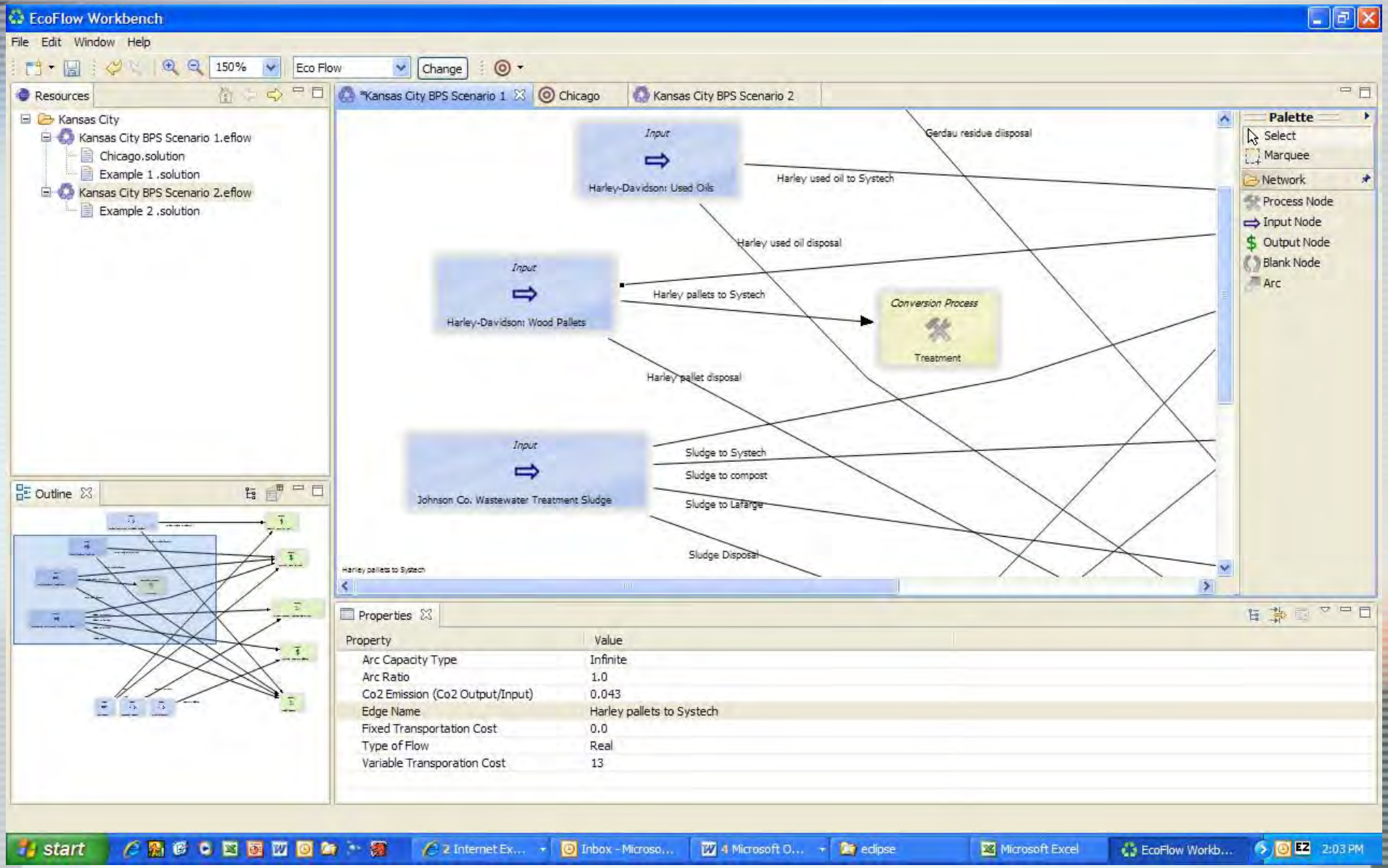


Industrial ecology is a process systems approach that mimics natural cycles, converting waste into “food”

Ohio By-Product Synergy Network

Converting solid waste streams into economically valuable byproducts

Eco-Flow™ Graphical Interface



Material flow analysis and optimization tool (partially funded by EPA STAR grant)

Ohio BPS Network Estimated Benefits

By-Product Synergy Metrics	Annual Savings
Total Cost Savings	$3,495,393
Waste to Landfill avoided (tons)	29,066
Direct Greenhouse Gas Emissions (MT)	1,182
Life Cycle Greenhouse Gas Emissions (MT)	230,137
Life cycle Water Use Reduction (1000 gal)	73,430
Total Life Cycle Energy Use (1000 GJ)	34,900
Non-renewable Resources (1000 tons)	503,416

Sustainable Business Practices

Release Reduction

Hazard Reduction

Benign Waste Disposition

Product Recovery

Disassembly

Recyclability

Energy & Material Conservation

Source Reduction

Servicization

Demater-ialization

Detoxif-ication

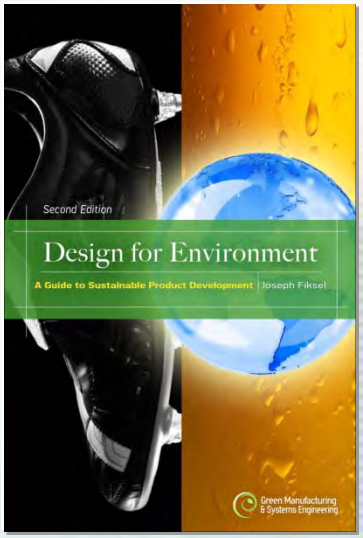
Value Recovery

Capital Protection and Renewal

Human Capital

Natural Capital

Economic Capital



Source: J. Fiksel, **Design for Environment**: A Guide to Sustainable Product Development, McGraw-Hill 2009

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