

Meet Sustainability Goals Using a Framework for Life Cycle Review of Products

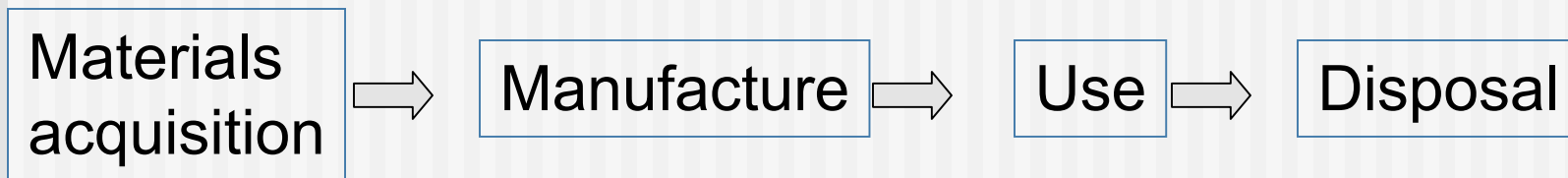
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Sustainability *via* Life Cycle Management

- Managing risks throughout the life cycle
 - Making *better* choices
 - Focusing on the worst first
 - Recognizing there are trade-offs in reducing risks
- Using the best information you can afford
 - Getting more information when there are serious concerns or
 - Defaulting to controls until you know more

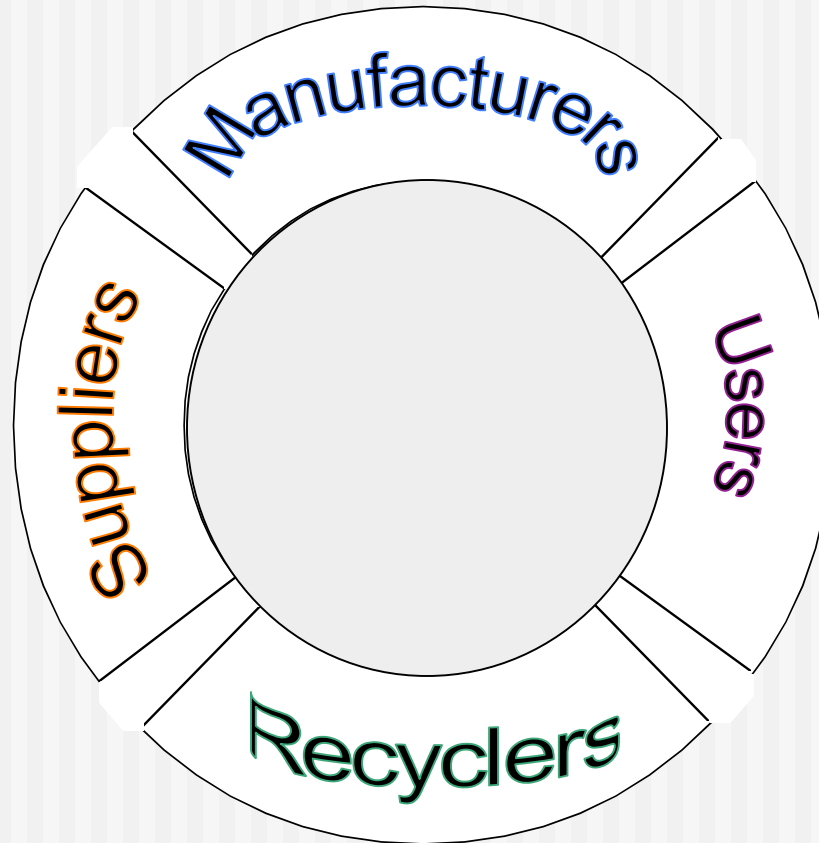
Life Cycle

“cradle to grave”

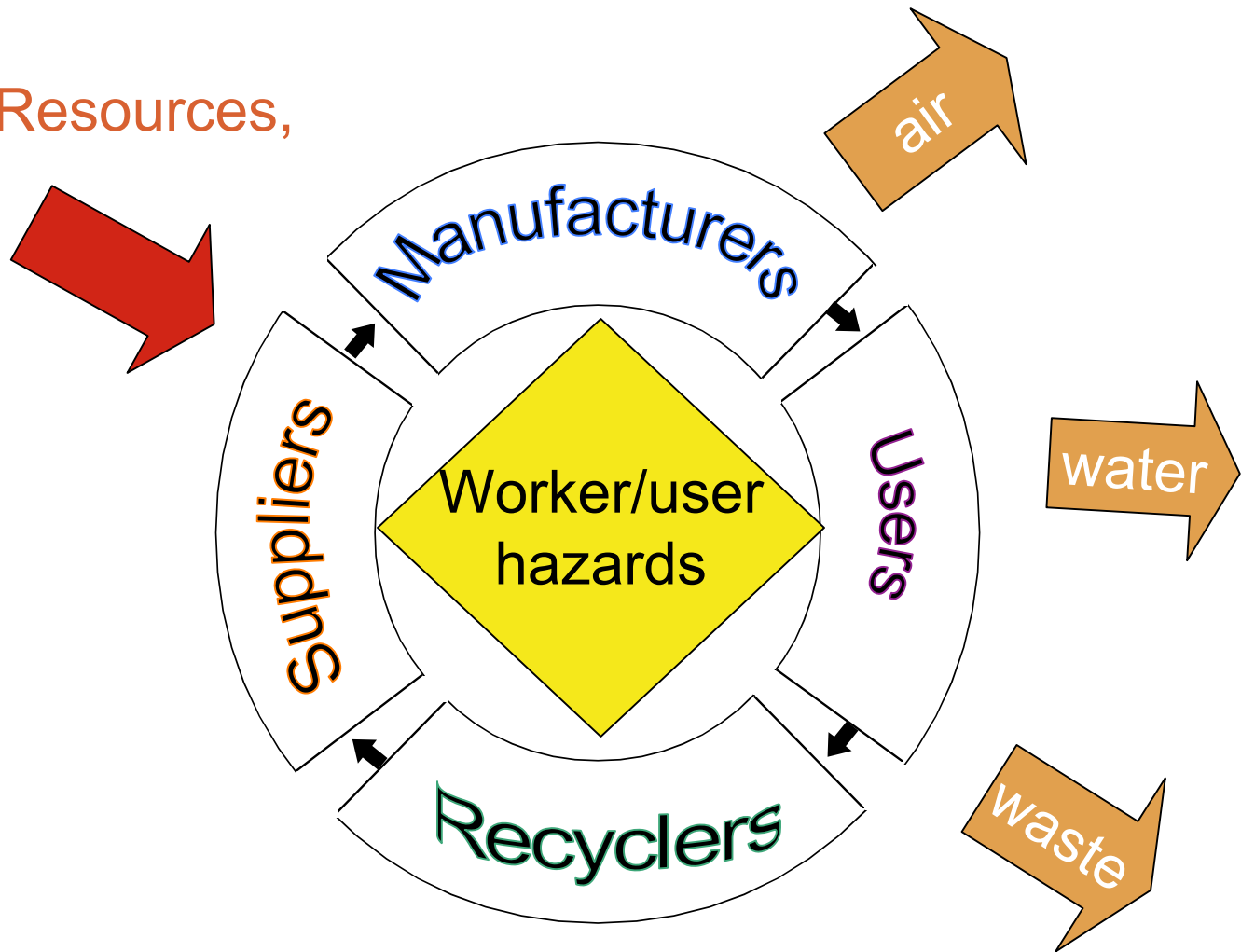


Life Cycle

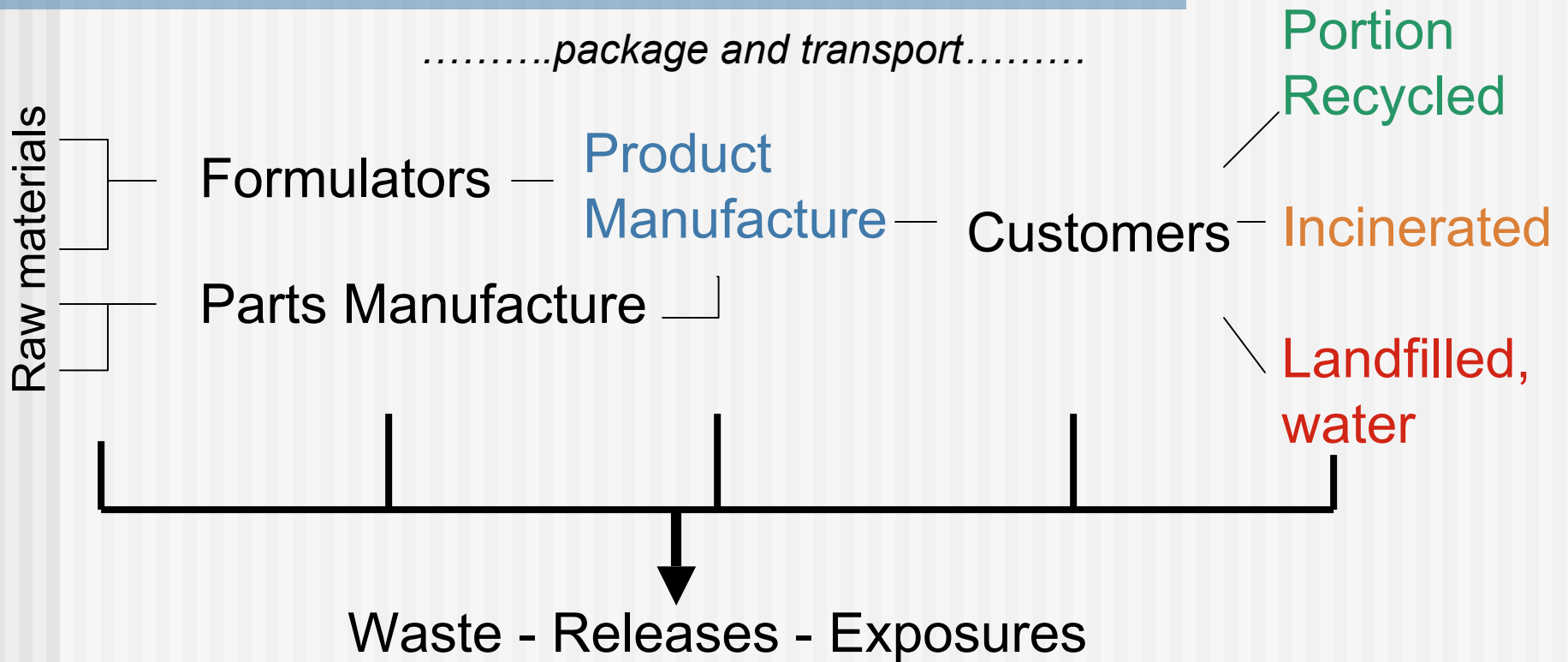
“cradle to cradle”



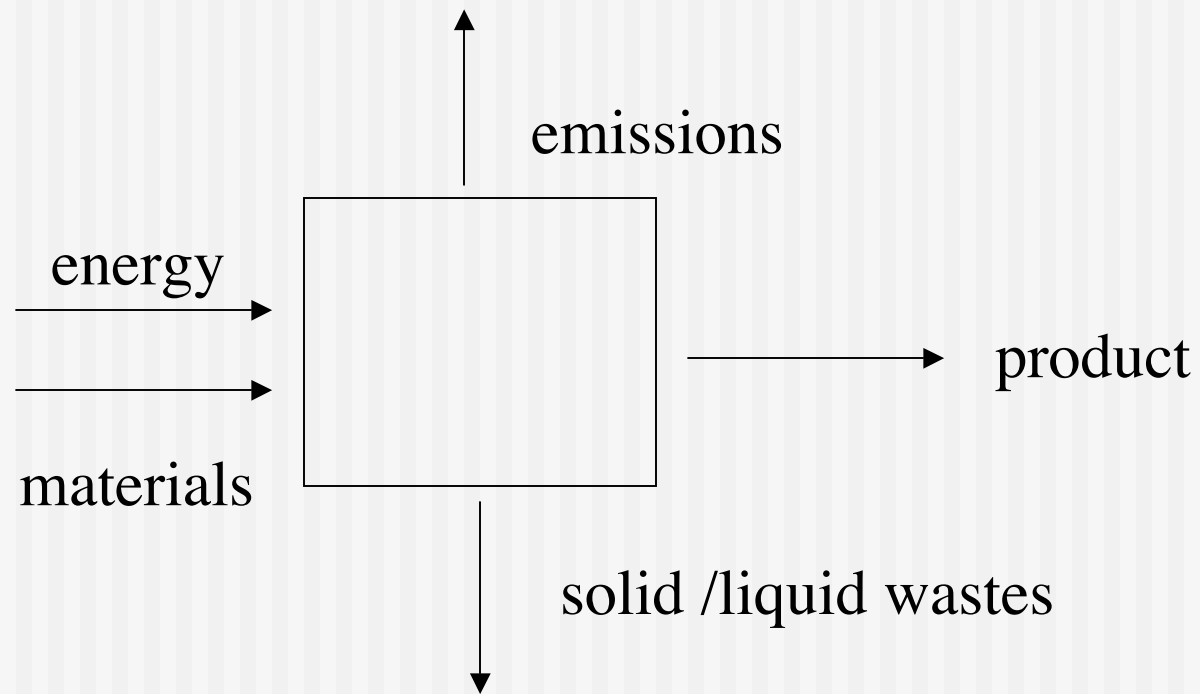
Natural Resources,
Energy



Life Cycle Flow

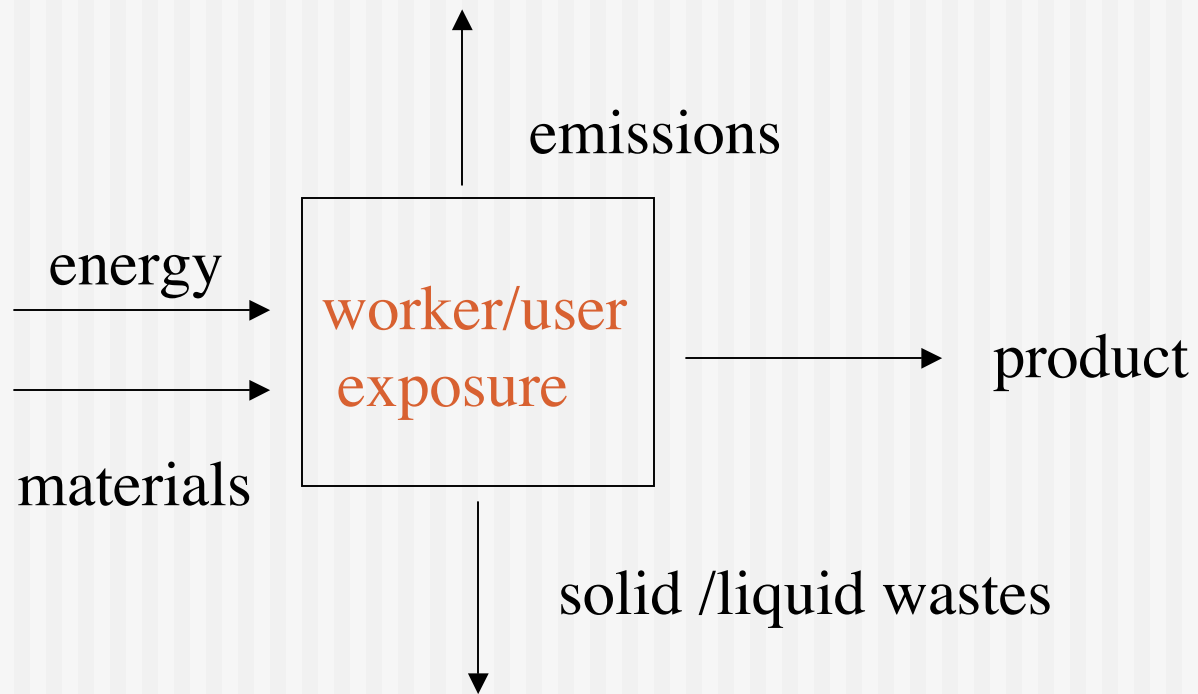


Impacts *at each stage*



Impacts

not just environmental concerns



For Each Stage

- **Characterize** the chemicals and hazards present
 - Toxic, reactive, flammable, volatile, respirable, degradable, highly regulated, public concerns
- What **losses** to environment occur
 - Quantity, media, dispersion
 - Neighbors and species affected
 - Energy use
- What **exposures** of concern (health and safety)
 - Workers and Users
- What is **unknown**, but are worried about
- **RISK = hazard and exposure**

Life Cycle Analysis (LCA)

- Life Cycle Analysis (or Assessment)
 - Formalized, scientific characterization of impacts of releases at each step in a product's life. Best, but...
 - Large number of variables and assumptions, many of which cannot be definitively measured nor have consensus values
 - Setting boundaries of the universe of inputs and outputs key
 - non-renewable resource mining or within the fence-line of a plant, exposures to nearby neighbors or to the planet as a whole
 - Very data intensive \$\$\$\$ and controversial
 - May be industry-specific algorithms available
 - <http://www.epa.gov/ORD/NRMRL/lcaccess/lca101.htm>
 - http://www.setac.org/htdocs/who_intgrp_lca.html

**Life Cycle
Risks +
Improvements**

Suppliers

Manufacture
Process

Uses

Disposal

	Suppliers	Manufacture Process	Uses	Disposal
Environ- ment				
Health				
Safety				
Public Concern				

**Life Cycle
Risks +
Improvements**

Suppliers

Manufacture
Process

Uses

Disposal

<p>E</p>	<p>Energy, Air, Water, Waste, Resources, Climate, Ecosystem</p>			
<p>Health</p>				
<p>Safety</p>				
<p>Public Concern</p>				

**Life Cycle
Risks +
Improvements**

Suppliers

Manufacture
Process

Uses

Disposal

Envir

H

Safety

Public
Concern

Acute and chronic toxicity from
chemicals and pathogens

**Life Cycle
Risks +
Improvements**

Suppliers

Manufacture
Process

Uses

Disposal

Envir

Health

S

Injury - ergo, mechanical, electrical, radiation

Public
Concern

**Life Cycle
Risks +
Improvements**

Suppliers

Manufacture
Process

Uses

Disposal

Envir

Health

Safety

Public
Concern

Chemicals, child labor, NIMBY, ????

Life Cycle Management

- Put it all together and highlight the most serious concerns
 - Cross-functional team reviews most powerful
- What do you **need to know** more about to decide?
 - Supplier, screening tests, analytical, compare to similar chemicals and products, talk to users
 - Buy some experts - focused LCA
 - Can be qualitative or quantitative depending on level of concern and resources
- What can you do to better **reduce risks** overall?
 - Can you find “fixes” that improve multiple stages?
 - If you fix one issue, did you create another problem (or opportunity) up- or down-stream?

Product X

	Suppliers	Manufacture Process	Uses	Disposal
E	Hazardous waste	Recover metals	compliant	Not recyclable
H	?	respirators slurry	No chemical release	None known
S	?	None known	Cuts - packaging	None known
Public Concern	Heavy metal 3rd world	Small particulate	Kids	Municipal landfills

Life Cycle Management

- More hazard communication
- Green chemistry
- Enclose hazards away from workers and user
- Pollution controls
- Improve yields through process changes
- Work with suppliers on alternate materials, hygiene controls, delivery methods
- Restrict marketing
- Develop take back programs
- Design for disassembly/recycle
- Reformulate, redesign

Assumptions

- Make explicit
- Start a life cycle review with assumptions that certain standard controls will be in place
 - MSDS, labeling
 - Waste handling infrastructure (*not always outside US*)
 - Compliance
- Know when assumptions don't apply and what management techniques are even possible
- Re-evaluate the life cycle matrix with any new risk management practices put in place (or disappear)
- Take reasonable precautions for unknowns*
- Be aware of **changes** to your assumptions over time

*“Precautionary Principle”

- If there is a reason to believe a significant hazard may exist, practice management to reduce exposure
 - Use experience with related materials and processes
 - Maintain careful watch over practices and adapt management accordingly
- Be prudent and vigilant, but not phobic

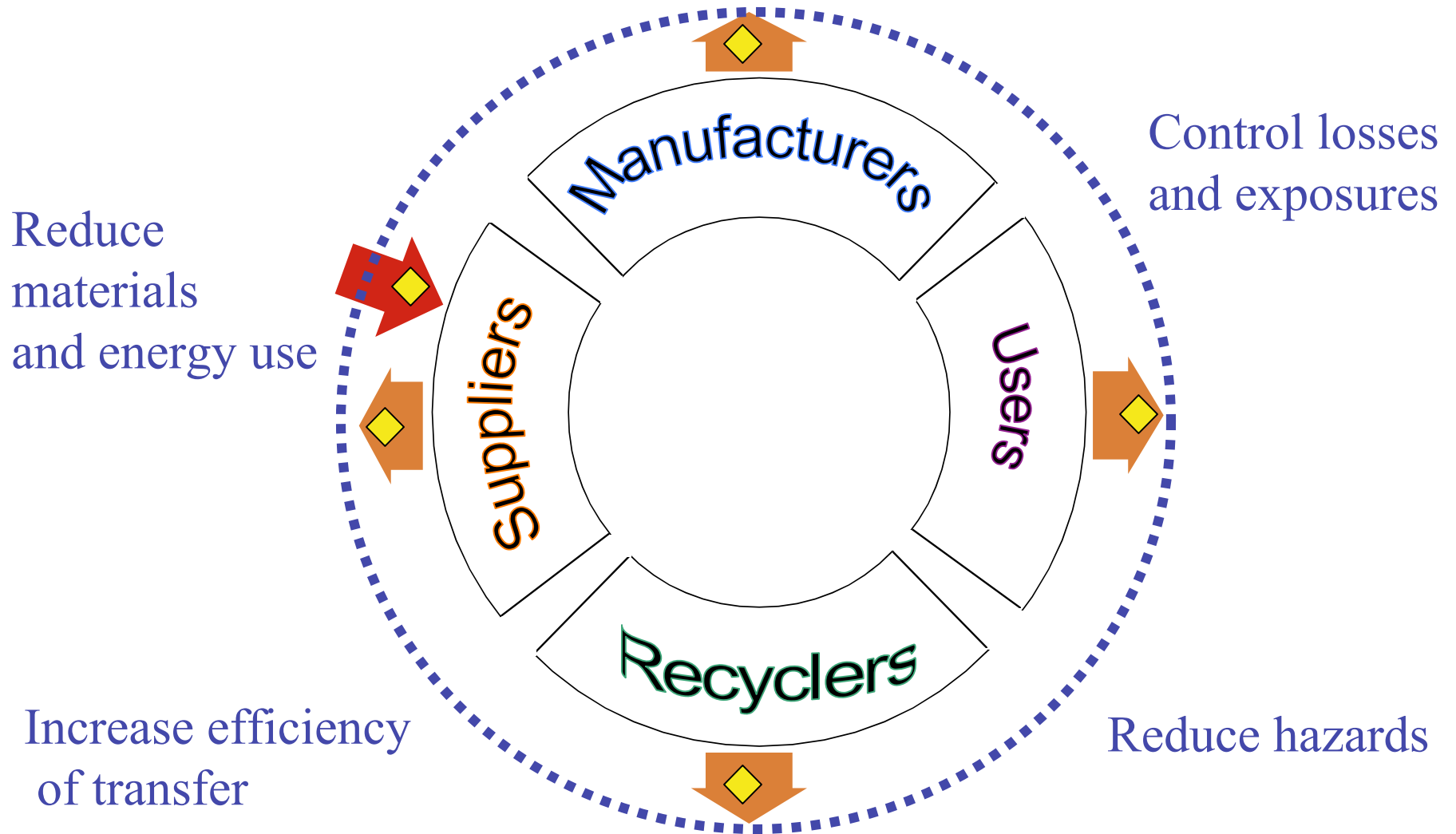
Sustainability *via* LCM

- Be **better** than other products and processes
- Build **relationships** throughout the entire life cycle
 - Collaborate with suppliers and recyclers
 - Solve customer issues
- Find **business advantages**
 - Market claims
 - Reputation
 - Technologies to share
 - Reduced costs

Life Cycle Management - Summary

- Get into **Life Cycle Thinking** mode
 - What's happening at each life cycle stage that can cause impacts of concern?
 - How can product design and manufacturing processes be affected to reduce or eliminate risks?
 - Think environment, health **and** safety
 - Think about assumptions and make necessary changes
 - How do decisions in one stage affect other stages?
 - Get more data or make default assumptions and control
 - Optimize the whole system
 - Design in improved EHS performance up front
- **Help make better decisions toward sustainability**

Life Cycle Management



Sustainability *via* Life Cycle Management

