Engineered Path Towards Innovative and Sustainable Nanotechnology Through the Lens of Manufacturing

Industrial Ecology and Manufacturing Session
Sustainable Nanotechnology Organization (SNO) Conference
November 8-10, 2015
Portland, Oregon

Leanne Gilbertson
Assistant Professor
Civil and Environmental Engineering
University of Pittsburgh

Sustainable Nanotechnology Organization
Research | Education | Responsibility

Session 3A Industry/Manufacturing Systems (Parliament Room)			Session Chair: Leanne Gilbertson and Jun Liao		
Time	**Title**	**Speaker**	**Institution**	**Co-Author**	**Co-Author**
10:30	Path Towards Innovative and Sustainable Nanotechnology Through the Lens of Manufacturing	Leanne Gilbertson	University of Pittsburgh		
10:50	Increasing the net environmental benefit of nanomaterials: Lessons from the design and production of ligand-stabilized gold nanoparticles	Jim Hutchison	University of Oregon		
11:10	The SERENADE project : toward safer and eco-designed innovative nanomaterials	Jean-Yves Bottero	CEREGE-CNRS-GDRI-I-CEINT	Jerome Rose	
11:30	Antibacterial Activities and Cytotoxicity of Green Synthesized Stable Gold Nanoparticles from Flavonoid Derivatives	Francis J. Osonga	SUNY Binghamton, Department of Chemistry	Wunmi Sadik	David Luther
11:50	Complexation of III/V ions to nanoparticles involved in chemical mechanical polishing (CMP) process	Xiangyu Bi	Arizona State University	Paul Westerhoff	
12:10	LUNCH*				

Session 4A Industry/Manufacturing Systems (Parliament Room)			Session Chair: June Liao and Leanne Gilbertson		
Time	**Title**	**Speaker**	**Institution**	**Co-Author**	**Co-Author**
2:00	Graphene and metal hybrids for high-performance supercapacitors	Jun Jiao	Portland State University		
2:20	Sustainable CNT-enabled Lithium-ion Battery Manufacturing: Evaluating the Tradeoffs	Jackie Isaacs	Northeastern Univeristy	Ali Hakimian	Sagar Kamarthi
2:40	Lifecycle Benefits and Impacts Assesment of Ag Nanoparticles	Leila Pourzahedi	Northeastern Univeristy	Matt Eckelman	
3:00	Break				
3:30	Nano-silver textiles - a case study for sustainability	Andrea L. Hicks	Univ. Wisconsin	Thomas L. Theis	
3:50	Green Production of the Structure- and Composition-Tunnable Fe-based Nanoparticles/rGO Composite	Yang Qiu	Brown University	Xiaoshu Lv	Robert Hurt
4:10	LCA of transparent conductors	Pei Zhai	Northeastern Univeristy	Jackie Isaacs	Matt Eckelman
4:30	END OF SESSION	_			
5:00	POSTER SESSION	_			

1. How should we think about manufacturing differently?

   (Not just doing the same thing on a smaller scale!)

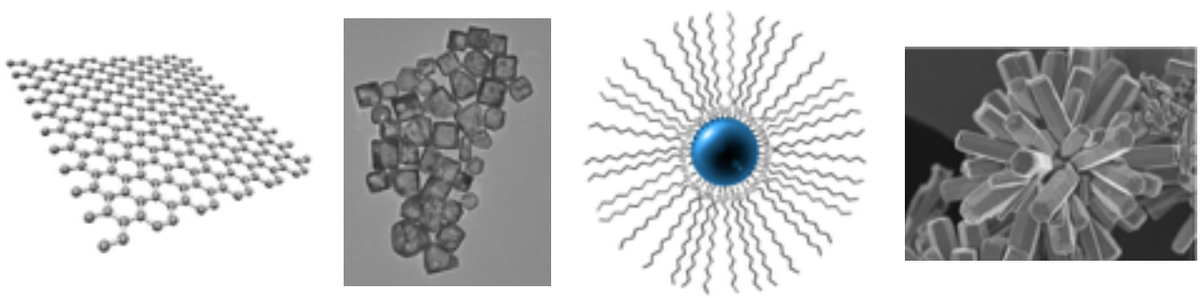
2. When to nano-enable?

   (It may not always be the best solution!)

Manufacturing meets nano
It's complex!

Nanomaterial Synthesis
(many and diverse classes of ENMs)

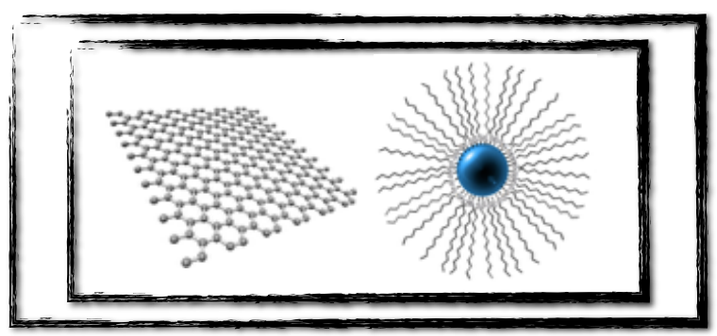
metals (Ag, Au, Pt, Cu)
metal oxides (TiO2, CuO, SiO2,ZnO)
cellulose
carbon (CNTs, graphene)
mixed composition



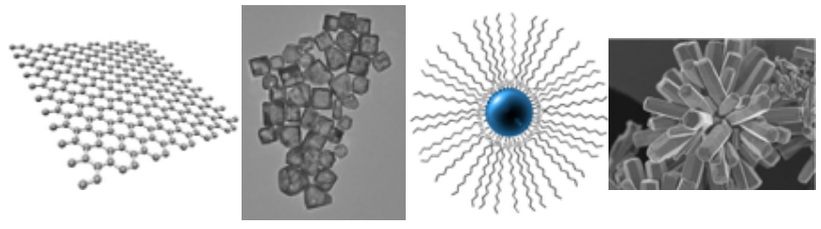
Google Images

Nano-enabled Products
(many applications, markets, and industries)

environmental remediation
water treatment
electronics
energy
drug delivery/medical
agriculture



Not just doing the same thing on a smaller scale

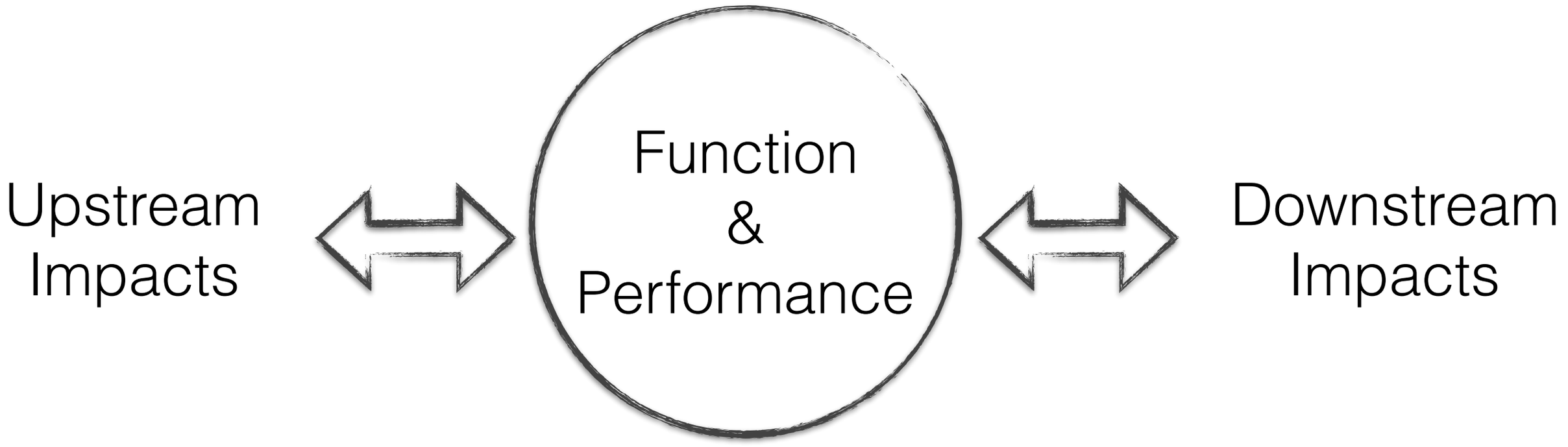


✗ How do I engineer a nanomaterial to be the best catalyst (e.g., by changing size, shape and/or composition)

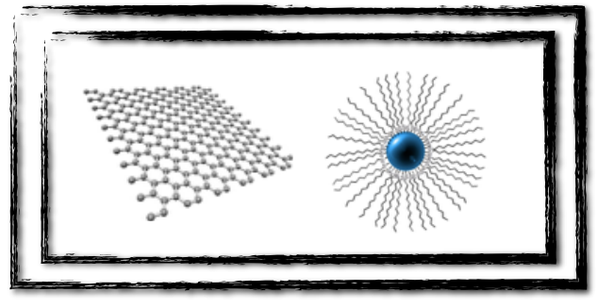
✓ How do I engineer a nanomaterial to be the best catalyst using benign precursors that are not rare and depleting?

✓ How do material manipulations influence other inherent material properties? (e.g., hazard)

Same focus, slightly different approach to thinking



Not just doing the same thing on a smaller scale

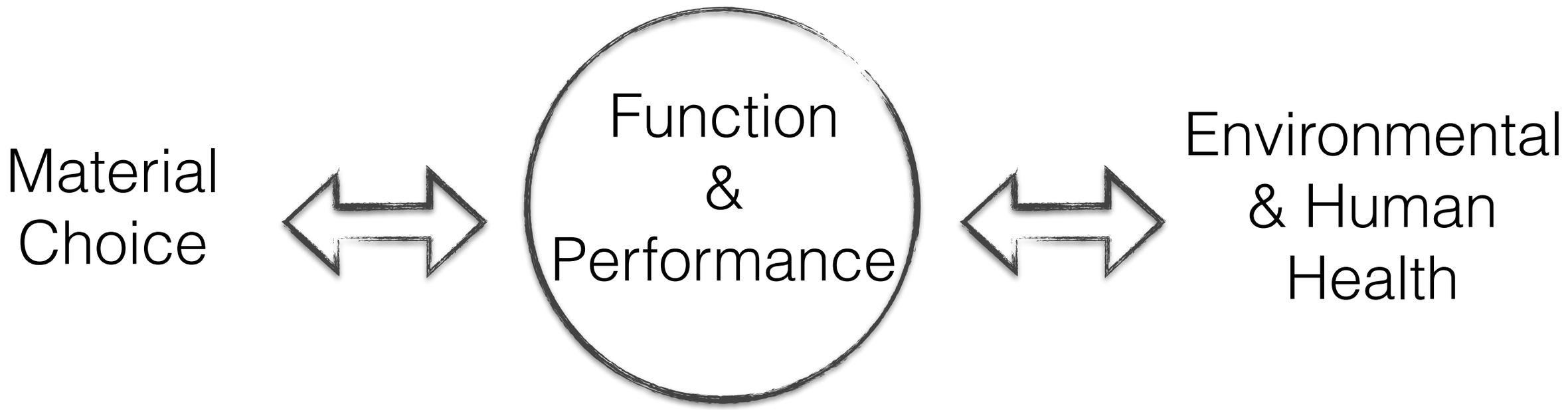


✗ Which nanomaterial can I use to treat water?

✓ How do I develop a water treatment technology or process that does not require harsh chemicals and does not produce toxic disinfection byproducts?

✓ Is the new technology *better* than the current approach?

Same focus, slightly different approach to thinking



When to nano-enable?
(balancing tradeoffs)

Negative Impacts of ‘nano’

Benefits of ‘nano’

The ‘nano’ alternative is considered *better* when the benefits (or potential to realize the benefits) exceed the life cycle environmental and human health impacts.

‘Nano’ may not always present a *better* option

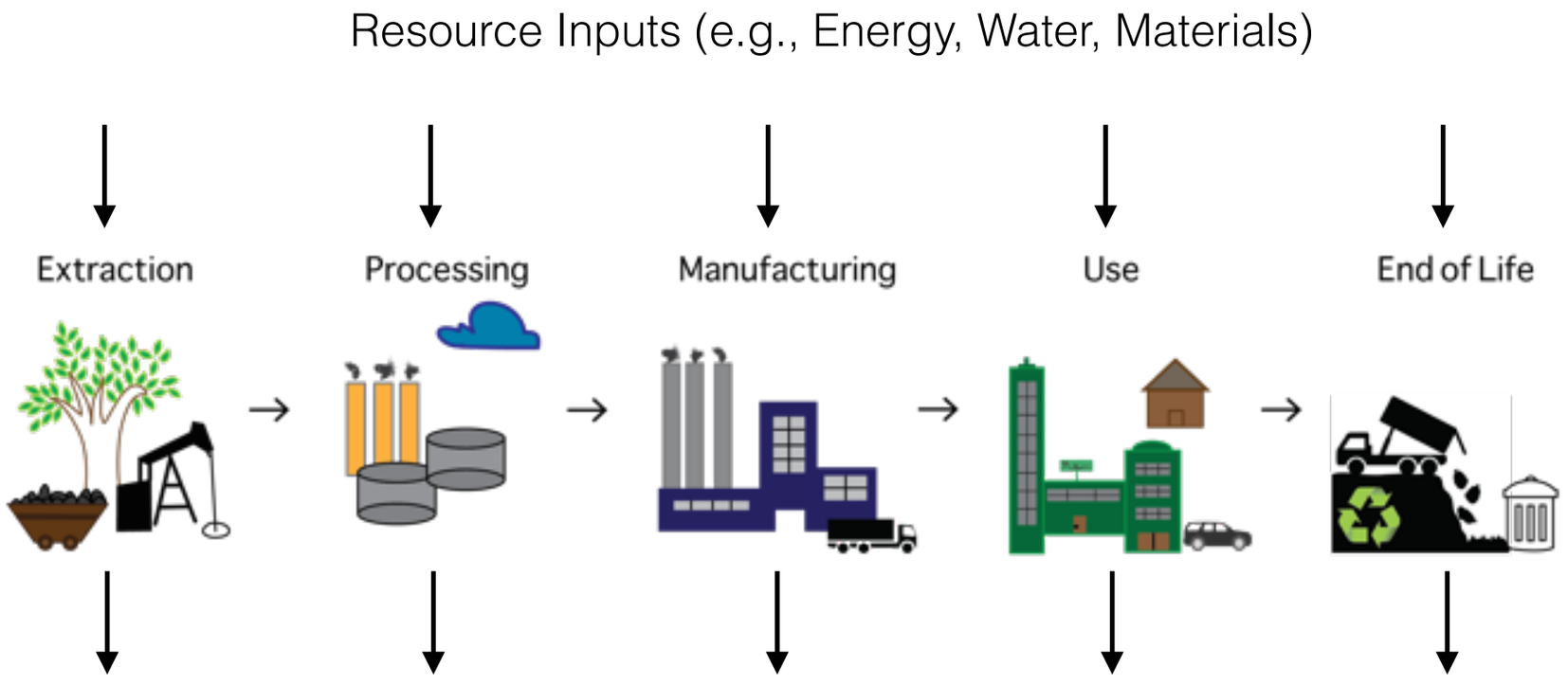
✗ This product is better because it incorporates ‘nano’.

✓ What performance, environmental, and/or human health benefit(s) does the nanomaterial, product, or process offer over the conventional or current alternative?

Nano may not always present a better option

✓ Is the benefit(s) realized across the entire life cycle not just in the stage of interest?

(don't pass the burden!)



Nano may not always present a better option

✓ What tools exist (or should be developed) to enable prospective quantification of tradeoffs? And how do we effectively apply them early in the design phase?

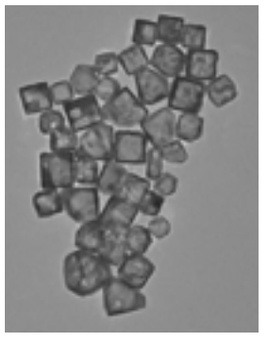
1. How do we think about manufacturing differently?

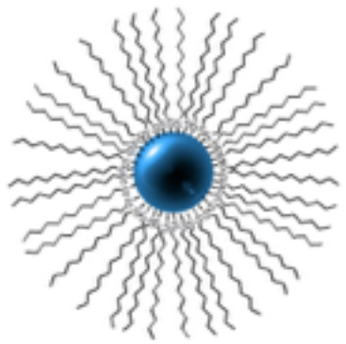
   (Not just doing the same thing on a smaller scale!)

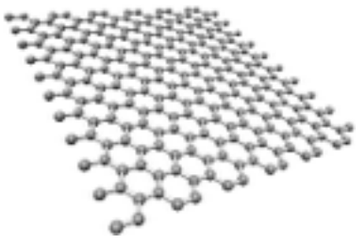
2. When to nano-enable?

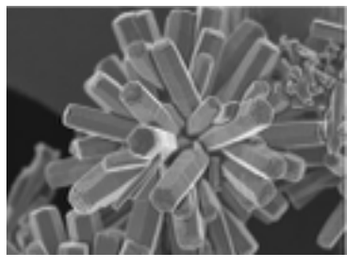
   (It may not always be the best solution!)

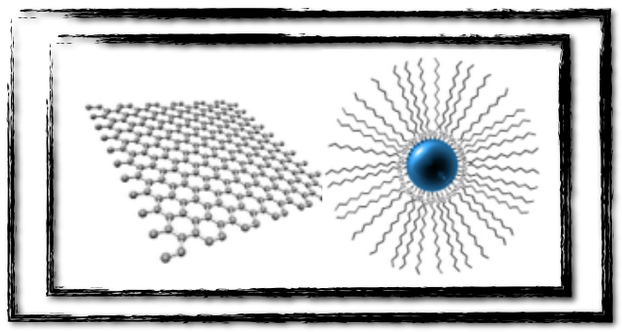
Morning Session



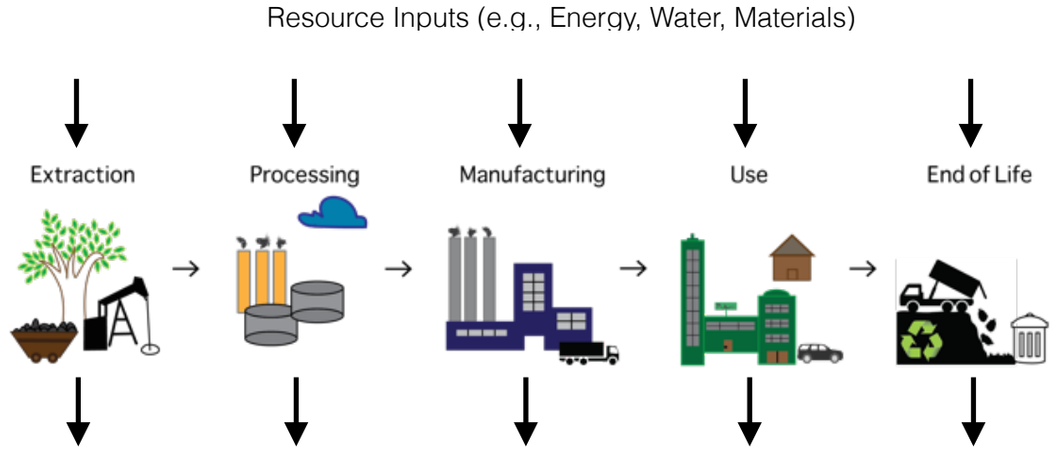








Afternoon Session



Dr. Jacqueline A. Isaacs
Associate Director, CHN
Professor, Mechanical and Industrial Engineering
Northeastern University

Invited Speaker
Afternoon Session

Sustainable CNT-enabled Lithium-ion Battery Manufacturing: Evaluating the Tradeoffs

Environmental Assessment of Single-Walled Carbon Nanotube Processes

2008

Meagan L. Healy, Lindsay J. Dahlben, and Jacqueline A. Isaacs

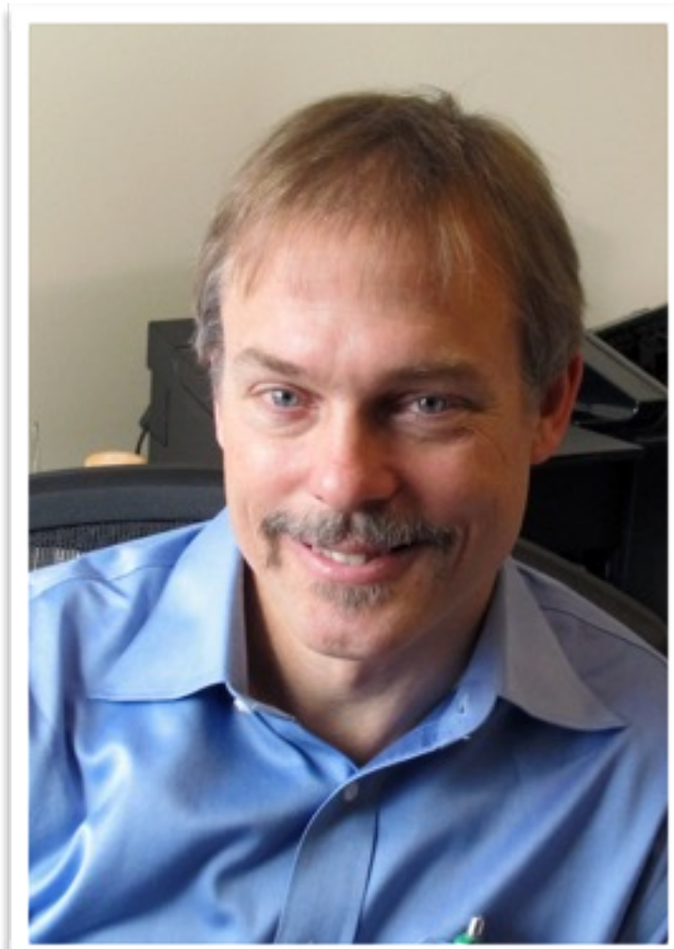
A Critical Review of Methodol

F.R. Field III, J.A. Isaacs, and J.P. Clark

onomic Consequences of creasing Polymer Content the U.S. Automobile cycling Infrastructure

ıeline A. Isaacs and Surendra M. Gupta
Department of Mechanical, Industrial, and Manufacturing Engineering
Northeastern University
Boston, MA, USA

1997



Dr. James E. Hutchison

Founding Director, ONAMI Safer Nanomaterials and Nanomanufacturing Initiative

Lokey-Harrington Chair and Professor, Chemistry and Biochemistry

University of Oregon

Invited Speaker
Morning Session

Increasing the net environmental benefit of nanomaterials: Lessons from the design and production of ligand-stabilized gold nanoparticles

Synthesis and Characterization of a Superoxo Complex of the

Greener Nanoscience: A Proactive Approach to Advancing Applications and Reducing Implications of Nanotechnology

James E. Hutchison*

Department of Chemistry and Materials Science Institute, University of Oregon, Eugene, Oregon 97403

Cedex, France. Received April 8, 1992

2008

ic Teaching Laboratory:
nthesis of Adipic Acid

2000

R 97403-1253; *hutch@oregon.uoregon.edu