Moderator:
Terry Medley (DuPont)

Short statements:
Steve Brown (Intel)
Arturo Keller (UCSB/CEIN)
Stacey Harper (Oregon State University)
Golam Mustafa (EPA)

NANO-EHS

NANOTECHNOLOGY AND ENVIRONMENTAL HEALTH & SAFETY

Terry L. Medley, J.D.
Global Director Corporate Regulatory Affairs, DuPont

Regional, State, and Local Initiatives in Nanotechnology
NNI nano Regional Workshop
Skirvin Hotel, Oklahoma City, Oklahoma
April 2, 2009

The miracles of science™

“The increasing use of engineered nanoscale materials in industrial and consumer products will result in greater exposure of workers and the general public to these materials. Responsible development of nanotechnology implies a commitment to develop and to use these materials to meet human and societal needs while making every reasonable effort to anticipate and mitigate adverse effects and unintended consequences”

National Research Council, 2009
Review of the Federal Strategy for Nanotechnology-Related Environmental, Health, and Safety Research
National Academy of Sciences, Washington, D.C., Page 3

An Integrated Approach to Addressing EHS Concerns

Enabling technology innovation and application, while identifying and addressing environmental health and safety (EHS) concerns requires an oversight system that utilizes all viable options in an integrated manner. Such a system should include:

1) Workplace Safety and Product Stewardship Initiatives
2) Voluntary and Mandatory Agency Programs
3) Collaborative Efforts

These initiatives, programs and efforts should be based on science/risk-based policies.

Responsible Development of Nanomaterials

Integrated Approach

STEVE BROWN, INTEL

NanoEHS

What activities does your organization undertake or participate in to meet its nanoEHS needs (e.g., developing materials databases and standards, materials R&D, product stewardship initiatives, and work place safety measures – including, as appropriate, worker training, workplace monitoring and controls, and other risk management methods)?

- <u>Internal Activities</u>
  - Developed nanomaterial handling policy and workplace guidelines
  - EHS reviews all nanomaterial R&D and manufacturing operations
  - Exposure controls based on precautionary principle,
    - Unknown nanomaterial toxicity dictates conservative exposure controls
    - Utilize existing controls for handling hazardous materials (engineering controls)
    - All unbound nanomaterial handling operations occur with ventilated enclosures
    - No direct skin contact with nanomaterials

- <u>External Activities</u>
  - Founding member of International Council On Nanotechnology (ICON)
  - Provide Funding of Support of Nanomaterial EHS research
    - NOSH Consortium, Bio-NanoInteraction, E U Nano Interact, International Alliance for NanoEHS Harmonization, UCLA Center for Environmental Implications of Nanotechnology
  - Support Nanomaterial Standards development, e.g. ISO TC229, ASTM E56
  - Support Sematech evaluations on the use of nanomaterials in semiconductor manufacturing operations

NanoEHS

How could these approaches be expanded or enhanced to accelerate the responsible development of nanotechnology, and how should this new work be shared among academia, government, industry, and other stakeholders?

- Identify fellow travelers with similar interest, form consortiums to pool resources;
  - Development of metrology and analytical measurement techniques
  - Nanomaterial toxicology assessments of common interest nanomaterials
  - Perform nanomaterial exposure assessments and publish results of common nanomaterial applications
  - Participate in trade organizations to share common information on Nano EHS issues

- Participate in the standards development process;
  - Standards Development Organizations (SDO) are in need of experts to participate in all phases of standards development; e.g. normative research, technical writing, nominated technical expert input and organizational leadership positions

- Communicate technical expertise at public forums, professional conferences/workshops and organizations such as ICON Best Practices Wiki

- Fund and publish Nano EHS research results for public disseminations

ARTURO KELLER, UCSB CEIN

UCCEIN Center for Environmental Implications of NanoTechnology

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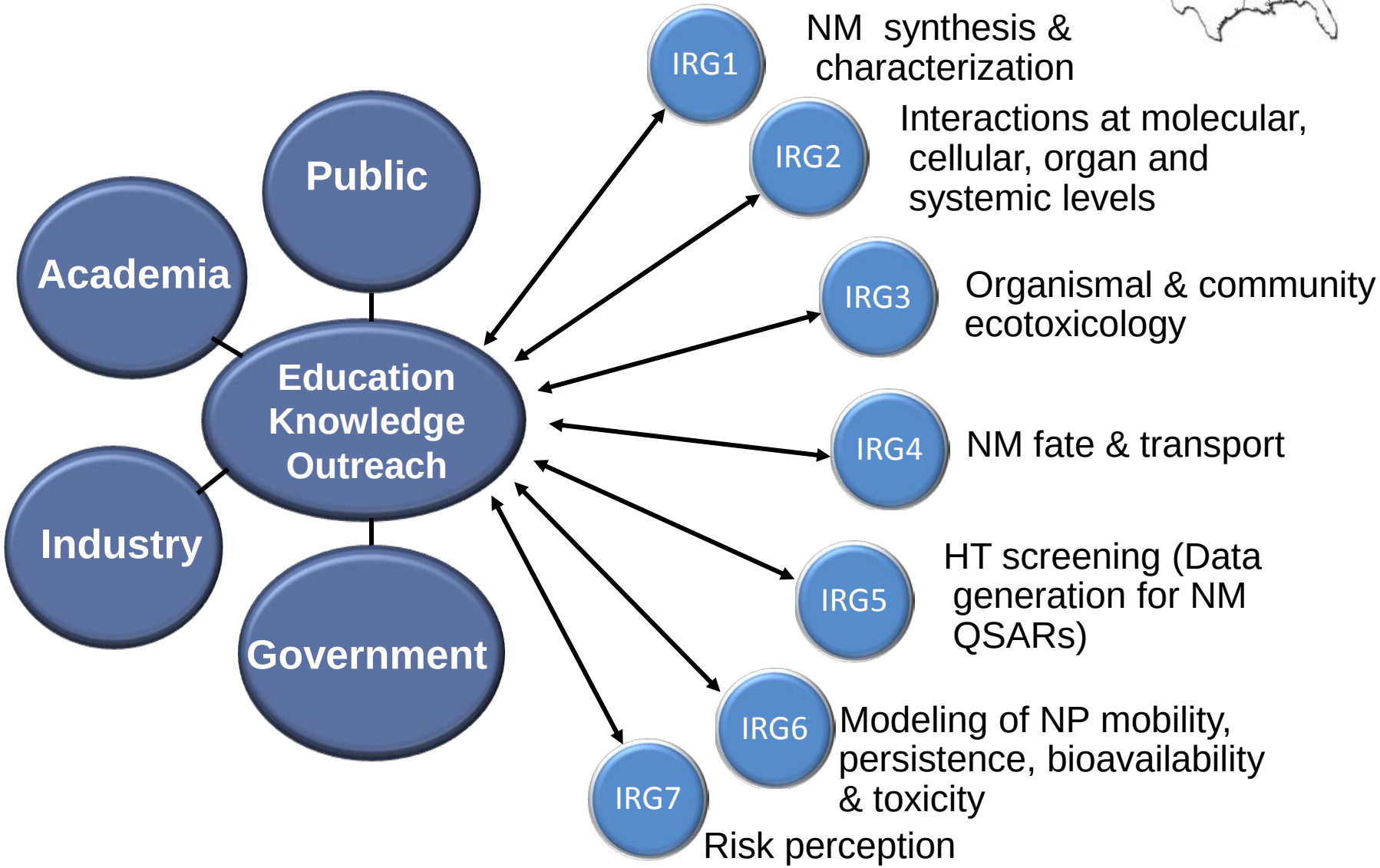
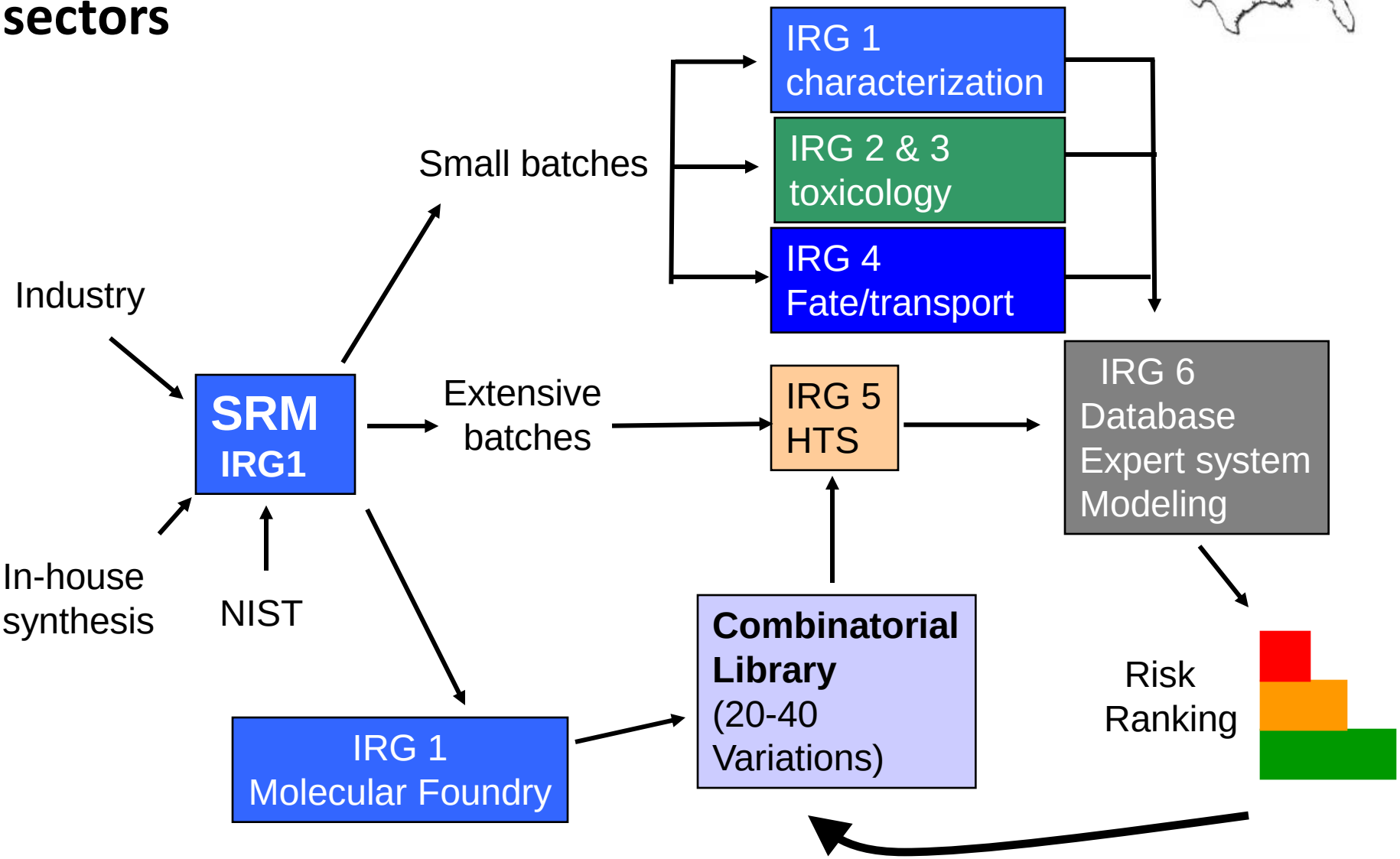
Mission of UC CEIN

Ensure that nanotechnology is introduced and implemented in a responsible and environmentally-compatible manner to allow the US and the international community to leverage the benefits of nanotechnology for global economic and social benefit

NanoEHS: Activities at UC CEIN on Environmental Implications of Nanotech



UC CEIN: Workflow to expand/enhance knowledge base & share with other sectors



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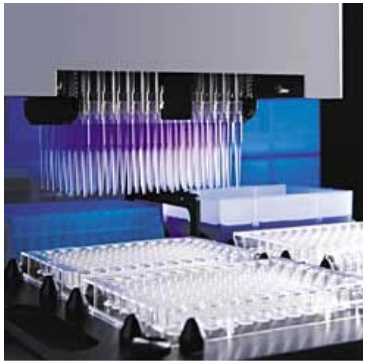
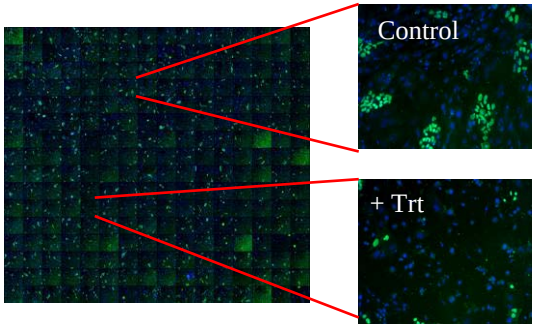
UC CEIN IRG 5: High Throughput Screening





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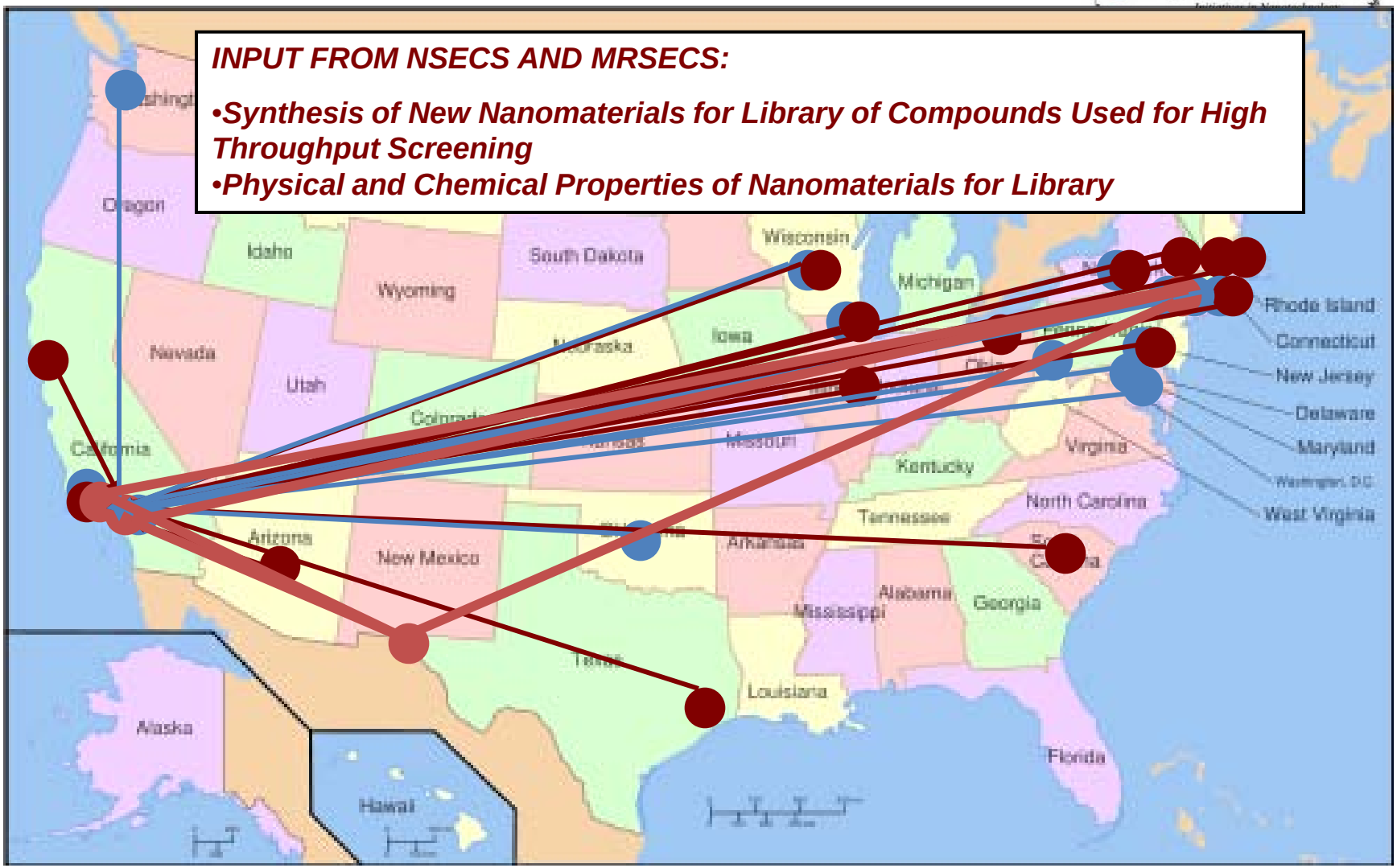
INPUT FROM NSECS AND MRSECS:

- ***Synthesis of New Nanomaterials for Library of Compounds Used for High Throughput Screening***
- ***Physical and Chemical Properties of Nanomaterials for Library***



UC CEIN partner institutions NSECs MRSECs

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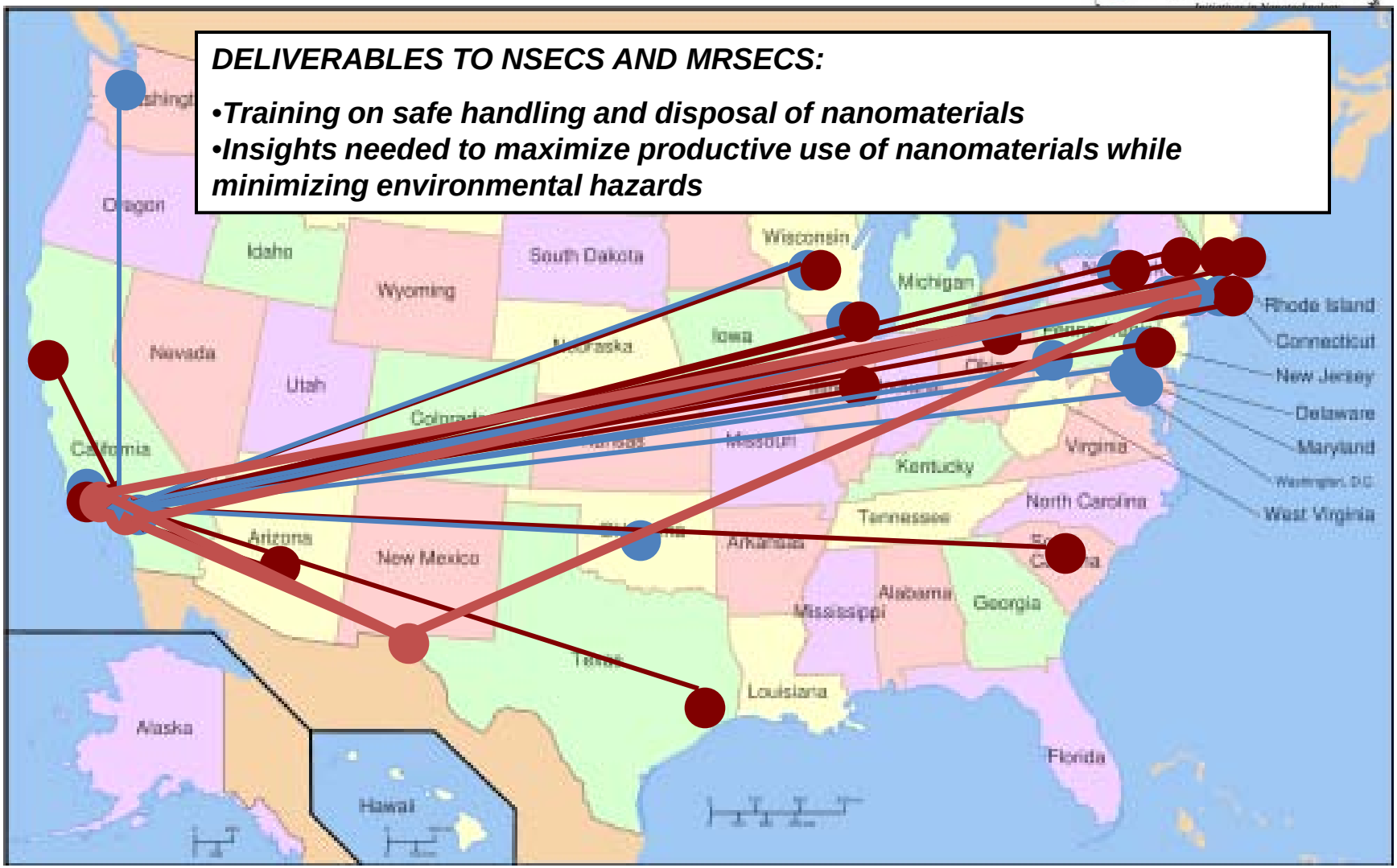
DELIVERABLES TO NSECS AND MRSECS:

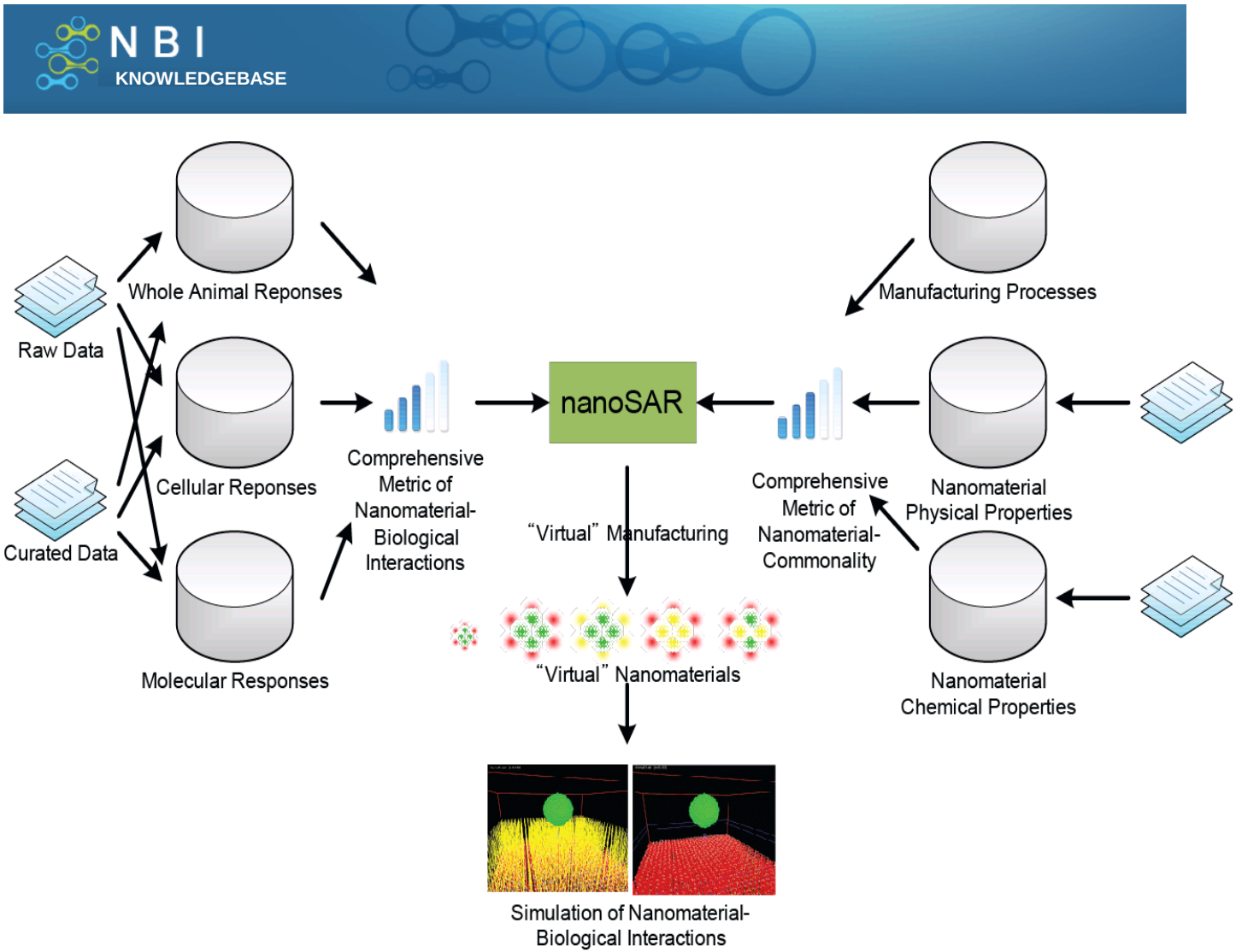
- ***Training on safe handling and disposal of nanomaterials***
- ***Insights needed to maximize productive use of nanomaterials while minimizing environmental hazards***



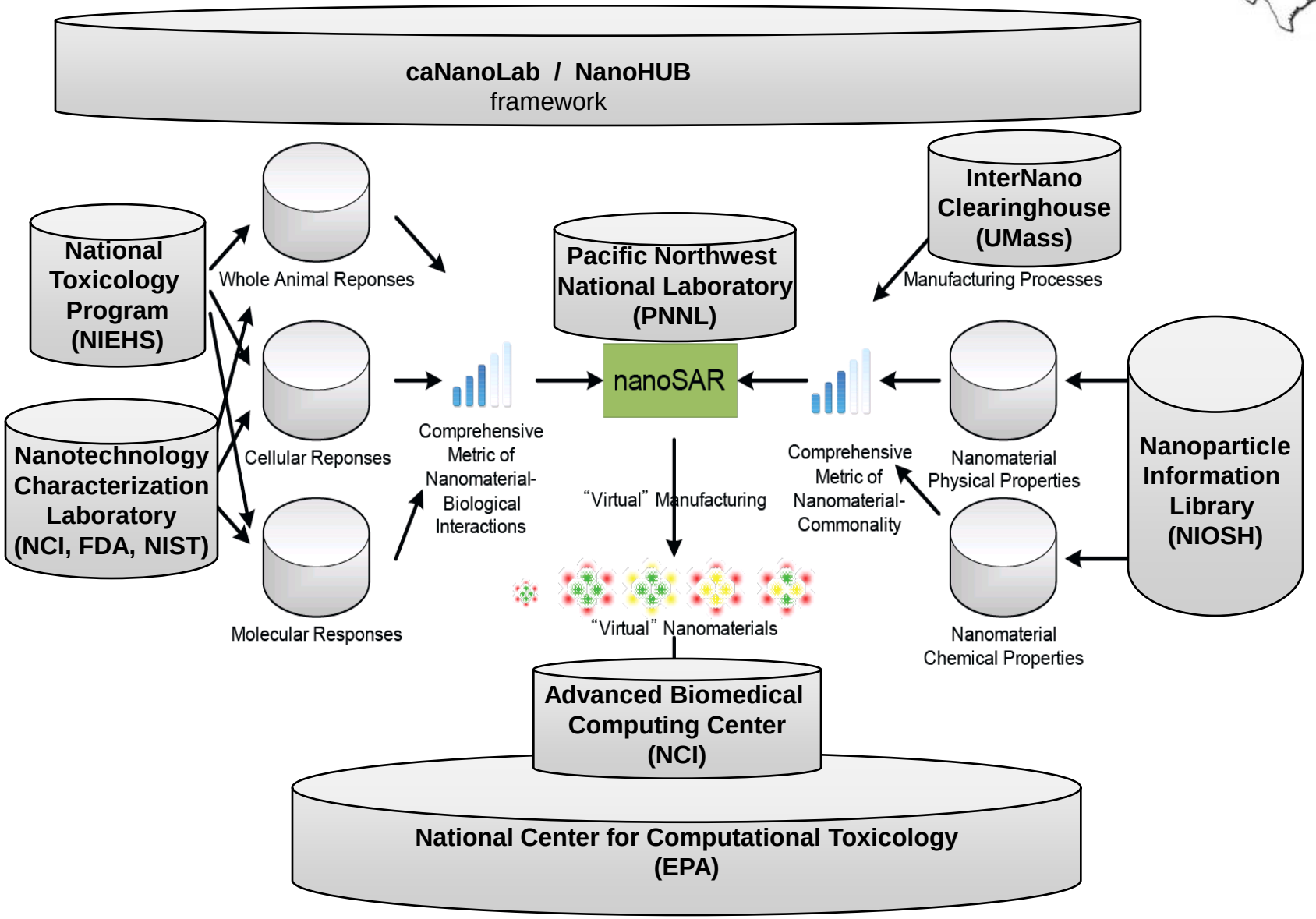
UC CEIN partner institutions NSECs MRSECs

STACEY HARPER, OREGON STATE UNIVERSITY

SNNI Activities in NanoEHS



Interoperable, Federated System of Data/Knowledgebases for NanoEHS



GOLAM MUSTAFA, EPA

Disposal/Recycling of Nanomaterials:

Regional, State, and Local Initiatives in Nanotechnology – NNI nanoRegional Workshop

April 1-3, 2009
Oklahoma City Oklahoma

Presented by:
Golam Mustafa, Ph.D.
US EPA Region 6
Dallas, Texas

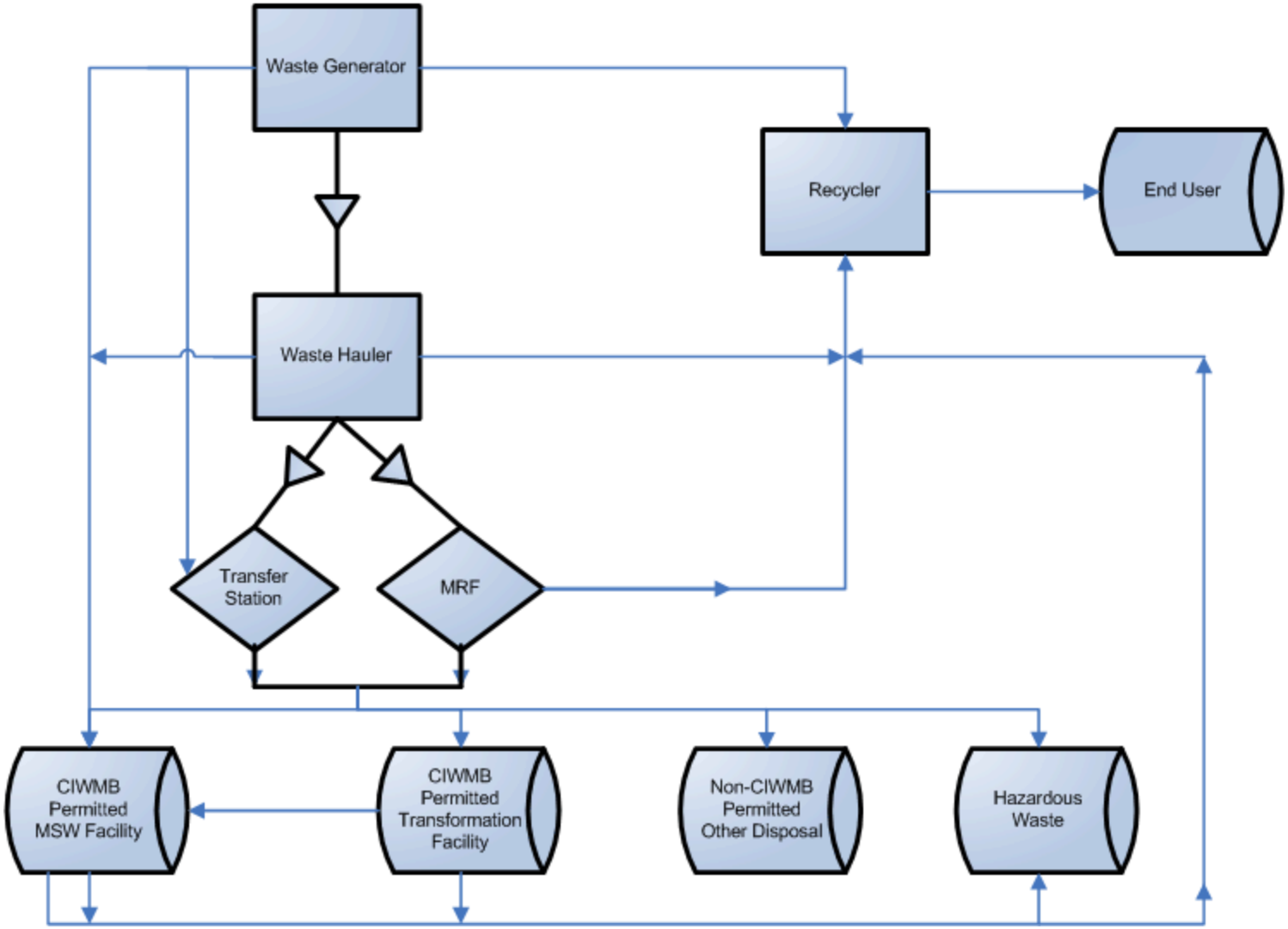
Presentation Outline

- Focus of Waste Disposal/Recycling
- Waste Management and Regulations
- Nano Waste and Possible Regulations
- Information Needed for Nanomaterials Disposal/Recycling

** *How EPA currently deals with waste*

- Generator/Hauler
- Transfer Station / Material Recovery Facility (MRF)
- Recycler / End User
- Permitted Solid Waste / Hazardous Waste / Other Special Waste Facilities

Solid Waste System Flow Chart



** One Possible Pathway for Hazardous Waste

Hazardous Waste Generation

Hazardous Waste Transporation

Hazardous Waste Disposal

** Ancillary Waste - Copper Slag

Copper Slag at Chino Mine New Mexico and Miami Smelter in Arizona

→

Copper slag can be used for road base and sub-base construction

→

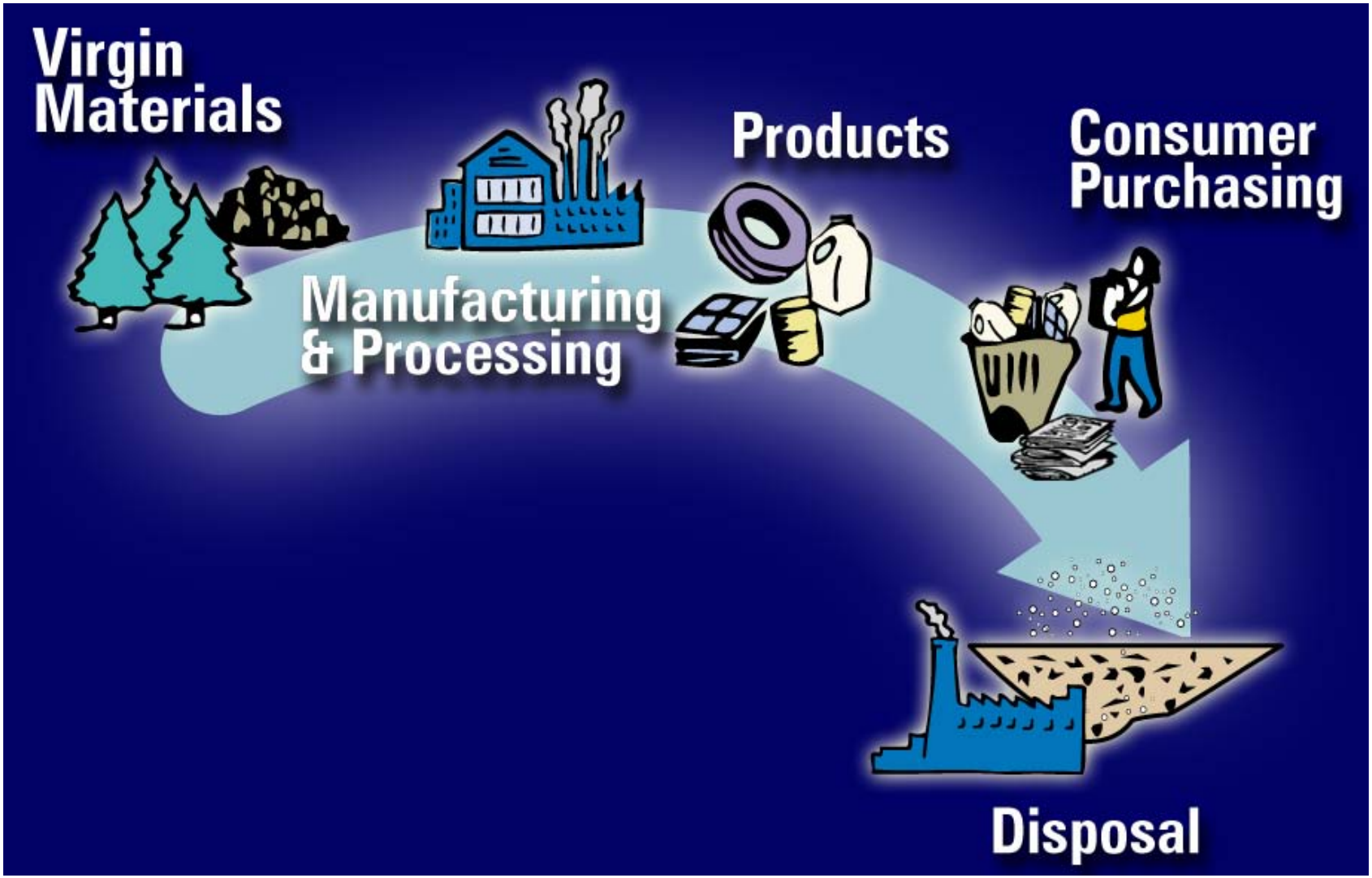
Finished road

** Ancillary Wastes – Silver and Gold Slags

Silver Slag

Gold Slag

Traditional Waste Cycle



Current Waste Cycle

What do we mean by Nanomaterials Waste Streams?

- Pure Nanomaterials Manufactured (e.g., Carbon Nanotubes).
- Nano By-products with organic or inorganic.
- Liquid Suspensions Containing Nanomaterials.
- Items Contaminated with Nanomaterials (e.g., Wipes/PPE).
- Solid matrixes with Nanomaterials.

4 Kinds of Regulations

- Pollution Prevention & Risk Mitigation
- Information Decimation
- Creating Waste while Protecting the Environment
- Direct Waste Management

Possible Regulatory Options for Nano

- Environmental Monitoring
- Manufacturers or Importers Checklist (Material Safety Data Sheet, MSDS)
- Labeling
- Product take-back requirements
- New Regulations for Nanomaterials.

Final Thoughts!

- Nanomaterials are very special.
- Essentially, there are no specific regulatory control for Nanomaterials.
- There will be waste generated from nanotechnology.
- We need to be proactive about disposal and recycling of nanomaterials and products containing nanomaterials to make sure that we protect public health and the environment.