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## **Nanomaterials Disposal and End of Life Issues**

# Disposal/end-of-life issues for business and industry

- What should my company do today to handle nano EOL/disposal in good conscience?
  - What information do I need?
  - Where do I get that information?
  - What do I do with the information?
  - Timing of repeating the information cycle
- EOL/disposal issues for others (public, policy makers, etc)
  - How to help the public understand nano issues?
    - How do we help put nano risks in context?
  - Should business/industry be required to proactively “post-bond” (legacy issues)?
- Cross-sector coordination/Best practices



# What should my company do today to handle nano EOL/disposal in good conscience?

## What to do with information?

- Assess potential for exposure and limit it.
  - Waste generated during manufacture
  - Use and product disposal
  - Waste streams from dispersed application
- If it looks like something “dangerous” or regulated, treat it accordingly.
  - *Lots of discussion on this point*



# EOL/disposal issues for others (public, policy makers, etc)

- Develop hazard categories for nano
  - Use compositional and physical attributes
- Offer definitions of key terms
  - Develop consensus definition for nano
- Guidance for limiting of exposure
  - Production reporting levels
  - Thresholds of concern based on context of use
  - Design considerations into products- eg persistence
- Stakeholders should participate in developing guidance for disposal (funding agencies, venture capital firms, insurance companies, etc.)
- State trade assoc. should develop small business disposal collaborative
- Need research on whether NM in municipal waste stream poses a hazard & if so, how handle (e.g., segregate NM out of waste stream like household recycling)
- Venture capitalists, CPAs & biz/industry need info on how to manage legacy issues



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# Where to get information

- Good nano guide
- Toolkit Livermore labs
  - Online resources
- International Chemical Control handbook

# Recommendations

## To Business:

- **If it looks like something hazardous, treat it accordingly.**
  - Develop a decision tree, including but not limited to:
    - What is it made of?
    - What is its shape?
    - What is its reactivity in environmental media?
    - How much of the nano will be produced/used?
  - Design tree needs to be easy to follow
  - Tree needs to be precise and focuses upon disposal/EOL issues (designed in conjunction with regulatory framework)
  - Include recycling recommendations in the decision tree
  - Group businesses according to supply chain location (nano manufacturer, intermediate user, incorporator into final product, etc.) to contribute to the initial structure to the decision tree
  - Group nanos in relation to routes of environmental introduction to contribute to the initial structure to the decision tree



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# Decision Tree (Con't)

- Consider four categories of nanos for decision tree:
  - Dry powder
  - Solid polymer matrix
  - Non-solid polymer matrix
  - Liquid dispersion
- Creation of a multi- stakeholders local organization to develop this decision tree (example conveners: NCDNR, Dept. of Agriculture, trade association, Commerce Dept., Environmental Health Collaborative)
  - Factor in how public should be involved
  - Ensure no hidden penalties resulting from participation
- Provide incentives to business to use the decision tree (eg “gold star” concept, certification program, agreed upon standard that public can understand, consider cost concerns of business)
  - Members of “nano-star” program would contribute to a fund dealing with end of life issues
  - Responsible stewardships of end of life issues

# Decision Tree (con't)

- Additional considerations for decision tree:
  - Enumerate all ways NM may be released into environment / human body (direct vs indirect; intentional vs unintentional; via manufacturer disposal / recycling, consumer use / disposal; municipal solid waste / biosolids or waste water)
  - For each potential route of release, what are disposal requirements & plans?
    - Engineering self-destruction, providing financial incentives for this engineering.
  - Can environmentally responsible recycling / disposal be engineered into product design?
  - Consider EUs framework for establishing thresholds of concern in the design of the decision tree



# Cross-sector coordination/Best practices

## Recommendations:

- **Convey best disposal practices at the local level**
  - State needs to invest \$\$\$ (grants) to university extension services to develop outreach
- **Manufacturers and regulators need to assess if current mechanisms for managing legacy are adequate**
  - If not, then they develop recommendations.

## Recommendation: Establish mechanisms of Information Dissemination

- Establish communities of practice
- Annual professional meetings
- Annual “extension” workshop
- Portal
- Industry clearinghouse (need a NC Nanotechnology Center)
- Funding agency-sponsored meetings of ongoing research

# Recommendation:

- Provide incentives for environmentally friendly design (facilitate recovery/recycling, self-destruction, env. friendly materials)

# Feedback recommendations

- Disposal routes
- Recycling issues
- Self-disposal
- Legal consideration

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# Recommendations to Industry

## High

- Use a decision framework to evaluate best EOL/disposal practices 12
- Engineer nanomaterials for responsible disposal (green materials, self destruct characteristics, facilitate recycling) 11
- Develop a community of practice that supports the industry 10
- First and foremost, limit exposure 9

## Low

- Develop ASTM disposal Best Management Practices 0

# Recommendations to Others

## High

- Have a cross-sector collaborative develop the decision framework 12
- State should provide funds for EHS infrastructure (will provide incentive to new industry in the state) 10
- State should provide incentives for nano disposal industry 9
- Develop incentives for compliance (eg. nanostar) 9

## Low

- Develop guidance for limiting exposure 1
- State Trade Dept. develop a small biz disposal laboratory 0
- Have a cross-sector collaborative assess if legacy management framework is adequate 0
- State grants for outreach 0
- EPA and state should re-evaluate existing regulations in relation to nanomaterials: 0
  - leachate management requirements
  - biosolids from waste waters management requirements
  - product disposal practices/technologies



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