

Life Cycle Impacts of Nanotechnology



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Green Design

Motivation

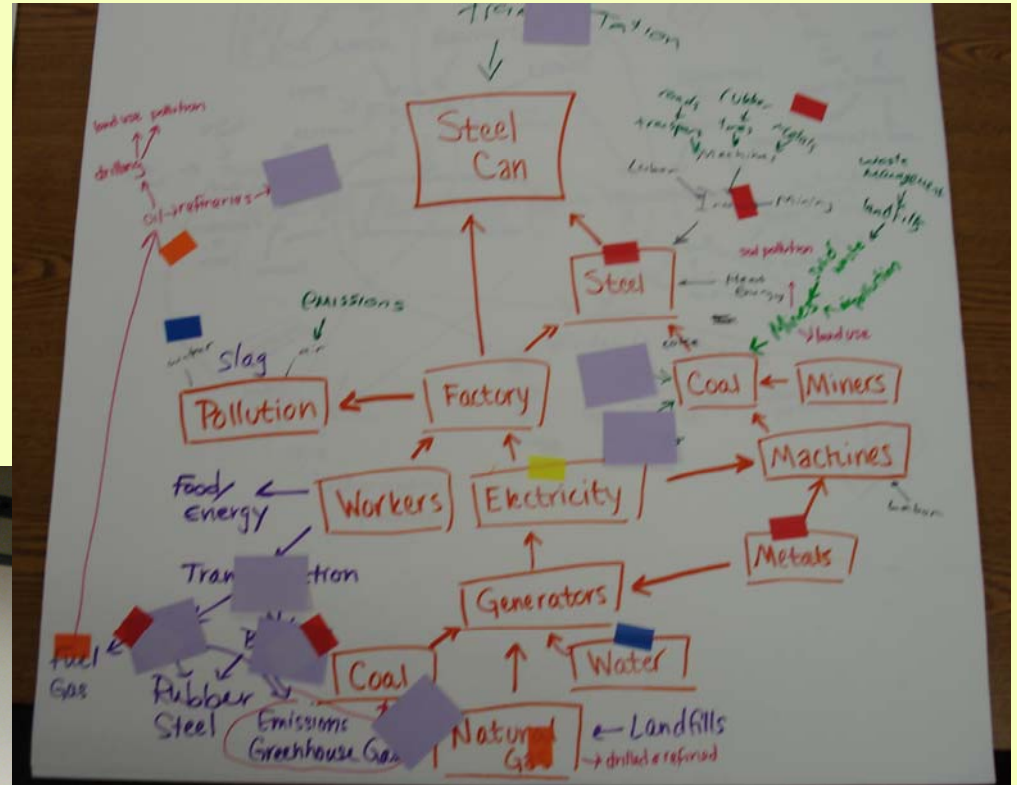
- Nanotechnologies introduced daily
- Many have health or environmental benefits (but also risks)
- EPA has suggested it plans to regulate nanotechnologies
 - But does not know how to do it
 - What is the right framework?

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Challenges

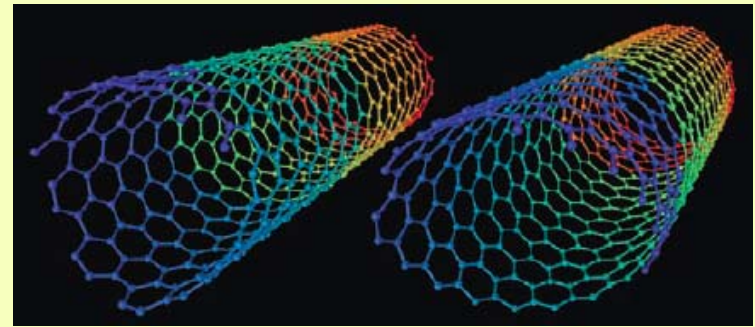
- How to deal with possible toxicity?
 - We barely understand it for bulk materials
 - We may never know for nanomaterials
 - And we can not afford to test them all
- What do we need to know?
 - Is *relative* toxicity good enough?
- Is a screening tool enough?

Life Cycle Analysis



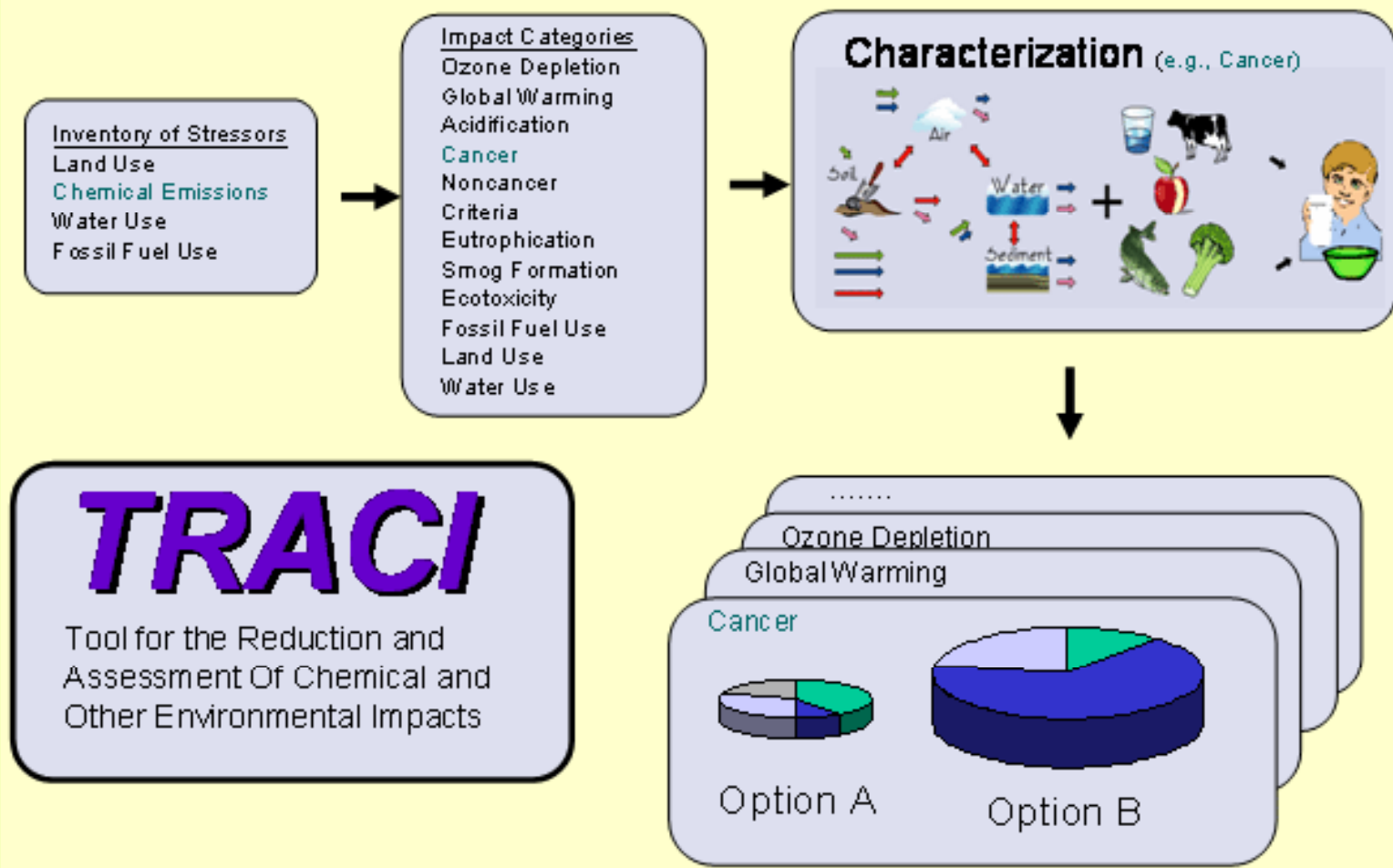
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An Example



- Substitution of nanotubes in tires make cars ride better
 - But potential health risks from exposure
- Better -> less fuel use -> less CO₂
- How to trade-off risk vs. benefit?

Impact Assessment



Intended Results

- Weighted impact of CO2 benefits
- Scenarios of risk from air, water releases
- Ranges of toxicity of nanomaterials
- Net impact as function of toxicity

Example Recommendation

- “The use of this nanotechnology is likely to have weighted impact benefits even if the toxicity of the nanomaterial is 1,000,000 times that of the bulk material (and it is all released).”
 - Thus this application is likely in the social interest

A Path Forward

- Screening tool
- Allows comparison of applications in face of technology uncertainty
- Allows comparison of products
- Identifies use cases of concern

For More Information

- See our website: gdi.ce.cmu.edu
- Karn and Matthews, “Nanoparticles without Macroproblems”, *IEEE Spectrum*, 2007.