



Ensuring Sustainable Development of Water Treatment Technologies

Water Sustainability through Nanotechnology: Nanoscale Science and Engineering at the Solid-Water Interface

Khara D. Grieger¹, David Berube², Jacob Jones²

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¹Health and Environmental Risk Assessment, RTI International, Research Triangle Park, NC

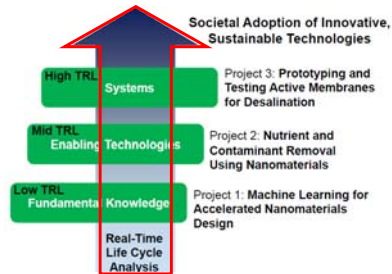
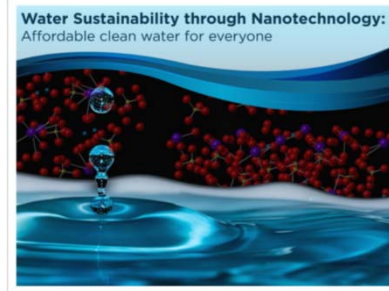
²North Carolina State University, Raleigh, NC

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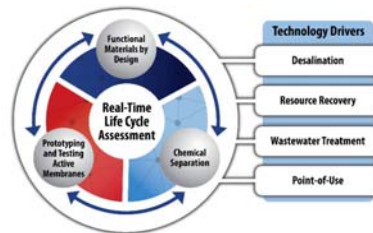
Water Sustainability through Nanotech

- RTI-NCSU collaboration:
 - Game-Changing Research Incentive Program (GRIP)
 - 3 key thrusts, using nanotech:
 - Increase water availability
 - Improve efficiency of water delivery and use
 - Enable next-generation water monitoring systems
 - 3 year project (2017-2020)
- Project 4: Real-Time Life Cycle Assessment
 - To ensure sustainable nanomaterial, technology development



Water Sustainability through Nanotech

- Importance of water sustainability
- Project 4:
 - Develop Real-Time Life Cycle Assessment
 - Scope: health, environment, society, ethics
 - Use results in Projects 1-3
 - Leverage in future work
- Impact:
 - Enable technology developers to receive real-time feedback in design phase
 - Inform decision-making
 - New approach to ensure nanomaterial, technology sustainability
- This presentation is overview of proposed approach



Water Sustainability through Nanotech

- Why is sustainability important?
 - Consensus on sustainable, responsible nanotech development
 - NNI's goal; EU strategy for nanotech
 - Past experience with emerging technologies
 - Help avoid public backlash
 - Importance of "green design"

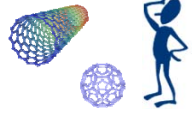


www.nano.gov/node/1113; europa.eu/legislation_summaries/research_innovation/research_in_support_of_other_policies/i23024_en.htm; <https://www.rit.edu/>; <http://gmoinside.wpengine.com/wp-content/uploads/2013/10/NoGMOsCheerios-920w.png>

Water Sustainability through Nanotech

- Why sustainable nanomaterials and nano-enabled products?

- What are nanomaterials?



- Why are they unique?

- Why are they used in water treatment technologies?



- What are some potential concerns?



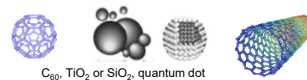
- How to ensure their sustainable development and use?

<https://www.rit.edu/>

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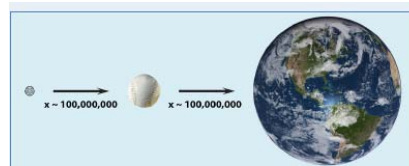
- What are nanomaterials?

- ~0-100 nm
 - New functionality, novel properties
 - 2016, >1600 consumer applications



- Why are they unique?

- Lighter, stronger materials
 - Electrical, magnetic, conductive properties
 - Nano-medicine, antimicrobial, etc.
 - Environmental applications



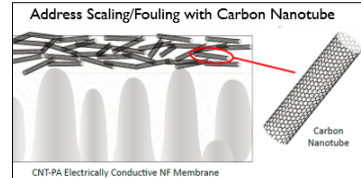
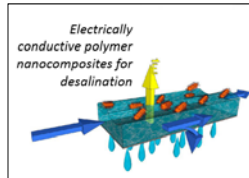
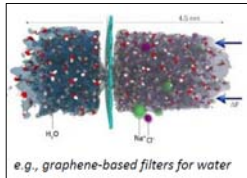
If a buckminsterfullerene molecule (60 carbon atoms arranged in a sphere, with a diameter of 1.1 nanometers) were as big as a softball, a softball would be as big as the Earth.



Wise et al. 2010; www.vestergaard-frandsen.com/lifestraw; National Nanotechnology Initiative 2016; htinhabitat.com/nanosolar-thin-flexible-solar-cell-coating/; nanopatentsandinovations.blogspot.com/2009/12/250-billion-cost-estimate-to-clean.html

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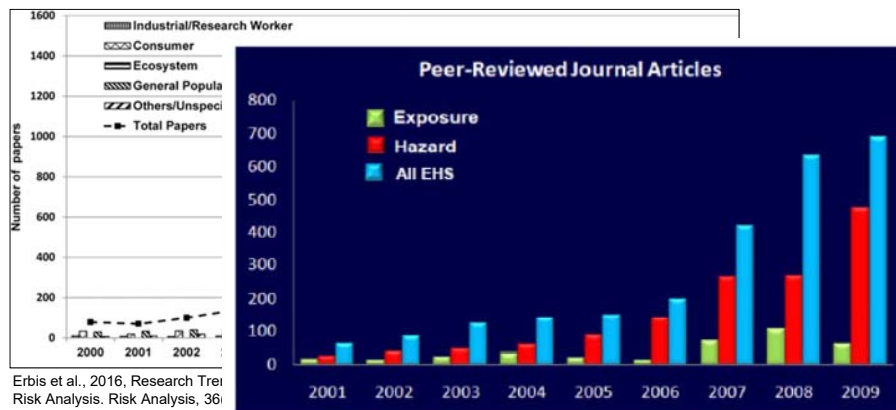
- Why are they used in water treatment technologies?
 - Utilize small size, large specific surface area, novel properties



- Benefits:
 - Better desalination technologies
 - More efficient resource recovery from waste streams, secure sustainable food cycle
 - Technology advancement in water treatment sector

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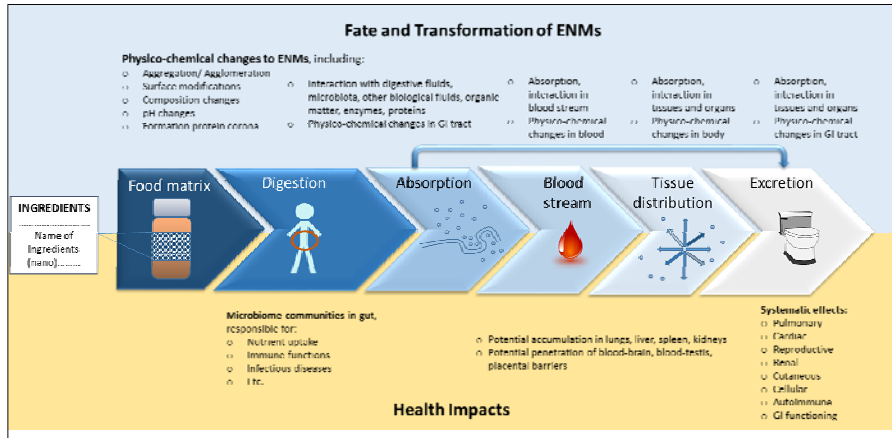
- What are some potential concerns?



The National Academies Press, A Research Strategy for Environmental, Health, and Safety Aspects of Engineered Nanomaterials (2012)

Water Sustainability through Nanotech

- What are some potential concerns?



Grieger, K., Harrington, J., Mortensen, N. 2016. Prioritizing Research Needs for Analytical Techniques Suited for Engineered Nanomaterials in Food. Trends in Food Science & Technology, 50: 219-229.

Water Sustainability through Nanotech

- What are some potential concerns?

Natural Solutions

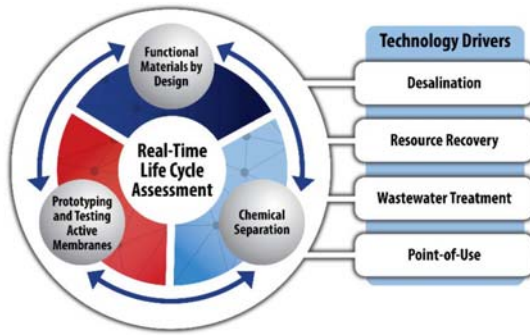
Holistic Beauty, Body, and Bath



<http://www.ciel.org/nanoparticles-baby-formula/>; <http://www.bewellstaywell.com/Earths-Beauty-Q-and-A-s/167.htm>

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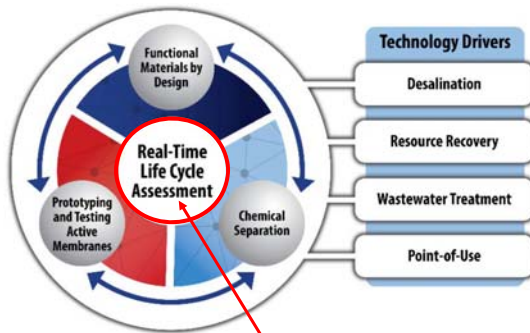
- How to ensure their sustainable development and use?
 - Project 4: Real-Time Life Cycle Analysis



- ✓ Enable material, technology developers to receive real-time feedback
- ✓ Inform decision-making
- ✓ New approach to ensure nanomaterial, technology sustainability

Water Sustainability through Nanotech

- How to ensure their sustainable development and use?
 - Project 4: Real-Time Life Cycle Analysis



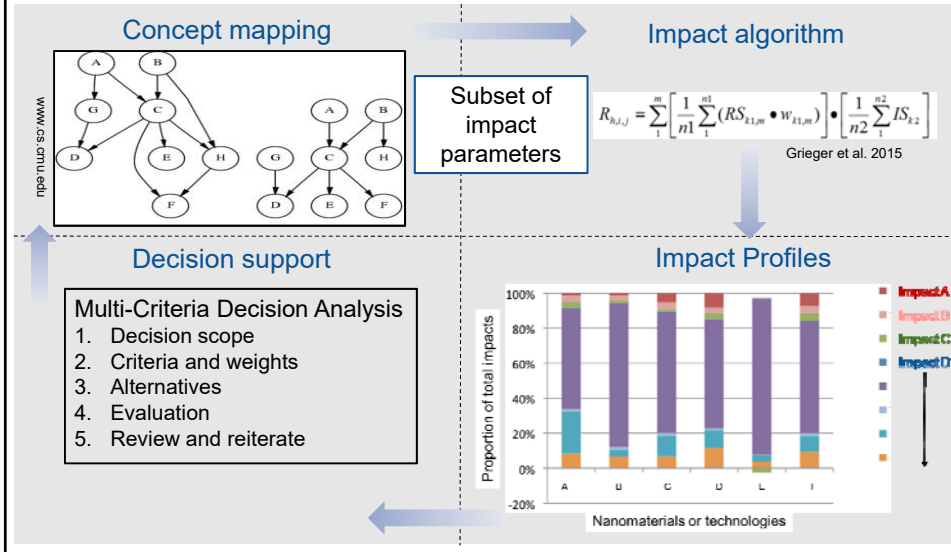
- ✓ Enable material, technology developers to receive real-time feedback
- ✓ Inform decision-making
- ✓ New approach to ensure nanomaterial, technology sustainability

Feedback on materials, across life cycle:

- ☐ Physical/chemical properties
- ☐ Environmental, health, safety impacts
- ☐ Social, ethical impacts
- ☐ Economic, performance

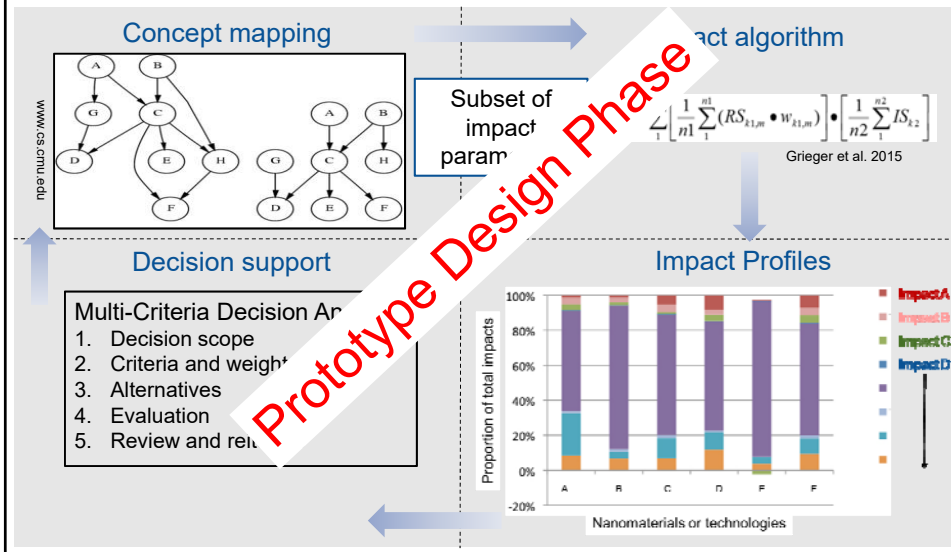
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- How to ensure their sustainable development and use?



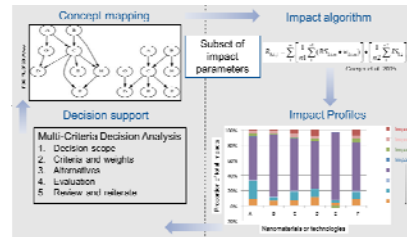
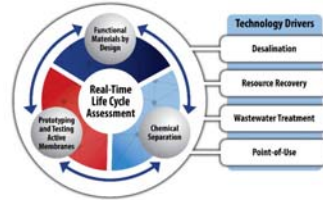
Water Sustainability through Nanotech

- How to ensure their sustainable development and use?



Water Sustainability through Nanotech – Main Messages

- Ensuring sustainability is important
- RT-LCA can help
- Outcome:
 - Enable material, technology developers to receive real-time feedback
 - Inform decision-making
 - New approach to ensure nanomaterial, technology sustainability
- Approach:
 - Incorporate into development phases
- Next steps:
 - Develop prototype design
 - Attract additional funding



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- Phillip Strader
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- Min Chi

NC STATE UNIVERSITY

Thank you!

Dr. Khara Grieger

Environmental Risk Assessor, Research Scientist

RTI International

kgrieger@rti.org