



## NANOTECHNOLOGY RESEARCH PROGRAM

### Assessing Nanomaterials Potential Impact with a Life Cycle Approach

#### Issue:

Materials that incorporate particles manufactured at the nano scale (nanomaterials) may have many potential benefits to society with their development and deployment in science, engineering and technology. Their benefits, however, need to be weighed with any potential cost to the environment and public health. As a result, scientists at the U.S. Environmental Protection Agency have recognized the need to develop risk assessment processes to study the potential health and environmental impacts of nanomaterials.

In addition, scientists want to understand how the manufacture, use, and waste management of these nanomaterials could potentially contribute to ongoing environmental problems during their life-cycle from cradle to grave, including recycling. For example, is there the potential for

nanomaterials to impact global warming, stratospheric ozone depletion, acidification (formation of acid rain) or eutrophication (the increase of chemical nutrients in water)?

#### Scientific Objective:

EPA's Nanotechnology Research Program in the Office of Research and Development is conducting a series of Life Cycle Assessments (LCAs) on various products made from nanomaterials to gain knowledge about potential release into the environment. The assessments are holistic and comprehensive and track a product from its inception (cradle) through its final disposal (grave). LCAs are essential to analyze, evaluate, understand, and manage the overall health and environmental impacts of products.

LCA experts worldwide agree that existing LCA tools are capable of supporting the

development of decisions on the manufacture and use of nanomaterials as long as uncertainties and data gaps are clearly stated (Kloepffer et al 2007).

In addition to tracking products made with nanomaterials throughout their life cycle to identify where and in which situations release may occur, scientists will identify and model impacts to environmental problems mentioned above as well as investigate safety issues of workers in the nanomanufacturing field (Meyer et al 2009) as part of the LCA.

Scientists will conduct an analysis using a life-cycle approach that will compare environmental impacts of current technology with nanotechnology used to make commonly known products.

The LCAs are focused on answering questions which include:

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- What are the trade-offs associated with nanomaterials?
- Is the large-scale production of an environmentally taxing material justified if it has beneficial applications for society or if it can reduce costs or enhance performance?

Characterization of nanomaterials on a life cycle basis is challenging because this is a new field of study. Finding adequate data to model the potential fate and effects of unintended releases of nanomaterials into the environment may be difficult to obtain. EPA researchers are working to locate and provide the necessary data. Also, many nanomaterials are not yet in full production to create a consumer product, so much of the data must be estimated.

Products being studied include lithium batteries, which incorporate nanomaterials to enhance performance, and products that contain nano silver and titanium dioxide (such as sunscreen).

### Application and Impact

The research on LCAs by EPA will provide a better understanding of the issues involved with collecting data for nanomaterials. In addition, this knowledge will be incorporated into the development of a decision support guidance manual that will help users take into account the diverse nature and application of nanomaterials and the products made from them, and offer a framework that integrates LCA results (the environmental component of sustainability) with cost and social impacts specific to nanomaterials.

### REFERENCES

Kloepffer, et al (2007) Nanotechnology and Life Cycle Assessment: Synthesis of Results of a Workshop Held in Washington D.C. 2-3 October 2006(Kloepffer, Curran et al. 2007).

David E. Meyer, Mary Ann Curran and Michael A. Gonzalez. An Examination of Existing Data for the Industrial Manufacture and Use of Nanocomponents and Their Role in the Life Cycle Impact of Nanoproducts. Environ. Sci. Technol.; ASAP; Web Date: January 28, 2009 (Policy Analysis); DOI: 10.1021/es8023258.

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