Comprehensive Environmental Assessment:

A Meta-Assessment Approach to Increase Effectiveness of Risk Management and Research Planning*

Comprehensive Environmental Assessment (CEA) is a holistic approach for evaluating the environmental implications of various choices among chemicals, products, and technologies. CEA can be used to identify and prioritize research to support future assessment efforts and/or to provide input to risk managers to enable better targeted decisions. CEA offers both a *framework* for systematically organizing complex information and a *process* that uses collective judgment to evaluate such information. Because it incorporates and builds on other assessment and analytic methods, including conventional life cycle analysis, exposure assessment, hazard analysis, and risk characterization, CEA serves as a *meta-assessment* approach.

As highlighted in Figure 1, the CEA *framework* starts with the inception of a material and encompasses the environmental fate, exposure-dose, and impacts. All of these linked events take place in various environmental media under physical, chemical, biological, and social conditions. This detailed consideration of downstream events subsequent to the product life cycle (value chain) is one of the features of CEA that distinguishes it from many other life-cycle-based assessment approaches. CEA focuses, for example, not only on material and energy flows associated with life-cycle stages but on subsequent events or conditions in the environment that can figure importantly in how materials come in contact with organisms and other entities, and ultimately have various direct and indirect impacts. Note that the sequence of events in Figure 1 is not always linear when, for example, transfers occur between media or via the food web.

Another distinguishing feature of CEA is the use of collective judgment based on diverse perspectives. This means that CEA involves more than a small set of narrowly focused experts going through a standard checklist of issues in evaluating complex information. As summarized in Figure 2, collective judgment is a central aspect of the CEA *process*. It incorporates a variety of technical and stakeholder viewpoints in a structured process that allows the participants to learn from one another yet come to their own independent judgments in prioritizing risk trade-offs and/or information gaps. These prioritized information gaps and risk trade-offs can then be used in planning research and developing adaptive risk management plans. The knowledge gained from these research and risk management activities feeds back in an iterative process of periodic CEA updates.

The CEA approach has been successfully applied in the initial stages of developing a research strategy for nanomaterials by using selected case studies of nanoscale titanium dioxide (U.S. EPA, 2010b) and nanoscale silver (U.S. EPA, 2010c) and by convening formally structured workshops (U.S. EPA, 2010a). The case study documents were organized around the CEA *framework*, with chapters devoted to product life-cycle stages, environmental fate, exposure-dose, ecological and human health effects, and other pertinent data. For the collective judgment step of the CEA *process*, individuals from various technical disciplines (manufacturing, environmental fate, exposure, ecological effects, health effects, risk management, etc.) and sectors (academia, government, industry, and NGO, civic, labor, or other organizations) reviewed the case study documents before coming together for multi-day workshops. The objective of these workshops was not merely to identify but, more importantly, to prioritize research or information needed to conduct future assessments of specific nanomaterial applications. A formal procedure helped ensure that each participant had an equal opportunity to state their views about priorities; multi-voting yielded a collective judgment of priority issues in ranked order.

Given the immature state of the science on the environmental implications of nanomaterials, CEA has thus far been used for research planning and strategy development purposes rather than for risk management purposes. However, for more mature issues, such as weighing trade-offs among various biofuel options or the use of genetically modified organisms, CEA offers a means of conducting a transparent evaluation of extensive and complex information to help those who set policies and manage risks better understand the implications of alternative choices facing them.

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Figure 1: Comprehensive Environmental Assessment (CEA) Framework

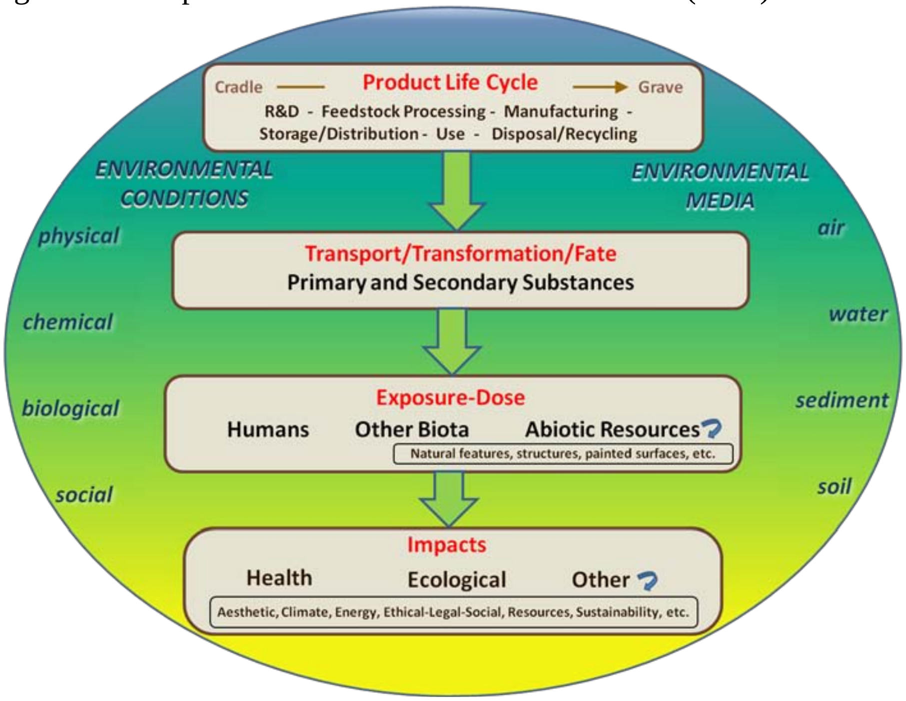
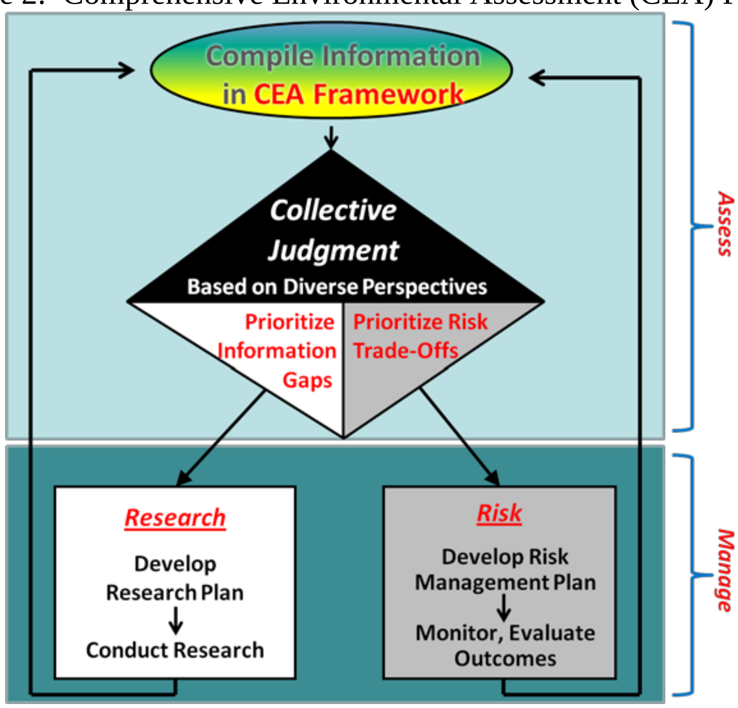


Figure 2: Comprehensive Environmental Assessment (CEA) Process



References

U.S. EPA (2010a) Nanomaterial case studies workshop: Developing a comprehensive environmental assessment research strategy for nanoscale titanium dioxide. EPA report 600/R-10/042 (http://www.epa.gov/osp/bosc/pdf/nano1005summ.pdf)

U.S. EPA (2010b) Nanomaterial case studies: Nanoscale titanium dioxide in water treatment and topical sunscreen (final). EPA report 600/R-09/057F (http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=230972)

U.S. EPA (2010c) Nanomaterial case study: Nanoscale silver in disinfectant spray (external review draft). EPA report 600/R-10/081 (http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=226723)