Committee on Environment and Sustainability

**Fact Sheet**

# CHEMICAL ALTERNATIVES ASSESSMENT

To advance chemistry in sustainable development, chemical use should consider many factors, including performance, costs, potential adverse effects to human health and the environment, and societal impacts. To this end, Chemical Alternatives Assessments (CAAs) are designed to facilitate evaluating these factors by assisting users in identifying alternative chemicals or approaches. CAAs allow for a holistic understanding of potential consequences and may identify safer substitutes with reduced environmental impacts. [NRC 2014] Other terms for AAs include alternatives analysis and substitution assessment [Jacobs et al. 2016]. Employing CAA will support U.N. Sustainable Development Goals [U.N. 2015] such as Goal 3 (Good Health and Well Being); Goal 6 (Clean Water and Sanitation), Goal 9 (Industries, Innovation & Infrastructure) and Goal 12 (Responsible Consumption and Production).

The NRC defined AAs as a process for identifying, comparing, and selecting safer alternatives to chemicals of concern due to inherent hazards, comparative exposure, performance, and economic viability. A chemical of concern can be a chemical in any material, process, or technology. Consequently, a safer alternative represents an option that is less hazardous to humans and the environment than the existing chemical or chemical process. Further, a safer alternative to a particular chemical of concern may include a chemical substitute or a change in materials or design that eliminates the need for a chemical alternative.

The NRC noted that differences exist between AAs and other kinds of assessments. The definitions below explain three other assessments used. Typically, AAs do not encompass these others.

- A safety assessment is when the primary goal is to ensure that exposure to a particular substance is below some prescribed standard.
- A risk assessment is a calculation of the risk associated with a given level of exposure.
- A sustainability assessment examines all aspects of the life cycle of a chemical and alternatives, including energy and material use. Ideally, in an alternatives assessment, it is important to at least consider all life cycle segments that would be affected by chemical substitutions to get the most comprehensive view of potential impacts and trade-offs. However, such a detailed assessment is rarely attainable given the limits in current life cycle assessment tools and could potentially lead to inaction. [NRC 2014] [Jacobs et al. 2016]

The NRC also suggested a generic framework for the proper identification of chemical alternatives. See Table 1 below for a concise overview of the NRC framework. Jacobs et al. [2016] articulate the need to incorporate additional quantitative measures into such general frameworks.

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*References*

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Jacobs, Molly M.; Malloy, Timothy F.; Tickner, Joel A.; Edwards, Sally. 2016. Alternatives Assessment Frameworks: Research Needs for the Informed Substitution of Hazardous Chemicals.

U.N., 2015 Transforming Our World: The 2030 Agenda for Sustainable Development.

**Table 1. Concise Summary of NRC Framework for Assessing Chemical Alternatives**

Phase I. Search for alternatives
- Identify chemical of concern
- Scope and formulate the problem
- Identify Potential Alternatives
  - If alternatives not available, research and de novo design are needed

Phase 2. Assessment of Physicochemical Properties in Three Parallel Aspects
- Assess Human Health Hazards
- Conduct Comparative Exposure Assessment
- Assess Ecotoxicity

Phase 3. Integration and Life Cycle Thinking
- Are alternatives safer based on all information? If not, return to research/de novo design
- Life Cycle Thinking

Phase 4. Additional Assessment
- Additional Life Cycle, Performance, and Economic Assessment

Phase 5. Final Selection
- Identify all acceptable alternatives
- Compare alternatives
- Implement alternatives

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