A Framework to Guide Selection of CHEMICAL ALTERNATIVES

NATIONAL RESEARCH COUNCIL
OF THE NATIONAL ACADEMIES

Board on Chemical Sciences and Technology

Board on Environmental Studies and Toxicology

Overview of Today's Presentation

Study background

Approach to study

Overview of Committee framework

Key elements of Committee's framework

Committee on Design and Evaluation of Safer New Chemicals– A Framework to Inform Government and Industry Decisions

Sponsor

- EPA, Office of Research and Development (with support from Office of Chemical Safety and Pollution Prevention (OCSPP))

National Research Council's Division on Earth and Life Studies

- Board on Chemical Sciences and Technology
- Board on Environmental Studies and Toxicology

Statement of Task

Decision framework for evaluating potentially safer substitute chemicals to:

- support consideration of potential impacts early in chemical design
- consider both human health and ecological risks
- integrate multiple and diverse data streams
- consider tradeoffs between risks and factors such as product functionality, product efficacy, process safety and resource use
- identify the scientific information and tools required

Demonstrate the framework's:

- application by users with contrasting decision contexts and priorities
- use of high throughput/content data streams

What the Committee Considered

- Existing Frameworks and Tools (based on OECD and others)
- Previous Committee Reports (e.g. Toxicity Testing in the 21st Century, Science and Decisions)
- Speakers on existing frameworks, DTSC, industry viewpoints, retailer viewpoints, NGO viewpoints, life cycle analysis, MCDA

Alternatives Assessment

is

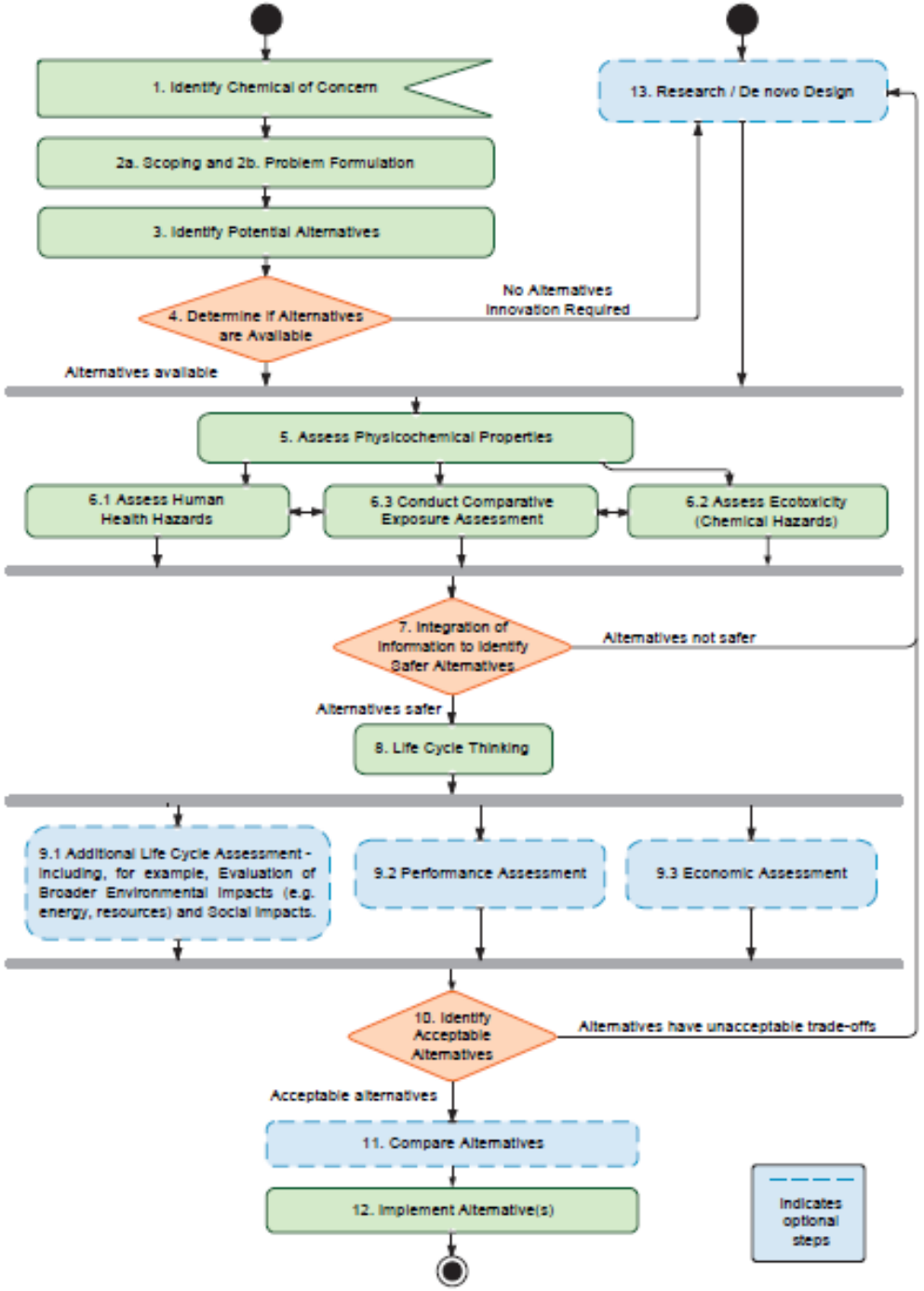
- is a process for identifying, comparing and selecting safer alternatives to chemicals of concern.
- has a goal of facilitating an informed consideration of the advantages and disadvantages of alternatives to a chemical of concern.

is not

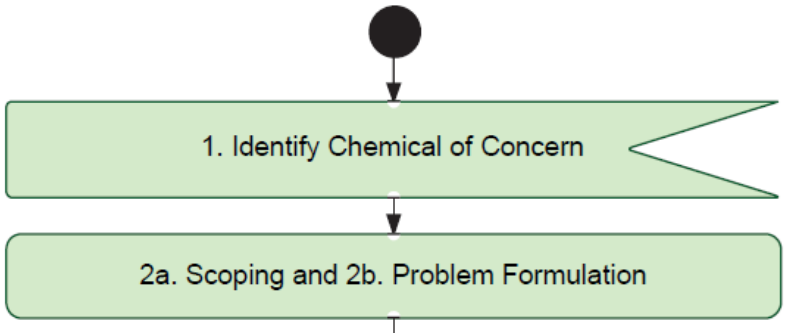
- a *safety assessment*, where the primary goal is to ensure that exposure is below a prescribed standard,
- a *risk assessment* where risk associated with a given level of exposure is calculated
- a *sustainability assessment* that considers all aspects of a chemicals' life cycle, including energy and material use.

Framework

- Two-tiered approach that considers health and ecotoxicity, along with comparing exposure, followed by a consideration of broader impacts
- Minimum steps and optional steps
- Acknowledged need for research and innovation



Scoping and Problem Formulation



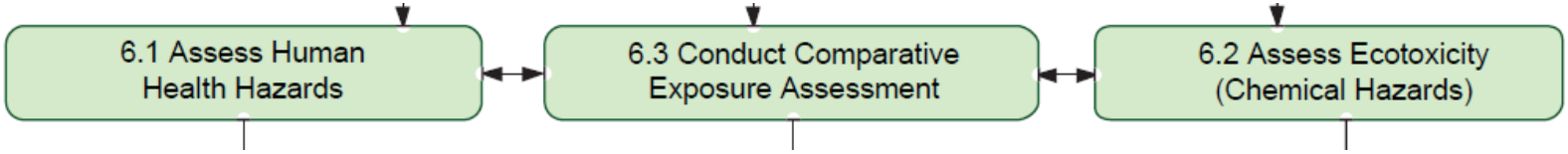
2a: Scoping:

- Documentation of *goals, principles, and decision rules* guiding the assessment.
- Make preferences of the decision-maker explicit in the form of decision rules or algorithms to be applied in the face of tradeoffs and uncertainty
- Decision rules established a priori.
- Documenting* assumptions, data, and methods in the assessment.

2b Problem Formulation

- Characterization of *function and performance requirements*
- Characterize chemical of concern
- Initial screening if necessary

Step 6



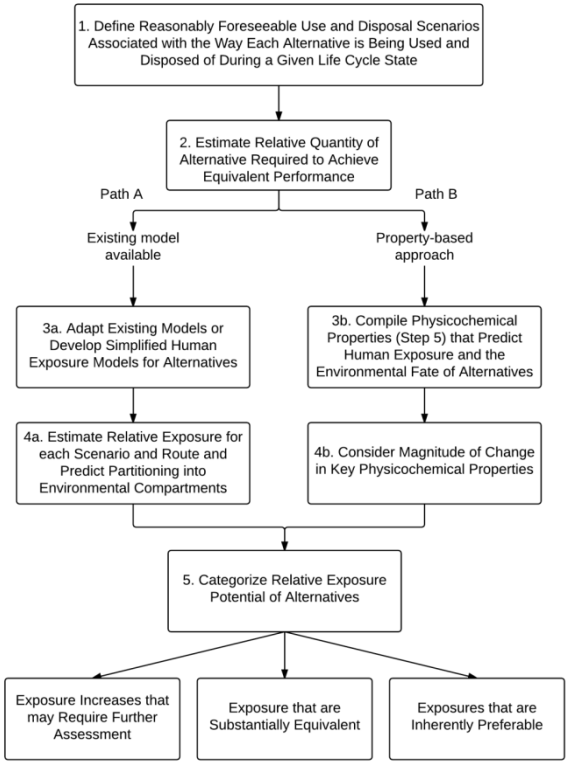
- Human health assessment
  - GHS-tied criteria with a few refinements
  - Moving beyond relying solely on using traditional types of data
- Ecotoxicity refinements:
  - Physicochemical data for environmental compartment partitioning
  - Using relevant high throughput data produced for human health testing.
- Emphasis on comparative exposure

Comparative Exposure

- If substantially equivalent exposure is expected, then the assessment can be mainly hazard based
- Some alternatives preferable due to inherent exposure-related properties
- If an alternative has substantially higher potential for exposure, more detailed assessment may be appropriate if further analysis suggests the effort is warranted

Determine If Substantially Equivalent Exposures Are Expected

- Outputs of simple exposure models (especially those considering estimates based on observed use patterns)
- Comparing key physicochemical properties of alternatives
- Exposure estimates should be derived in the absence of assumptions about controls.



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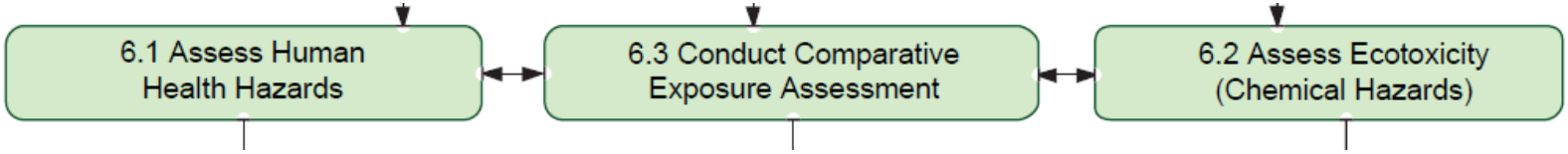
Step 6



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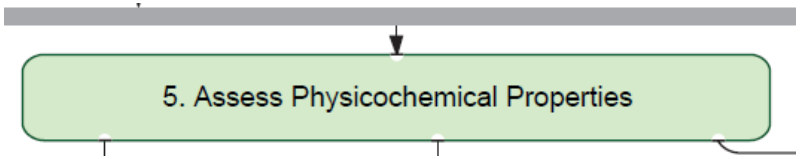
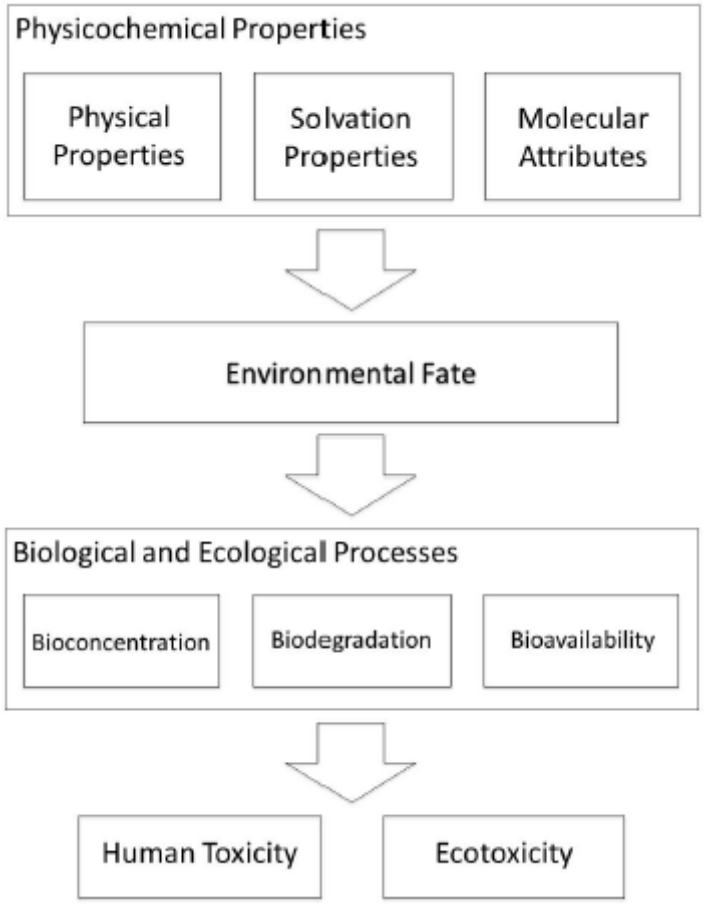
Broadening consideration of physicochemical properties



- Determining environmental compartments of chemical partitioning
- Estimating potential for bioconcentration and bioavailability
- Estimate likely routes of mammalian exposure and bioavailability
- Estimating likelihood for high aquatic toxicity

Physicochemical Properties Related to Human Toxicity and Ecotoxicity



Ecotoxicity Elements

- Review physicochemical data to determine environmental compartment partitioning
- Compile ecotoxicity, especially for identified compartments
- Estimate toxicity for missing data (read across, QSAR, etc.)
- Show relative hazard in different environmental media (soil, water, sediment, air)

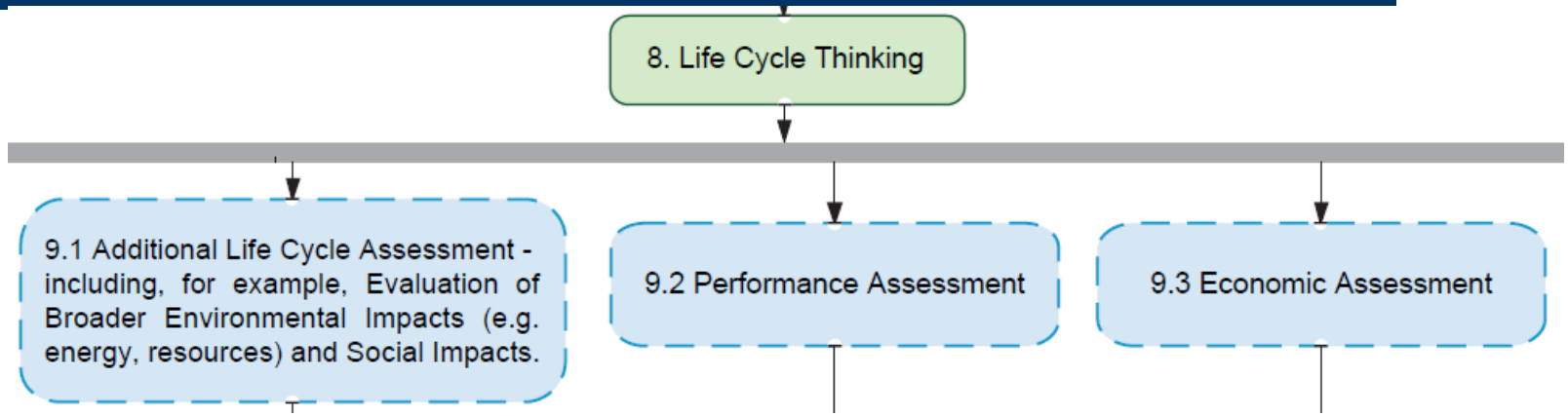
Human Health Assessment

- Use GHS criteria and hazard descriptors as possible
- Describe hazard data (H, M, L) and describe certainty
- Use assessment guidance when expert judgment required
- Use in vitro and in silico data where appropriate for as primary data (e.g., mutagenicity) and to fill data gaps
- Note which endpoints were not considered

Incorporation of In Vitro Data and In Silico Models

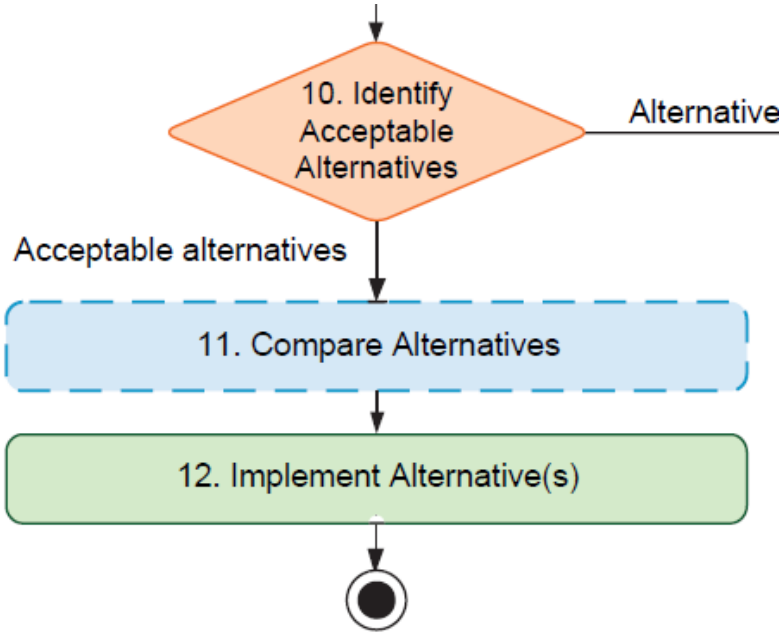
- Move beyond traditional types of data associated with GHS or other benchmarking approaches and towards greater incorporation of high throughput in vitro data and in silico modeling data.
- Potential uses of such data are: as primary evidence for a given endpoint, to fill gaps in data for a particular endpoint, and to use the information to screen out possible unintended consequences of data-poor chemicals.
- At this point, the committee suggests use to fill data gaps or screen for unexpected conssequences, except for certain mutagenicity and endocrine/reproductive toxicity assays.
- Principles or tools to support benchmarking and integration of high throughput data are needed.

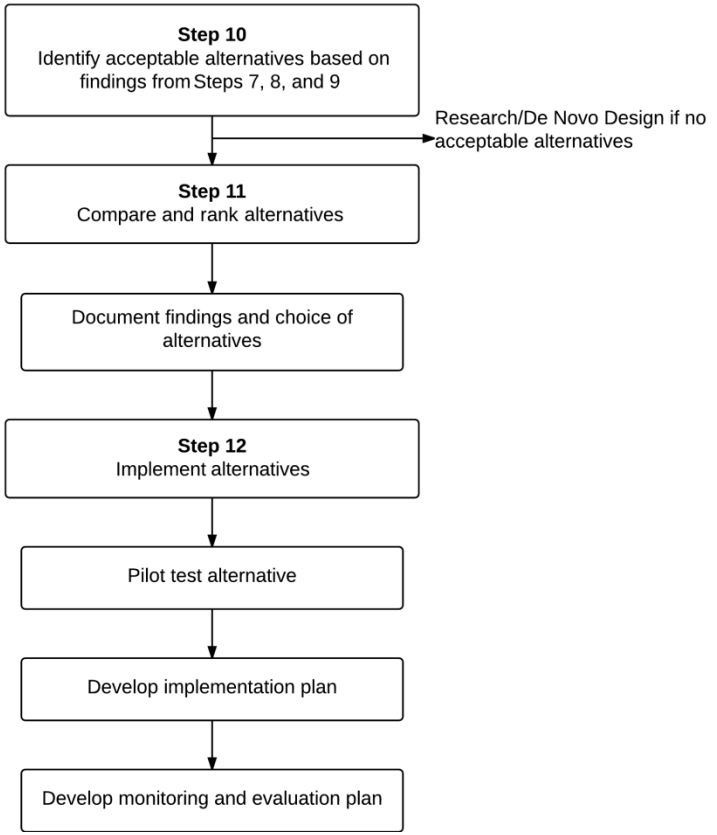
Life Cycle Thinking and Optional Steps



- Life cycle thinking: Consideration of life cycle differences between the chemical of concern and alternatives and their implications for broad environmental (e.g., water or energy use) or social impact.
- Consideration of performance and economic concerns.
- Monitoring and implementation.

Steps 10-12


10. Identify Acceptable Alternatives
Alternative
Acceptable alternatives
11. Compare Alternatives
12. Implement Alternative(s)


Step 10
Identify acceptable alternatives based on findings from Steps 7, 8, and 9
Research/De Novo Design if no acceptable alternatives
Step 11
Compare and rank alternatives
Document findings and choice of alternatives
Step 12
Implement alternatives
Pilot test alternative
Develop implementation plan
Develop monitoring and evaluation plan

For More Information

Public Release of Report:

Free PDF available for download October 10, 12:00pm EDT

http://www.nap.edu/catalog.php?record_id=18872

Webinar:

October 24, 12:30-2:00 EDT

https://nasevents.webex.com/nasevents/onstage/g.php?t=a&d=662936691

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