

# Alternatives Assessment in Context

Joel A. Tickner, ScD

Department of Community Health and Sustainability

University of Massachusetts Lowell

[joel\\_tickner@uml.edu](mailto:joel_tickner@uml.edu)

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# Why alternatives assessment

- The problem-based approach can not be effective in addressing hazards caused by thousands of chemicals in hundreds of thousands of products
- A need to take action despite imperfect information

## Why Alternatives Assessment

- Slow chemical by chemical risk assessment and risk management processes with high burdens on government
- Prevention delayed while debates over risk
- Data on toxicity use and exposure are limited
- Near impossibility of identifying “safe” levels of exposure
- Narrow focus on risks within jurisdictions and responding to problem of the day can lead to trade-offs

## Benefits of alternatives assessment

- Shift from problem-sphere to solutions and opportunities to promote innovation, cost-savings, job creation
- Greater opportunity for stakeholder engagement
- Allows agencies to use regulatory, bully pulpit or collaborative powers to encourage action even when science isn't perfect
- Leads to better product design
- Can lead to multi-risk reduction (energy/toxics)

# History of alternatives assessment

- Long history of prioritization of substitution in industrial hygiene and pollution prevention
- Lots of consideration of substitution in government policies
- But few requirements to conduct alternatives assessments

# History of Alternatives Assessment – Global and Europe

- Background in Northern European chemicals policies
  - “Anyone handling or importing a chemical product shall take such steps and otherwise observe such precautions as are necessary to prevent or minimize harm to human beings or to the environment. This includes avoiding chemical products for which less hazardous substitutes are available.” (Swedish Act on Chemical Products, 1985)

## Global/European History

- Montreal Protocol – 1989 - Chemical Technical Options Committee reviews alternatives for ozone depleting substances
- European occupational/environmental laws require substitution of specific high concern chemicals – CMRs – based on hazard classification
  - Cosmetics directive
  - Carcinogens and Chemical Agents directives

# Alternatives Assessment in the United Nations Stockholm Convention

2010 Stockholm Convention on Persistent Organic Pollutants adopts a Six Step General Guidance for Alternatives Assessment



# Alternatives Assessment in REACH

2007 European Union's REACH Regulation came into force

- Authorization requires that firms wishing to use Substances of Very High Concern (SVHC - Annex XIII) that cannot be adequately controlled must assess suitable alternatives and, if suitable alternatives are available, may prepare a substitution plan.
- Article manufacturers/retailers must identify SVHCs in products
- The European Chemicals Agency published Guidance on Alternatives Assessment for Restrictions (Annex XV) in 2007

## History of alternatives assessment in the US

- *National Environmental Protection Act* requires assessments of “all reasonable alternatives, including no action” in EIS’s to foster “excellent action” (1970)
- *Endangered Species Act* requires consideration of “reasonable and prudent alternatives” (1982)

# Drivers of substitution and alternatives assessment- US

- Great Lakes Water Quality agreement 1976: “the discharge of toxic substances in toxic amounts be prohibited and the discharge of any or all persistent toxic substances be virtually eliminated.”
- OSHA Generic Cancer Standard states that known and probable carcinogens should be substituted based on technical feasibility (1979)
- Pollution Prevention Act of 1990 – establishes prevention at source at top of hierarchy of prevention – EPA activities around Clean Technology Substitutes, etc
- More recent (2000s)– GSA and DOD purchasing requirements demanding less and non-toxic products
- Chemical plant security/Process safety management

## State actions on alternatives assessment

- California Safe Drinking Water and Toxic Enforcement Act of 1986 (aka Prop 65) prohibits businesses from discharging chemicals that have carcinogenic or reproductive toxicity effects into sources of drinking water—driver for substitution
- MA Toxics Use Reduction Act (1990) requires understanding materials throughput and alternatives assessment planning
- Numerous single state bans of chemicals

# State Chemicals Policy

## 2009-2010 Legislative Session

- **Single Chemical Restrictions**
  - Bisphenol A—7 states, 4 counties, 1 city enacted; 19 states, the District of Columbia, 1 county, 1 city proposed
  - Cadmium—4 state enacted, 4 states proposed
  - Lead—4 states enacted, 9 states and District of Columbia proposed
  - PBDEs—4 states enacted, 12 states proposed
- **Product Categories**
  - Cleaning Products—5 states enacted, 13 states proposed
  - Children's Products and Toys—3 states enacted, 24 states proposed
  - Cosmetics—9 states proposed
- **Comprehensive Policies to Identify, Prioritize, and Manage Chemicals of Concern**
  - 2 states enacted, 10 states proposed
- **Green Chemistry**
  - CT—Enacted legislation to establish Chemical Innovations Institute
  - MN enacted and MI proposed legislation to incorporate definitions of green chemistry into economic development policies

# Safer alternatives in TSCA Reform

- Safe Chemicals Act of 2011
- **POLICY.—It is the policy of the United States—**
  - “**(1) to protect the health of children, workers, consumers, and the public, and to protect the environment from harmful exposures to chemical substances and mixtures;**
  - “**(2) to promote the use of safer alternatives and other actions that reduce use of and exposure to hazardous chemical substances and reward innovation toward safer chemicals, processes, and products;**

## Elements of Alternatives Assessment in TSCA Reform

- Establishes a program to create market incentives for the development of safer alternatives to existing chemical substances that reduce or avoid the use and generation of hazardous substances, including:
  - Expedited review of new safer chemicals
  - Recognition by EPA as a safer chemical
  - Other incentives/job training, technical assistance
- Establishes a network of regional green chemistry and engineering centers

# Other non-governmental efforts

- CDC National Conversation on Chemical Exposure recommendations for alternatives assessment
- President's Cancer Panel
- State and federal safer chemicals campaigns
- Efforts by NGOs to develop tools to advance safer chemicals
- Industry initiatives

# Industry efforts to advance safer alternatives

- Tools to assess and prioritize chemicals and products
- Restricted Substances Lists
- Reformulation of products and product design strategies to eliminate chemicals of concern
- Ingredient disclosure
- Chemical use policies



# GreenWERCS Chemical Screening Tool

- Analyzes the composition of individual products from ingredient data entered by manufacturers
- Identify and reduce chemically hazardous products
- Helps make informed decisions based on:
  - Chemicals harmful to human health
  - Chemicals harmful to the environment
  - Sustainability goals



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## Welcome to CleanGredients

... an online database of institutional and industrial (I&I) cleaning product ingredient chemicals, providing verified information about the environmental and human health attributes of listed ingredients. CleanGredients :

- ✧ helps formulators to identify better ingredients
- ✧ helps suppliers to showcase better ingredients

## News and Announcements [read all](#)

CleanGredients  Version 2 is now online! We have spent the last year and a half developing this new version, which offers additional user features and easily accommodates new ingredient modules. Your username and password will remain the same. We are eager to hear your feedback about CleanGredients  Version 2, so please contact us with comments or questions at [info@cleangredients.org](mailto:info@cleangredients.org).

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SUBSPORT - SUBSTITUTION SUPPORT PORTAL

MOVING TOWARDS SAFER ALTERNATIVES

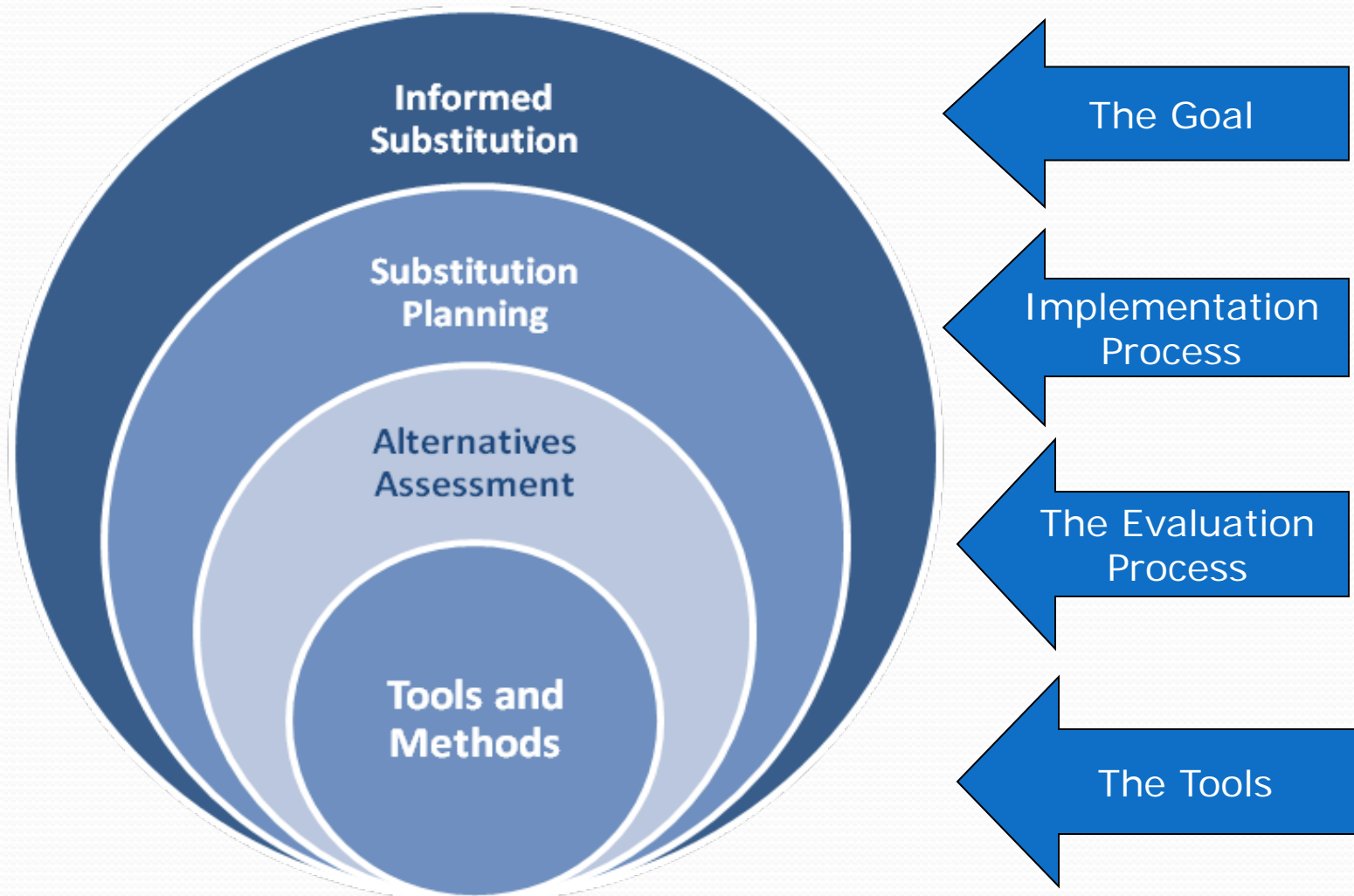
What does substitution mean?

The substitution of chemicals is a fundamental measure to reduce risks arising from the use of dangerous chemicals in products and processes. Substitution can support risk reduction for the environment, workers, consumers and public health. Substitution can be accomplished by the use of an alternative, less hazardous substance. In many cases other technologies

# CDC Recommendations on advancing alternatives assessment

- Evaluate existing methods and frameworks for conducting alternatives assessment to identify key elements and determine the best practices.
- Rank chemicals according to their toxicity, use, and exposure. Establish an initial list of toxicological properties, uses, and exposures of concern and identify chemicals with those known characteristics.
- Establish scientific principles for identifying safer substitutes (i.e., how to know that a substitute would be less toxic), including methods to address the lack of chemical toxicity data.
- Establish a comprehensive database of chemicals, basic toxicities that are known or suspected, and safer substitutes or alternative processes.

# Conceptualizing Alternatives Assessment

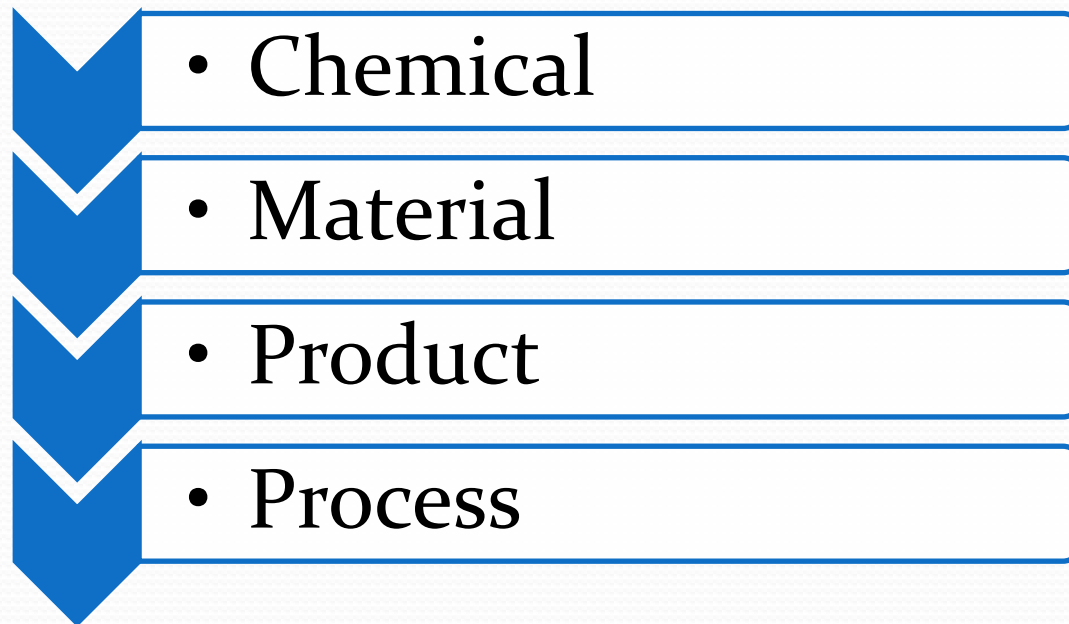


# 1. Informed Substitution

- The considered transition from a chemical of particular concern to safer chemicals or non-chemical alternatives.
  - To minimize the likelihood of unintended consequences
  - To enable a course of action based on the best information - on the environment and human health - that is available or can be estimated.
- Risk reducing substitutes for undesirable substances may result from:
  - Drop in chemicals
  - Changes in production processes
  - Changes in product design
  - Changes in how functions are performed
  - Non-chemical solutions
  - New systems of consumption

## Substitution Strategies

- Substitution strategies are defined by the points of intervention where an alternative is considered



## 2. Substitution Planning

The process of setting goals and timetables, assembling teams, marshalling resources, conducting alternatives assessments, identifying safer alternatives and implementing those alternatives

- Modeled on Pollution Prevention or Toxics Use Reduction Facility Planning Processes
- Involves the management processes necessary to affect the adoption of a safer alternative

# 3. Alternatives Assessment: The Process

Alternatives Assessment is a process for identifying and comparing potential chemical and non-chemical alternatives that can be used as substitutes to replace chemicals or technologies of high concern.

It is a step-defined process which may require several iterations

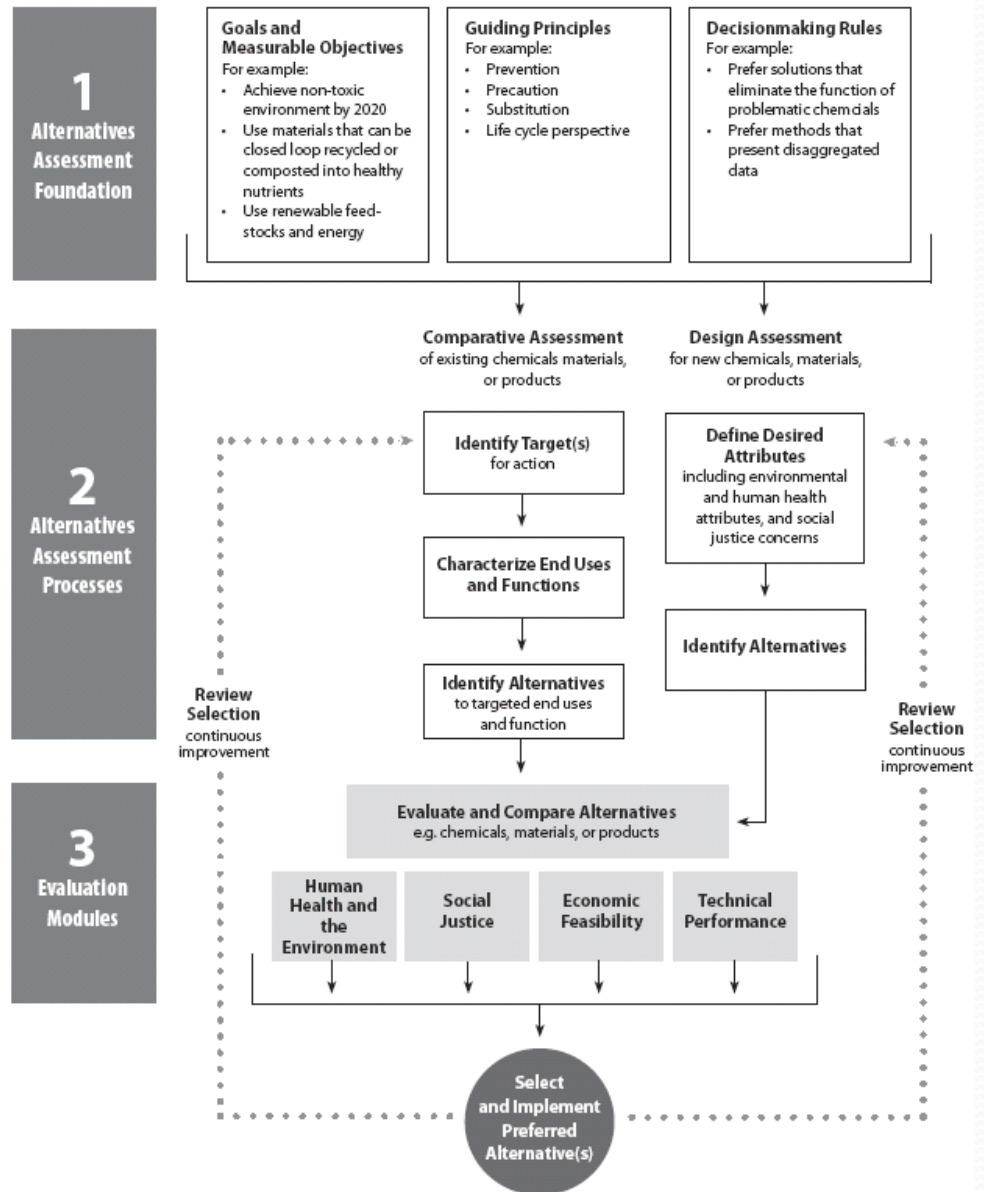
- Focus on function of chemical of concern
- Focus on substitution, process or product redesign
- Considers the “necessariness” of a chemical

# Lowell Center Framework

2006 Lowell Center publishes an Alternative Assessment Framework

Lowell Center Alternative Assessment Framework has three Sections

- Foundation  
(Goals, Principles, Rules)
- Evaluation Process  
(Steps)
- Evaluation Modules  
(Tools)



Lowell Center's framework defines two types of Alternative Assessments:

- Comparative Assessment to compare existing technologies
- Design Assessment to guide the development of new technologies

Figure 4 Alternatives Assessment Processes

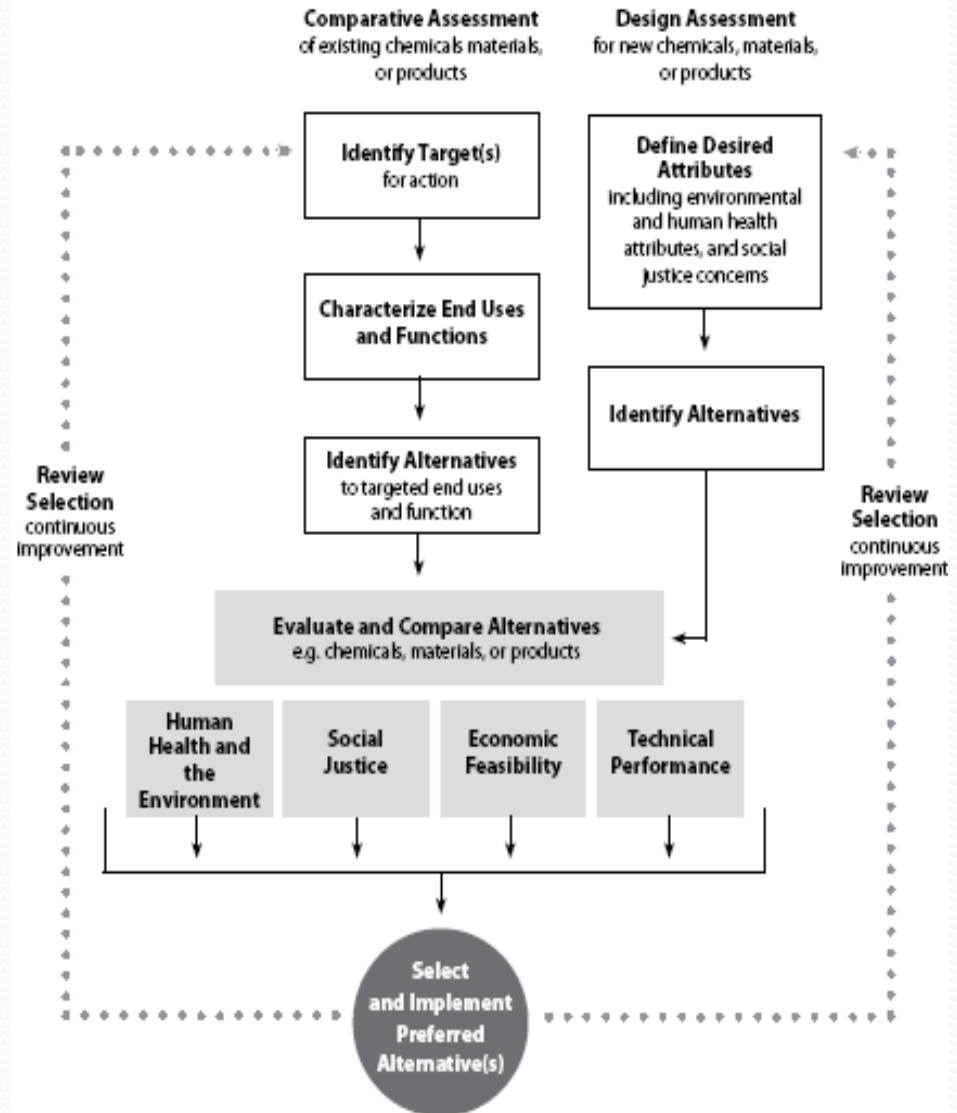




Figure 1 - IC2 Safer Alternatives Assessment process

## 4. Tools for Alternatives Assessment

- Comparative Chemical Hazard Assessments
- Life Cycle Assessments (*Life Cycle Thinking*)
- Cost and Performance Assessments
  
- Social Impact Assessments
- Risk Assessments

Tools

# Comparative Chemicals Hazard Assessment

Tools for comparing chemical alternatives on the basis of chemical hazards

Hazard-based analysis

- TURI's Pollution Prevention Options Analysis System (P2OASys)
- German Column Model
- EPA's DFE Chemical Hazard Assessment Framework
- Clean Production Action's Green Screen
- Washington DOE's QCATs

# EPA's DFE Chemical Hazard Screening Framework

Chemical	CASRN	Human Health Effects										Aquatic Toxicity		Environmental		Exposure Considerations	
		Acute Toxicity	Skin Sensitizer	Cancer Hazard	Immunotoxicity	Reproductive	Developmental	Neurological	Systemic	Genotoxicity	Acute	Chronic	Persistence	Bioaccumulation			
<b>Reactive Flame Retardant Chemicals<sup>2</sup></b>																	
<b>Tetrabromobisphenol A (TBBPA) (Albemarle, Chemtura, and others)<sup>3</sup></b>																	
TBBPA	79-94-7	L	L	L	L	L	M	L	L	L	L	H	H	M	L		
<b>DOPO (6H-Dibenz[c,e][1,2] oxaphosphorin, 6-oxide) (Sanko Co., Ltd. and others)</b>																	
DOPO	35948-25-5	L	L	L	L	L	L	L	L	L	M	M	L	L			
<b>Fyrol PMP (Aryl alkylphosphonate) (Supresta)</b>																	
Fyrol PMP	Proprietary	L	L	L	L	L	L	L	L	L	L	L	L	H	L		
<b>Reactive Flame Retardant Resins<sup>2</sup></b>																	
<b>Reaction product of TBBPA - D.E.R. 538 (Phenol, 4,4'-(1-methylethylidene)bis[2,6-dibromo-, polymer with (chloromethyl)oxirane and 4,4'-(1-methylethylidene)bis[phenol]] (Dow Chemical)</b>																	
D.E.R. 538	26265-08-7	L	M	M <sup>0</sup>	L	M <sup>0</sup>	M <sup>0</sup>	L	L	L	M	L	L	M	L		
<b>Reaction Product of DOPO - Dow XZ-92547 (reaction product of an epoxy phenyl novolak with DOPO) (Dow Chemical)</b>																	
Dow XZ-92547	Proprietary	L	M	M <sup>0</sup>	L	M <sup>0</sup>	M <sup>0</sup>	L	L	L	M <sup>0</sup>	L	L	H	L		
<b>Reaction product of Fyrol PMP with bisphenol A, polymer with epichlorohydrin (Representative Resin)</b>																	
Representative Fyrol PCB Resin	Unknown	L	L	M <sup>0</sup>	L	M <sup>0</sup>	M <sup>0</sup>	L	L	L	M <sup>0</sup>	L	L	H	L		

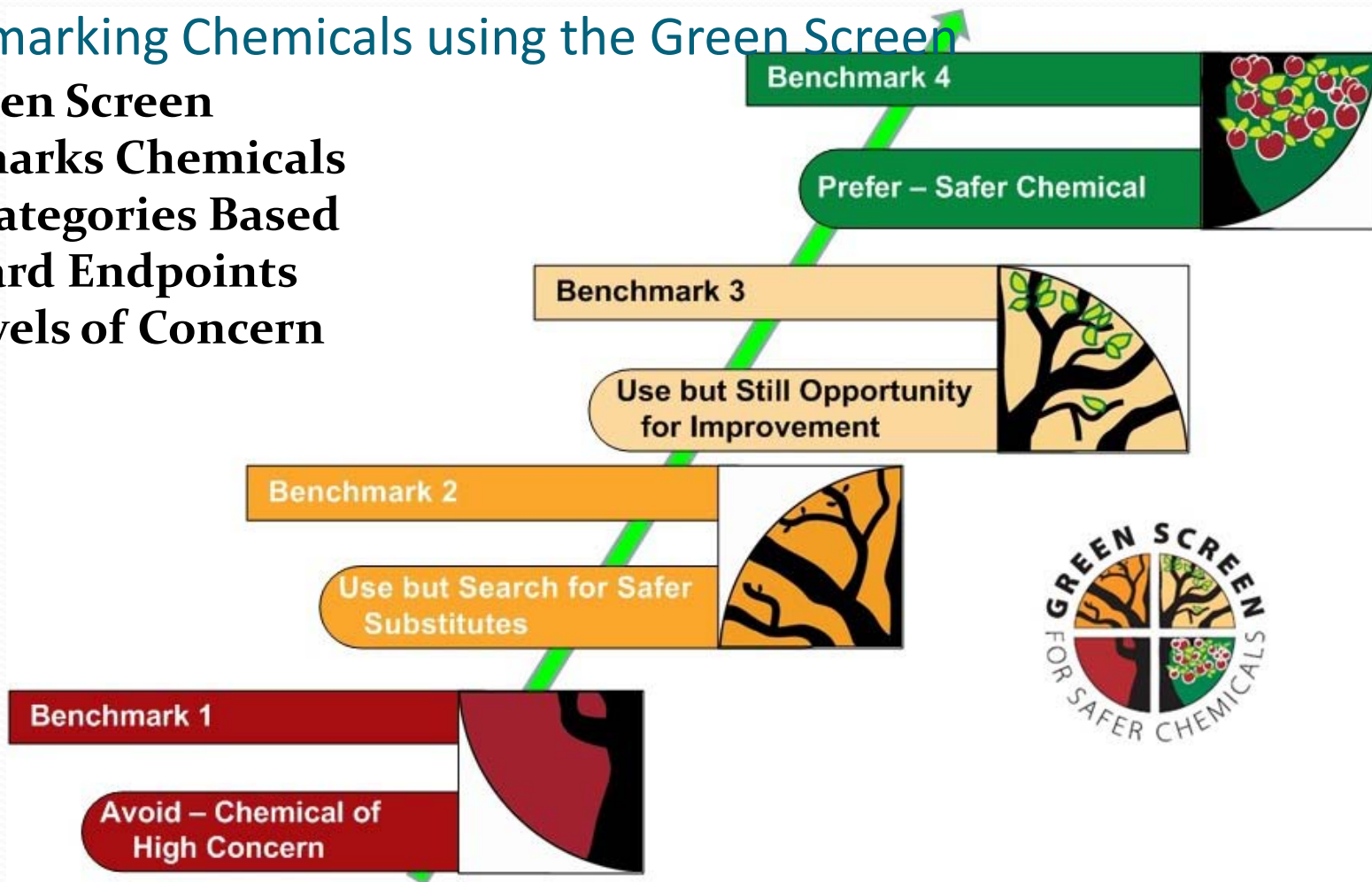
<sup>1</sup> The moderate designation captures a broad range of concerns for hazard, further described in Table 4-3.

<sup>2</sup> Reactive FR chemicals and resins may not completely react, and small amounts may be available during other parts of the lifecycle.

<sup>3</sup> The EU has published a comprehensive risk assessment for TBBPA in reactive applications. This risk assessment is a valuable source of information for choosing flame retardants for printed circuit board applications.

# Benchmarking Chemicals using the Green Screen

**The Green Screen  
Benchmarks Chemicals  
into 4 Categories Based  
on Hazard Endpoints  
and Levels of Concern**



## Challenges to alternatives assessment

- Ingrained problem mentality – stop bad things
- Data gaps – toxicity, use, exposure, lifecycle impacts
- How define safer? Consistent criteria?
- Lack of consistent approaches
- Technical barriers to implementation – rarely a drop in substitute
- Lack of mandates, funding, and expertise in agencies; often work at cross purposes

# Opportunities for the future

- Move from problem debates to win-win solutions
- Move from avoiding chemicals of concern to promoting safer solutions
- Focus not only on assessment but also on implementation
  - responsibility on government
- Important role of purchasing
- Consider workers in decisions
- Requires new ways of thinking, new tools, new capacities, new policy frameworks, and new collaborations
- Need for education/training