



Alternatives Assessment

New Tools for Safer Chemicals

Ken Geiser

Lowell Center for Sustainable Production

October 19, 2011



What is Alternatives Assessment?

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.

Goals –

- Reduce risk by reducing hazard
- Avoid regrettable substitutions

Alternatives Assessment: Investing in Solutions rather than Problems

- Rather than focus on one bad option, we focus on choices and opportunities
- We move from problems to solutions
- We assure ourselves that the solutions we are advocating are preferable to the hazards we are replacing
- We encourage transparency and documentation

The Uses of Alternatives Assessment

- Industries can evaluate safer substitutes for chemicals of concern
- Governments can evaluate potential substitutes before restricting chemical uses
- Chemists and chemical engineers can select safer chemical processes and products in production processes
- Advocates can document safer alternatives to chemicals of public concern

The Lowell Center's Alternatives Assessment Experience



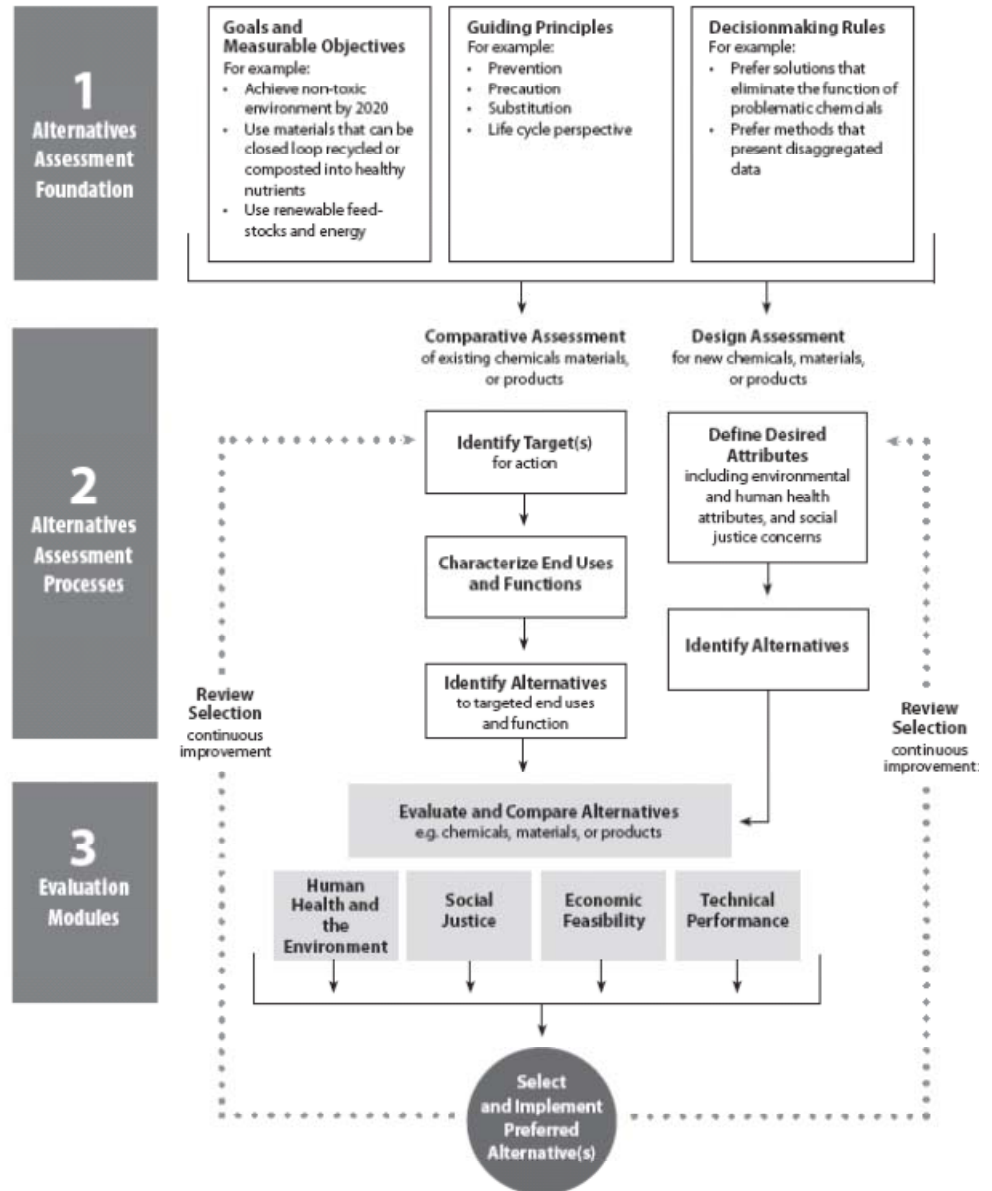
- 2001 Lowell Center's Sustainable Hospitals Project sets up Internet data base on alternatives to mercury, PVC and latex in healthcare
- 2003 Lowell Center's *Mercury Alternatives Report* provides the basis for Maine's mercury phase out legislation
- 2004 Lowell Center's *Alternatives to Decabromodiphenylether* report provides the basis for Washington's phase out of DBDE
- 2004 Lowell Center convenes an International Workshop on Alternatives Assessment



2006 Lowell Center publishes An Alternative Assessment Framework

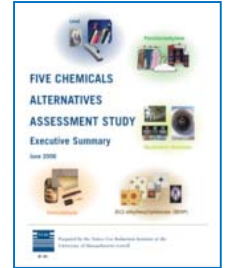
Three Parts

- The Foundation
- The Process
- The Modules





Massachusetts Toxics Use Reduction Institute's Five Chemical Alternatives Assessment



- 2005– Massachusetts Legislative sought a one year Alternatives Assessment on five chemicals of high concern
 - lead
 - perchloroethylene
 - formaldehyde
 - di (2-ethylhexyl) phthalate
 - hexavalent chromium
- The objective was to identify and assess alternatives in terms of cost, performance and health and environmental attributes

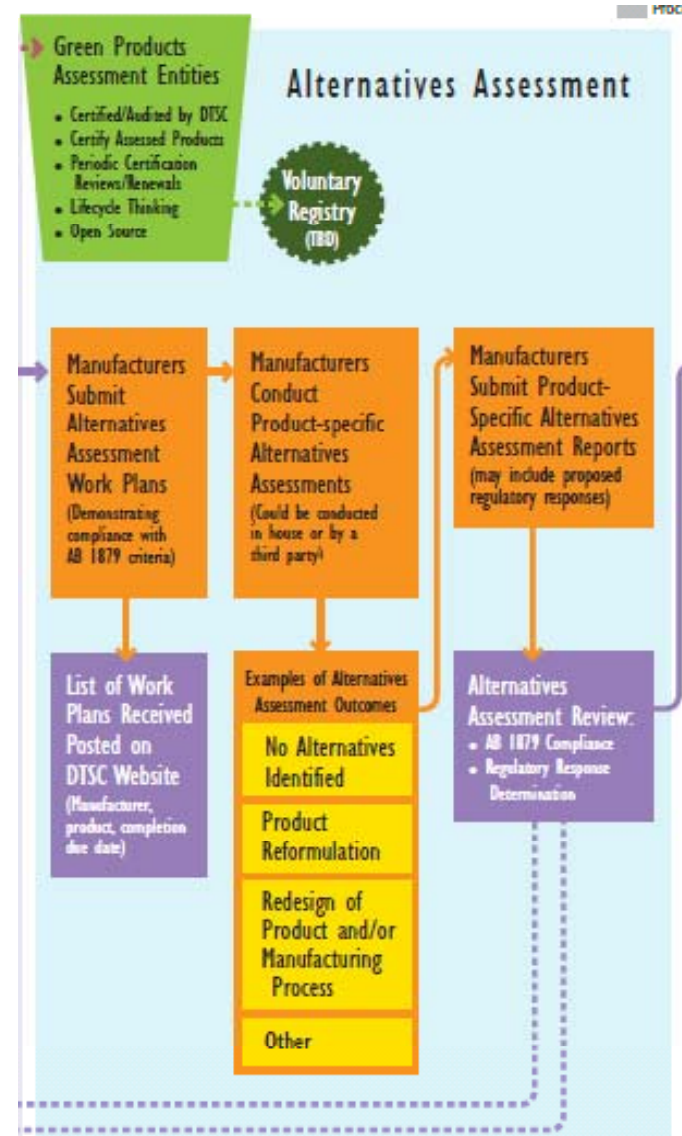
Alternatives Assessment in REACH

2007 European Union's REACH Regulation came into force

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

Alternatives Assessment In the California Green Chemistry Initiative

Manufacturers must prepare Alternative Assessments (taking into consideration life cycles) on products containing priority chemicals of concern



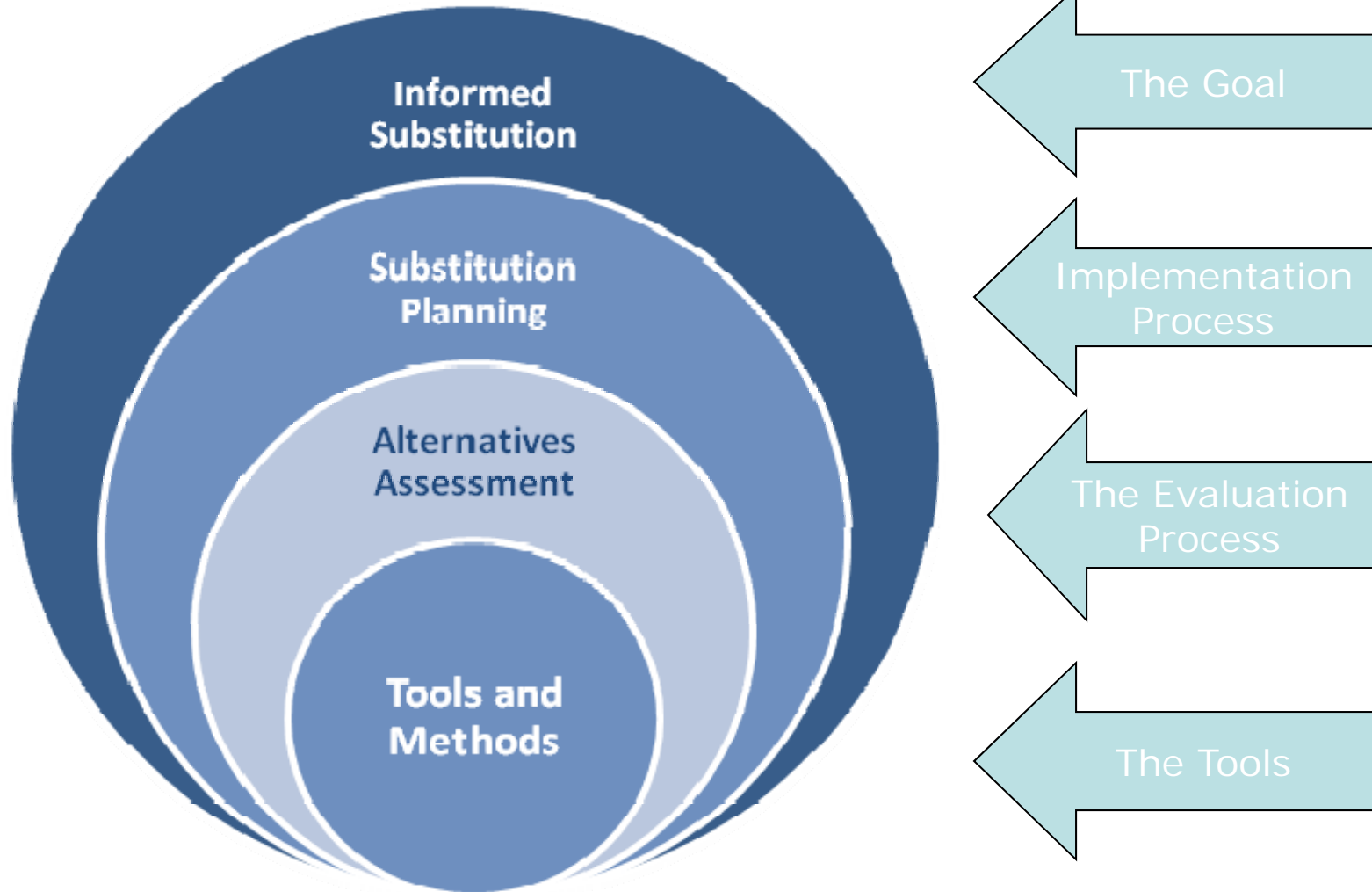
Alternatives Assessment: The Process

Alternatives assessment is a part of Substitution Planning and aimed at Informed Substitution

Alternatives Assessment 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 of concern

Conceptualizing Alternatives Assessment



Tools for Alternatives Assessment (Modules)

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

Comparative Chemicals Hazard Assessment

Tool for comparing chemical alternatives on the basis of chemical hazards

- 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

Seven Step Alternatives Assessment Process



The Alternatives
Assessment Wiki

Developed in
conjunction with the

Interstate Chemicals
Clearinghouse

INTERSTATE CHEMICALS
IC₂
CLEARINGHOUSE

Step 1. Define Scope and Goal



- Set scope of project
- Set policy vs. promote adoption
- Define decision criteria: what is meant by “safer”?

Step 2: Identify Chemical of Concern



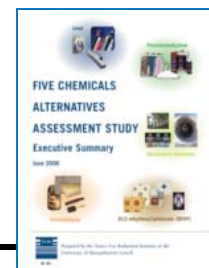
- Sufficiently characterize the chemical of concern
 - physical
 - chemical
 - hazard traits
- Identify its primary uses
- Identify relevant sources of information

Step 3: Identify and Prioritize Uses



- Identify uses of the chemical of concern
 - in products
 - in sectors
- Identify exposure potential
- Identify availability of alternatives

Example: Considerations for prioritizing Formaldehyde Use Categories



Use/Application	Important Considerations
Decorative laminants (plastics, computer monitors)	Not likely to have high emissions, Alternatives Available
Floor finish (commercial acid cured, varnish)	High emissions, high worker exposure, consumer exposure
Insulation (phenolic foam and fiberglass)	Consumer and worker exposure, Alternatives Available
Glass fiber roofing mats	Alternatives Available
Paper products (wallpaper, wet strength additives)	Relatively low emissions, consumer exposure
Paint	Consumer, worker exposure
Ceiling Tiles	Consumer, worker exposure

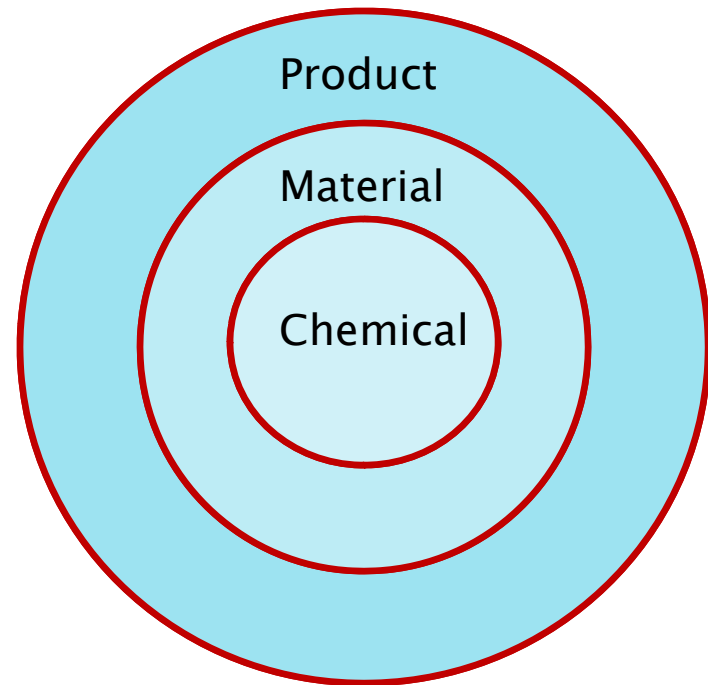
Step 4: Identify and Prioritize Alternatives



- Identify a suite of alternatives
- Screen out unacceptable alternatives
 - PBTs
 - CMRs
- Focus on most likely candidates

Identify Alternatives for Specific Uses

1. Chemical
2. Material
3. Product Re-design
4. Process Change
5. Eliminate the Use / Need for Function
6. Systems Change



Step 5: Compare Alternatives



- Environmental, Health & Safety
- Technical
- Economic & Financial
- Social & Community
- Use Life Cycle Thinking

EH&S Assessment – Chemical to chemical

Example: DEHP in medical devices

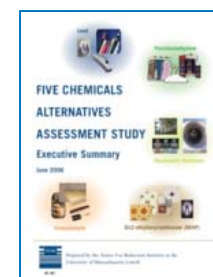
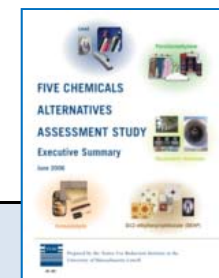


Table 7.4.2 B: Medical Device Plasticizer Alternative Assessment Criteria

Plasticizer Acronym	Performance and Cost Primary Criteria								Environmental Health and Safety Criteria									
	Physical and Aesthetic Properties				Processability				Cost per pound (Normalized using SF)	Carcinogen	Reproductive/ Developmental Toxin	Sediment Persistence	Bioaccumulation (BCF)	Other Health Effects		Fish Toxicity (mg/L)	Migration	Metabolite of Concern
	Clarity	Tensile Elongation	Cold Flexibility	Elastic Recovery	Sterilizability	PVC Compatibility	Emission During Mfg/ Use	LD50 (oral -g/kg)						Irritation (D,O,R)				
DEHP	Exc. (Ref)	Ref (MW 390)	Good (Ref)	Slow but acceptable (Ref)	Ref	Ref	Ref	\$0.70	EPA Class B2, IARC Class 3	Listed in Cal Prop 65, EU R43	140	310	34	D, O, R	No effect at 0.0025	Possible migration in lipid soluble drugs	MEHP (repro toxin)	
DEHA	Exc.	Similar to DEHP MW 370-390	Good	Slow but acceptable	Similar to DEHP	Fair	Lower volatility than DEHP	\$0.70	Not listed	Potential fetotoxicity (CHAP 2001)	78	61	5.6	O, R	>100 at 96 h	Migration probable	EHA (not known to be toxic)	
DINP	Exc.	Higher than DEHP MW 418	~ better than DEHP	Slow but acceptable	Similar to DEHP; slightly more tolerant of steam than DEHP	good	M: Expected to be similar to DEHP U: Slightly less than DEHP	\$0.77	Indicated in rodents (CHAP 2001)	Not listed	140	3.2	Unknown	No	>0.14 at 96 h	Expected to be similar to DEHP	MINP (possible repro. toxin)	
DINCH	Good	Higher than DEHP MW 514	Better than DEHP	Comparable to DEHP	Unk.	good (per mfg)	Unknown	\$0.91	Not listed	Not listed	Unk.	189	>5000	No	>100 (LC50)	Manufacturer claims low	Unk.	

Technical Assessment

Example: perc in dry cleaning



Assessment Criteria	Perc	Carbon Dioxide	Glycol Ethers	High Flash Hydrocarbon	N Propyl Bromide	Siloxanes	SolvonK4	Wet Cle
Cycle time (min)	45	35 – 45	> 45	65-75	45	50 - 60	60 – 65	20-40
Load capacity (lbs)	50	60	43	35-90	50	55	40-90	20-75
Cleaning capability	Aggressive	Gentle	Less effective	Effective	Aggressive	Less effective	Effective	Effective
Difficulty with fabrics and garments	Leather, suedes, beads, delicates	Triacetates, specially dyed acetates	None identified	Vinyl appliquéés	Leather, suedes, beads, delicates	None identified	Appliquéés or decorations glued to fabric	Leather, suede and fur
Time required for pre-spotting	Medium	High	Low	Medium	Low	High	Low	Low to Medium
Equipment compatibility	Perc equipment	CO ₂ equipment	Retrofit Gen IV or higher Hydrocarbon	Hydrocarbon	Retrofit Perc or Hydrocarbon Gen IV or higher	Retrofit Perc, Hydrocarbon Gen IV or higher	Retrofit Hydrocarbon or New SolvonK4 system	Wet Cleaning equipment
Special equipment	None	High pressure equipment	Vapor recovery	Fire safety equipment, including grounds and bonding to minimize static electricity build up	New seals, gaskets, and doors may be required	Combustible – must meet fire safety codes	Combustible – must meet fire safety codes	Additional finishing equipment and training required
Waste management concerns	Handle spent solvent and solids as hazardous waste	Waste soils and lint do not require special handling	Difficult to distill water prior to waste mgmt	Considered as waste oil in MA, to be disposed of as hazardous waste, empty containers may contain residual and may be dangerous	If used as a drop in replacement, residual perc may be present for up to 6 months	Separation needed before disposal. Treat as hazardous waste	Waste solvent disposed of as industrial waste.	Requires discharge to industrial wastewater treatment facility

Step 6: Select Preferred Alternative



- Refer back to goals
- Compare with substance of concern
- Score
- Consider modes of data presentation

Step 7: Promote Adoption of Safer Substitute



- Substitution planning
- Set incentives for adoption
- Promote research

Involve Stakeholders



- Identify all stakeholders
- Keep the process open and inclusive

Alternatives Assessment

- A decision support process yet under development
- A process valuable to those seeking conversion to a safer, more sustainable economy
- A process vulnerable to capture by those protecting the status quo

For more information see:

www.turi.org

www.sustainableproduction.org

www.ic2saferalternatives.org

Thank you.