U.S. EPA Design for the Environment Program

January 27th, 2010

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Agenda

- EPA Priorities
- DfE Program history and development
- Best Practices (where no viable substitutes exist)
- Life Cycle Analysis
- Goals of Informed Substitution
- Alternatives Assessments
- Safer Product Labeling

Administrator Jackson's Seven Priorities

- Taking action on climate change
- Improving air quality
- Assuring the safety of chemicals
- Cleaning up our communities
- Protecting America's waters
- Expanding the conversation on environmentalism and working for environmental justice
- Building strong state and tribal partnerships

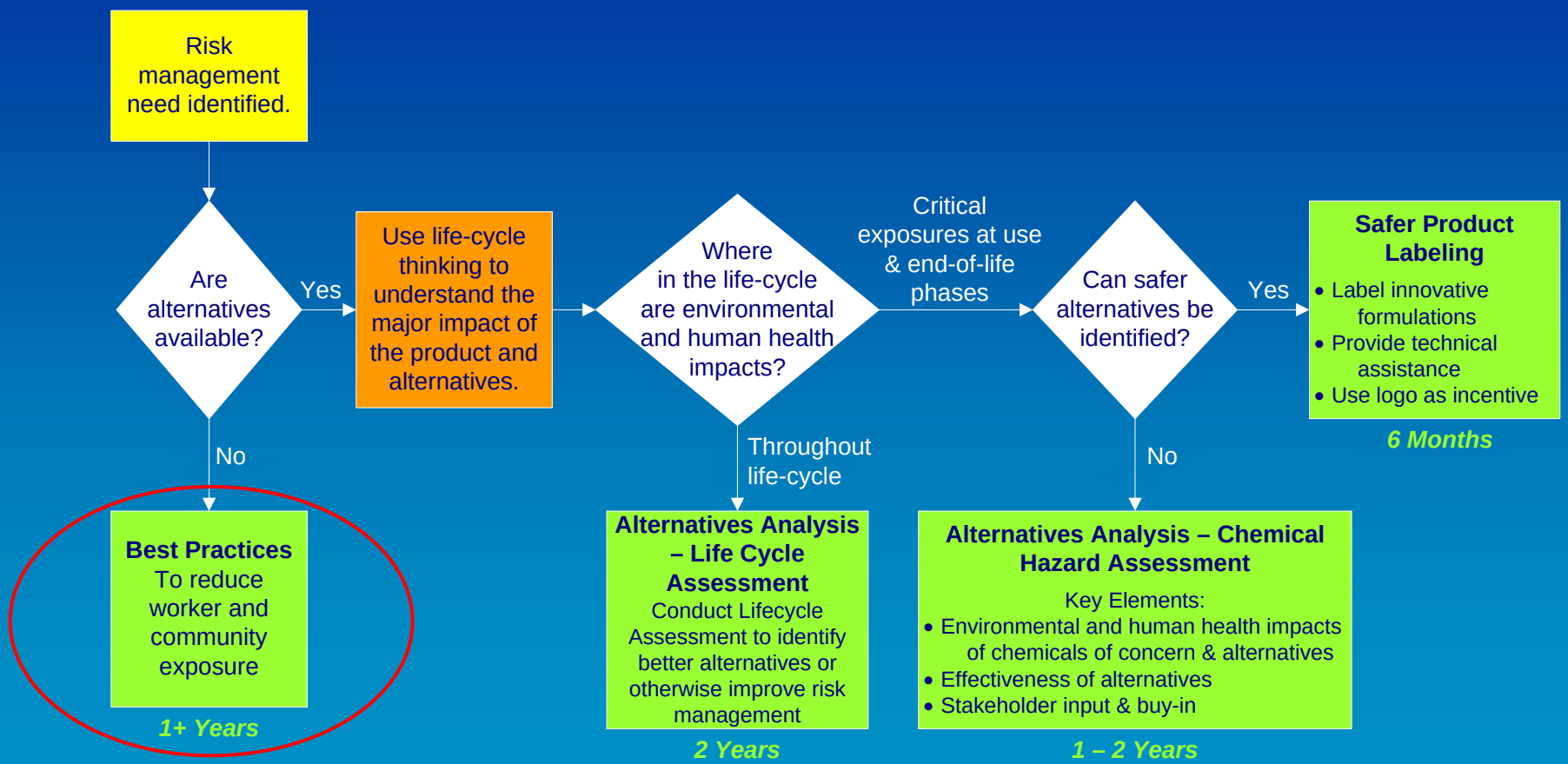
What DfE is About

- Goals
  - Safer Products
  - Safer chemical ingredients is baseline
  - Life cycle impacts are considered
  - Protecting Consumers – Especially Children
- Central Elements
  - OPPT technical tools and expertise
  - Multi-stakeholder participation
- Results
  - Industry partners reduced more than 500 million pounds of chemicals of concern last year

Program History

DfE Program Began	1992
Printed Wiring Board (PWB) Partnership	1995-2001
Screen Printing, Lithography, and Flexography Printing Partnerships	1994-2003
Garment and Textile Care Partnership	1996-2003
Safer Product Labeling Program	1997-Current
Best Practices for Auto Refinishing	1997-Current
LCD vs. CRT monitors LCA	1998-2001
Lead-Free Solder for Printed Circuit Boards LCA	2002-2005
Furniture Flame Retardants Alternatives Assessment	2003-2006
Flame Retardants in Printed Circuit Boards Alternatives Assessment	2007-Current
Alternatives Assessments-Phthalates, DecaBDE…	2010

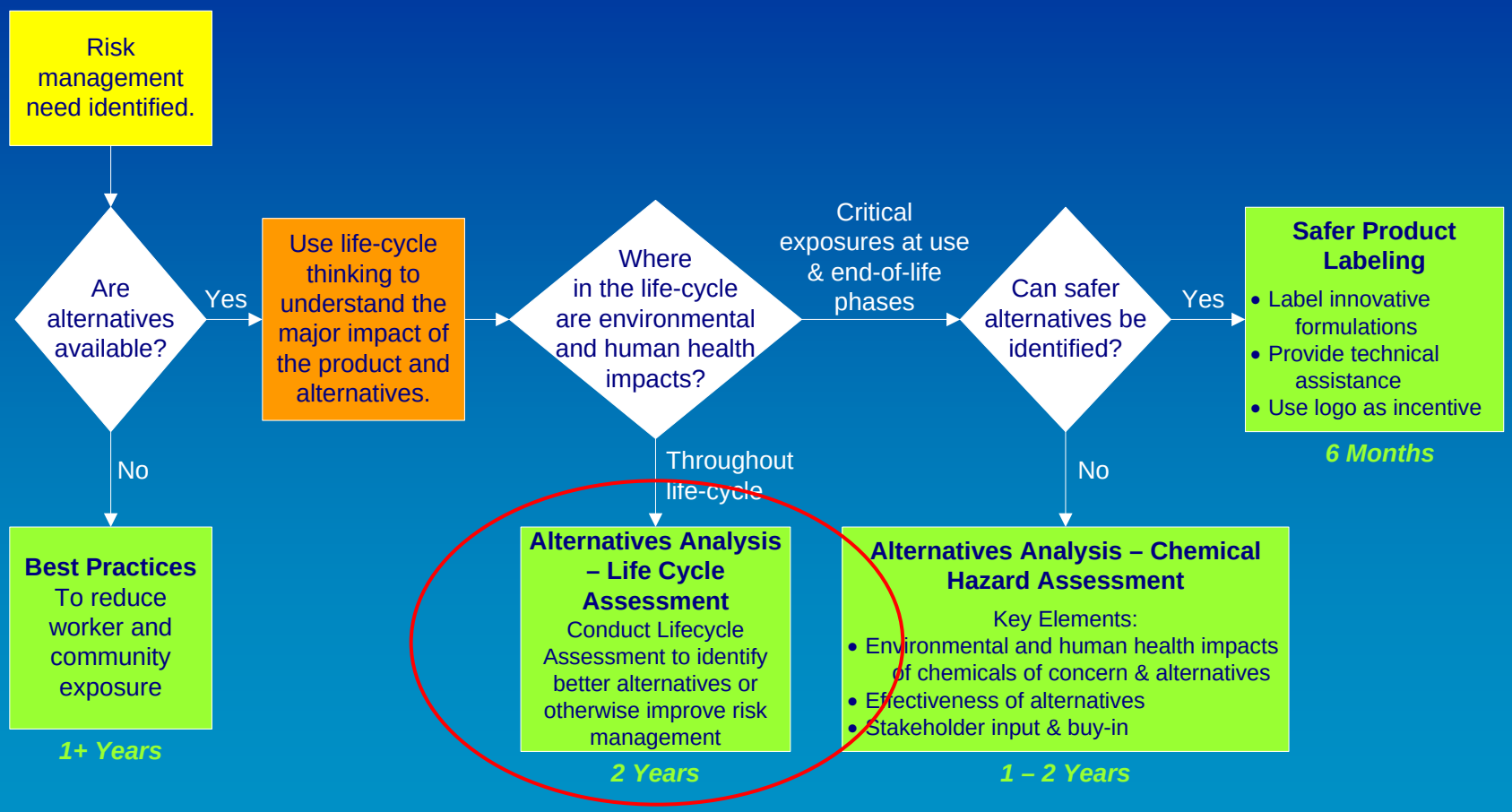
Decision Logic for DfE Approaches



Best Practices

- Where safer alternatives are not available, Best Practices reduce worker and community exposure to chemicals of concern.
- Diisocyanates Examples
  - Diisocyanates are the leading cause of occupational asthma
  - Diisocyanates provide a needed functionality in autobody paints, foams, and other uses.
  - Auto Refinishing
    - Documented best practices
    - Conducted train-the-trainer workshops and site visits to promote best practices that reduce emissions of diisocyanates
    - Used as the basis for CAA Area Source Rule for Auto Body
  - Spray Polyurethane foam (SPF) insulation in schools and other buildings is a current focus
    - Working with industry to improve hazard communication
    - Documenting Best Practices

Decision Logic for DfE Approaches



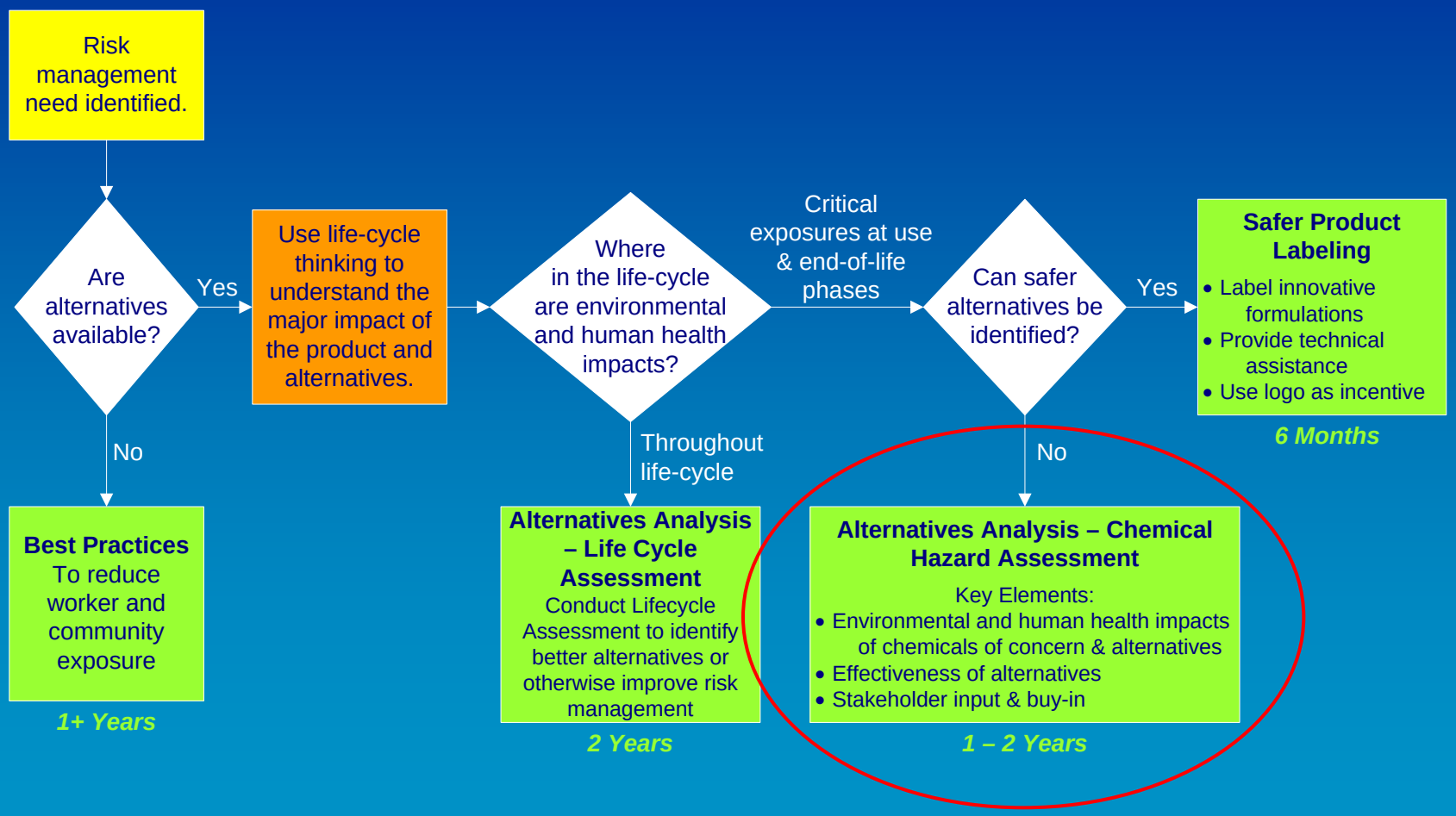
LCA on Nano-Enabled Battery Components for Hybrid and Electric Vehicles

- Energy Independence -- Hybrid and electric vehicles have great potential for reduction of GHG emissions
- Nano-innovations such as Single-Walled Carbon Nanotubes or SWCNTs could lengthen battery life
- Information from our LCA could inform battery designers now, as innovations are being made
- Demonstrate application of the LCA methodology for nano-scale materials; identify gaps in data and challenges in applying the life cycle methodology.

Battery LCA Partnership

- Industry, trade association: Altairnano, Electrovaya, EnerDel, Johnson Controls-Saft, Kinsbursky Brothers/Toxco, Umicore, Novolyte Technologies, Rechargeable Battery Association
- Academia: Rochester Institute of Technology
- Other governmental agencies: Dept. of Energy; Argonne National Laboratory
- Non-governmental organizations: NAATBatt, NextEnergy, Environmental Defense Fund

Decision Logic for DfE Approaches



Informed Substitution

- Goals:
  - Minimize likelihood of unintended consequences
  - Choose a course of action based on the best environmental and human health information that is available or can be modeled
- Alternatives must:
  - Be technologically feasible;
  - Deliver the same or better value in cost and performance;
  - Provide an improved profile for health and environmental issues;
  - Account for economic and social considerations; and
  - Have potential to result in lasting change.

Furniture Flame Retardancy Partnership
Alternatives Assessment (Completed)

- **Predominant flame retardant (pentaBDE) was being found increasingly in human tissue, breast milk and the environment.**
  - This flame retardant was phased-out at the end of 2004.
  - Need for fire safety will likely increase based on planned national standards.
  - Report provides data to inform industry.
  - Decision-making for alternatives to this 19 million pound per year chemical.

- **The Report**
  - Summary assessments of chemicals in flame retardant formulations.
  - Tables summarizing EPA assessment for environmental and human health endpoints.
  - Detailed hazard reviews.

Furniture Flame Retardancy Partnership

Results: Data Presentation

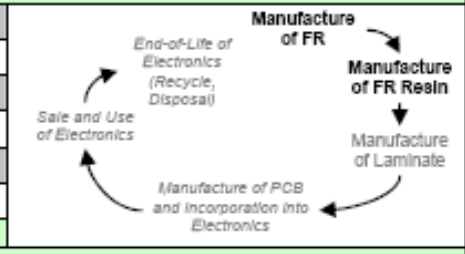
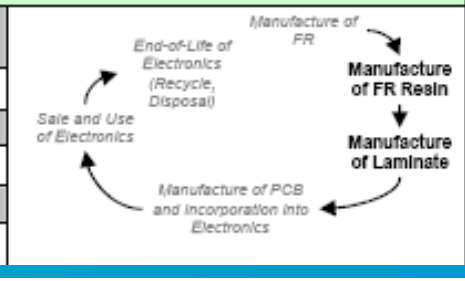
Human Health Hazard Concern | **Ecotoxicity Hazard Concern** | **Environmental Hazard Concern**

Company	Chemical	% in Formulation[3]	Human Health Effects							Ecotoxicity		Environmental		Potential Routes of Exposure							Reactive or Additive?
														Worker			General Population				
			Cancer Hazard	Skin Sensitizer	Reproductive	Developmental	Neurological	Systemic	Genotoxicity	Acute	Chronic	Persistence	Bioaccumulation	Inhalation	Dermal	Ingestion	Inhalation	Dermal	Ingestion	Aquatic	
Albemarle	SAYTEX RZ-243																				
	Proprietary E Tetrabromophthalate diol diester		L	L	L*	L*	L	M*	L	L	H	L?	L	N	Y	Y	N	N	Y	Y	Additive
	Proprietary B Aryl phosphate		L	L	M*	M*	M	M*	L	H	H	L	M	N	Y	Y	N	Y	N	N	Additive
	Triphenyl Phosphate CAS # 115-86-6		L	L	L	L	L	M	L	H	H	L	L	Y	Y	Y	Y	Y	Y	Y	Additive
Ameribrom	FR513																				
	Tribromoneopentyl Alcohol CAS # 36483-57-5		M	L	M	M	M	M	M	M	M	L	L	Y	Y	Y	N	N	Y	Y	Reactive
Great Lakes	Firemaster 550																				
	Proprietary F Halogenated aryl ester		L	L	M	M	L	M	L	H	H	L?	L	N	Y	Y	N	Y	Y	Y	Additive
	Proprietary G Triaryl phosphate, isopropylated		L	L	M*	M*	M	M*	L	H	H	L	M	N	Y	Y	N	Y	N	N	Additive
	Triphenyl Phosphate CAS # 115-86-6		L	L	L	L	L	M	L	H	H	L	L	Y	Y	Y	Y	Y	Y	Y	Additive
	Proprietary H Halogenated aryl ester		L	L	M	M	L	M	L	H	H	L?	L	N	Y	Y	N	Y	Y	Y	Additive

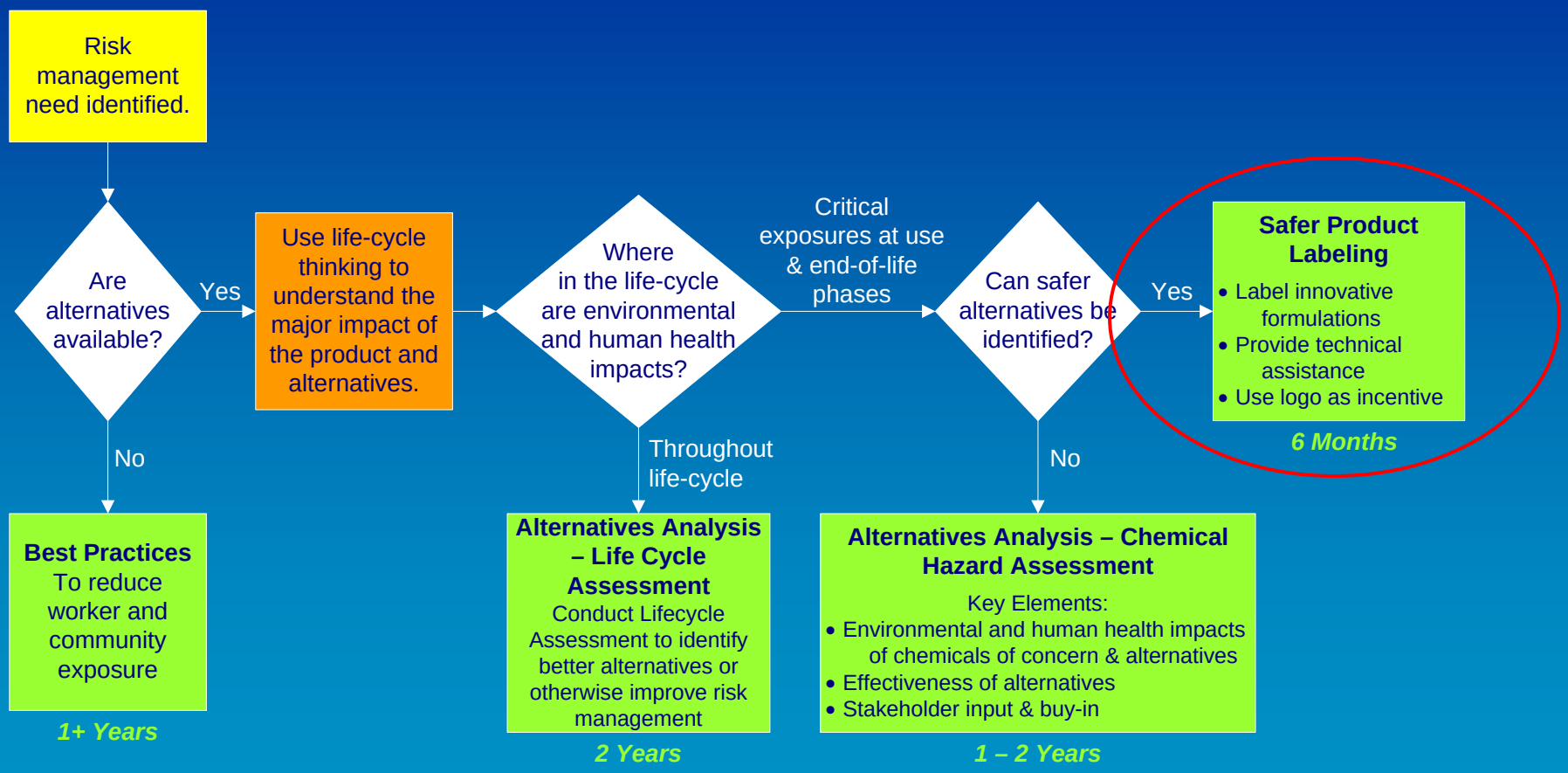
Flame Retardants in Printed Circuit Boards
Partnership Drivers

- Tetrabromobisphenol A / TBBPA
  - Highest volume brominated flame retardant used in printed circuit boards at ~ 330 million pounds/year
  - Reacted into the epoxy backbone of the PCB laminate
- Industry need for information on flame retardants
- Concern by some stakeholders over environmental impacts and combustion by-products

Flame Retardants in Printed Circuit Boards
Results: Data Presentation

		Human Health Hazard Concern									Ecotoxicity Hazard Concern		Environmental Hazard Concern		
		Human Health Effects									Aquatic Toxicity		Environ-mental		Exposure Considerations
Chemical	CASRN	Acute Toxicity	Skin Sensitizer	Cancer Hazard	Immunotoxicity	Reproductive	Developmental	Neurological	Systemic	Genotoxicity	Acute	Chronic	Persistence	Bioaccumulation	Availability of flame retardants (FRs) throughout the lifecycle for reactive and additive FRs chemicals and resins
Reactive Flame Retardant Chemicals[2]															
Tetrabromobisphenol A (TBBPA) (Albemarle, Chemtura, and others)															
TBBPA	79-94-7	L	L	L	L	L	M	L	L	L	H	H	M	L	
DOPO (6H-Dibenz[c,e][1,2] oxaphosphorin, 6-oxide) (Samko Co., Ltd. and others)															
DOPO	35948-25-5	L	L	L	L	L	L	L	L	L	M	M	L	L	
Fyrolflex PMP (Aryl alkylphosphonate) (Supresta)															
Fyrolflex PMP	Proprietary	L	L	L	L	L	L	L	L	L	L	L	H	L	
Reactive Flame Retardant Resins[2]															
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)															
D.E.R. 538	26265-08-7	L	M	M◊	L	M◊	M◊	L	L	M	L	L	M	L	
Reaction Product of DOPO - Dow XZ-92547 (reaction product of an epoxy phenyl novolak with DOPO) (Dow Chemical)															
Dow XZ-92547	Proprietary	L	M	M◊	L	M◊	M◊	L	L	M◊	L	L	H	L	
Reaction product of Fyrolflex PMP with bisphenol A, polymer with epichlorohydrin (Representative Resin)															
Representative Fyrolflex PCB Resin	Unknown	L	L	M◊	L	M◊	M◊	L	L	M◊	L	L	H	L	

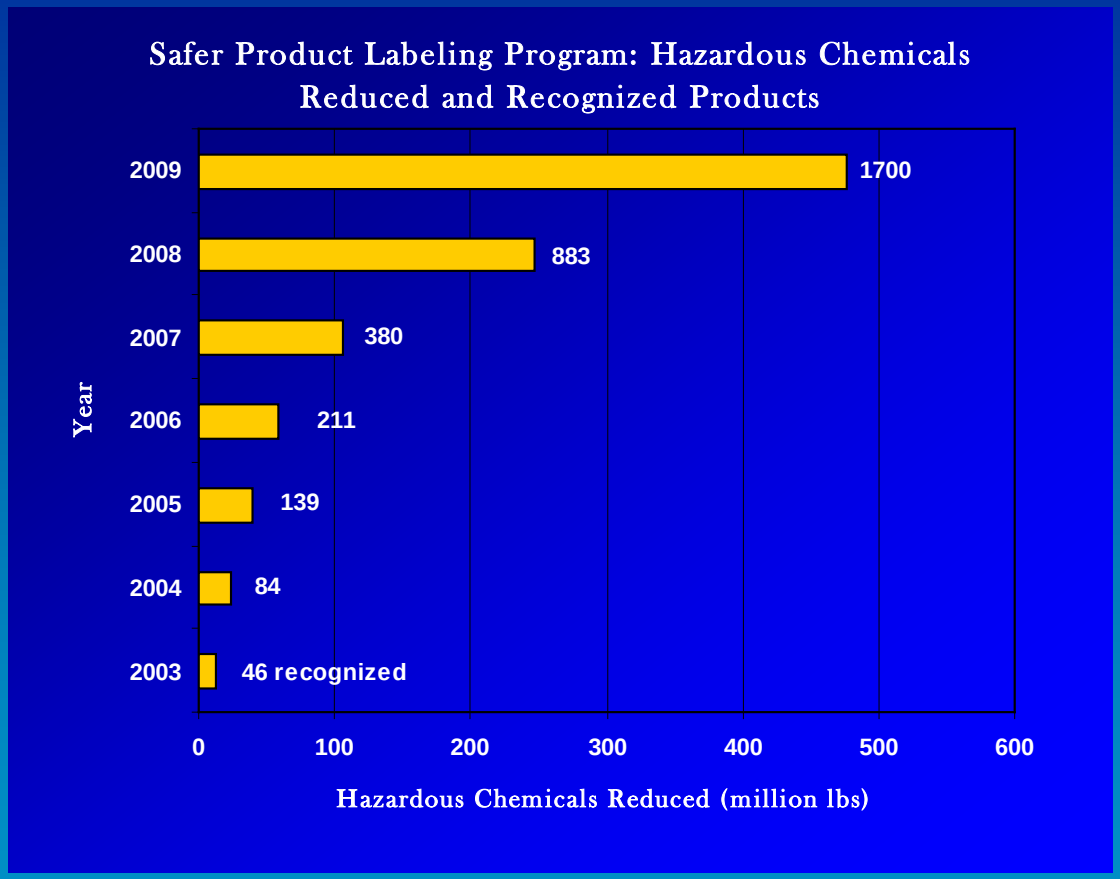
Decision Logic for DfE Approaches



DfE Safer Product Labeling

Current Sectors:

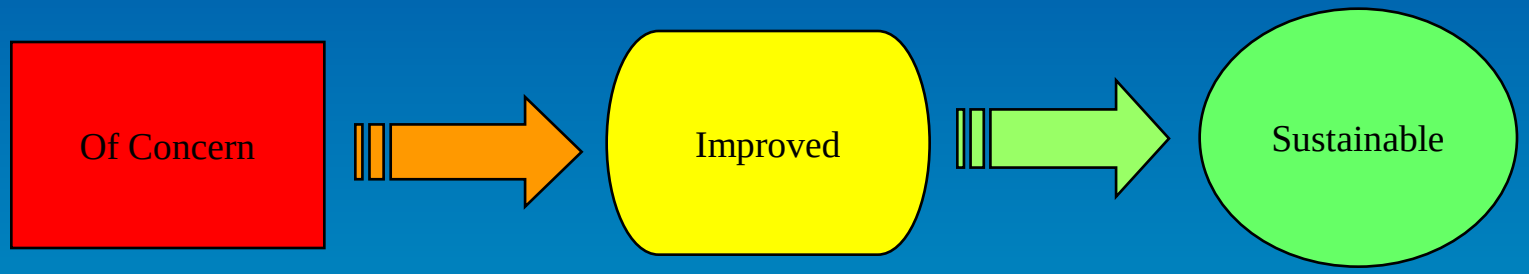
- Cleaning products
- Holding tank treatments
- Bioremediation products
- Deicers
- Industrial coatings
- Inks
- Field paint
- Tire balancing liquid



Continuous Improvement:
As innovation occurs, continuum may shift

Continuum of Improvement

Formula Ingredient by Functional Class



Characteristics of Ingredient of Concern

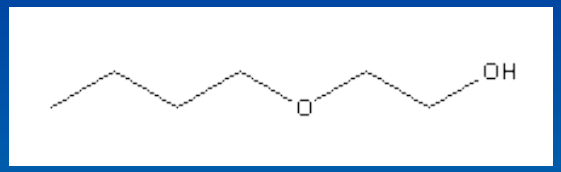
Characteristics of Improved Ingredient

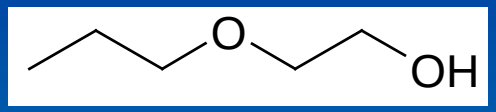
Characteristics of Sustainable Ingredient

Review – 3 Basic Components

1) Review <u>every</u> ingredient by functional use class
   - To promote green chemistry
   - To understand toxicity
     - Lists
     - Literature
     - Analogous chemicals – SAR
2) Review formulation as a whole
   - Synergistic effects
   - pH
   - Performance testing
3) Partnership Agreement

Structure-Activity Relationships (SARs)
Identifying Chemicals of Concern





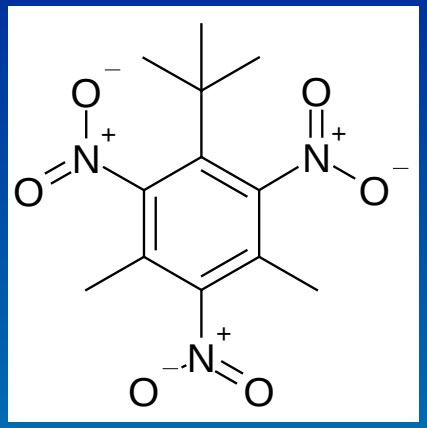
2-Butoxyethanol

- Solvent used widely in cleaning products
- Human health concerns include hemolysis leading to toxicity in kidney, spleen and liver.
- LOAEL (rat, oral, 6 wks): 222 mg/kg/d
- LOAEL (rat, inhalation, 13 wks): 77 ppm (0.37 mg/L)

n-Propoxyethanol

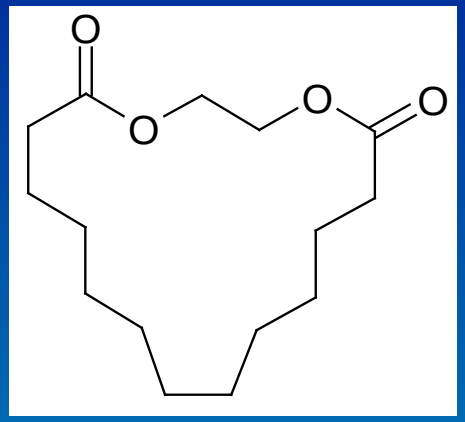
- Also can be used as a solvent in cleaning products
- Similar human health concerns including hemolysis leading to toxicity in kidney, spleen and liver.
- LOAEL (rat, oral, 6 wks): 195 mg/kg/d
- LOAEL (rat, inhalation, 14 wks): 200 ppm (0.85 mg/L)

Suggesting Safer Substitutes
(Fragrances)



Musk xylol

- Appears designed for maximum environmental persistence—nitro and t-butyl groups
- May bioaccumulate
- Potentially toxic to aquatic organisms
- May be an indirect toxicant, inhibiting the ability of cells to excrete harmful chemicals



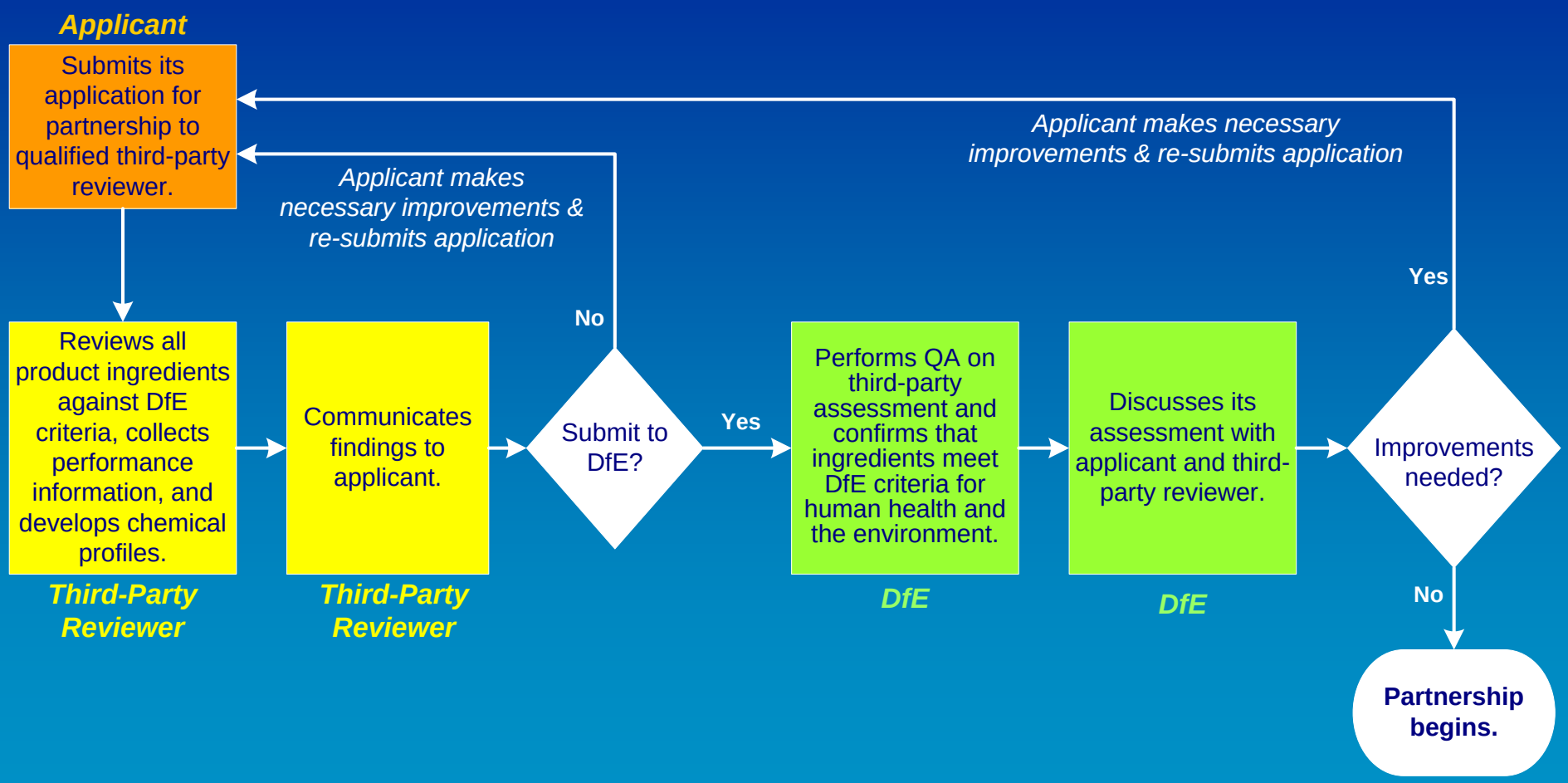
Ethylene brassylate

- Faster biodegradation—ester linkages
- Fragrance houses have worked with EPA's Design for the Environment Formulator Program to replace musk xylol with ethylene brassylate

DfE Criteria (Screens) for Safer Chemicals

- Every chemical is assessed against criteria
  - Lists
  - Data from studies
  - Modeling to fill data gaps
- Based on internationally agreed toxicological endpoints and thresholds
  - Acute mammalian toxicity
  - Aquatic toxicity
  - Bioaccumulation
  - Biodegradation
  - Carcinogenicity
  - Eutrophication
  - Genetic toxicity
  - Neurotoxicity
  - Repeated dose toxicity
  - Reproductive and developmental toxicity
  - Respiratory sensitization
  - Skin sensitization

Steps to Earning the DfE Label



Enhancing Auditing

- **Annual Desk Audits**
  - Verify contents of recognized products and labels
  - Ensure safer chemistry status (continuous improvement)
  - Review production volumes, use of logo, etc.
- **On-site Audit**
  - Once during 3-yr partnership period -- if more than one facility, two sites selected randomly will be audited
  - Confirms materials usage compared to Partnership Agreement (using batch tickets)
  - Ensures Good Manufacturing Practices (e.g., non-contamination of labeled products)
  - Reviews overall partnership compliance (e.g., documentation of end-user training, packaging)

CleanGredients® - Marketplace for Green Chemistry Ingredients

- Leverages EPA green chemistry expertise and tools
- CleanGredients is a marketplace…
  - for suppliers to showcase safer chemical ingredients for cleaning products, and
  - for formulators to find those ingredients.
- Identifies ingredients that meet DfE Criteria for Safer Chemicals

CleanGredients® - Marketplace for Green Chemistry Ingredients

- Multi-stakeholder development
  - More than 800 stakeholders
  - Technical Committees define modules for safer functional ingredient classes
    - 15-30 organizations typically represented on each Technical Committee
    - Expertise in formulary chemistry and toxicology
    - Formulators, chemical suppliers, NGOs, and Government
- Steering Committee overseas project development

CleanGredients®
Search by Performance/P-Chem/Tox Properties

https://db.cleangredients.org - CleanGredients™ » Surfactant Search - Mozilla Firefox

cleangredients™

Logged in as Topher Buck from TestCorp.
Log out

search your account

Charge Class	Application	Supplier	Text
All	☐ Hard Surface Cleaner ☐ Hand Dish Soap ☐ Carpet ☐ Laundry	All	
Chemical Class	**CAS #**	**Biodegradability**	**Aquatic Toxicity**
All	All	All	All
HLB	**Physical Form**	**Flash Point**	**CMC**
Min: Max:	All	Min: Max: °C	Min: Max:
% Active Surfactant	**Sp. Gr. or Density**	**Cloud Point**	**pH**
Min: Max:	Min: Max: Sp Gr	Min: Max: °C	Min: Max:

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Disclaimer: Only data on acute aquatic toxicity, biodegradability, and degradation products are reviewed by a designated third party for purposes of listing in the CleanGredients(tm) database. All other data and product information are provided by ingredient suppliers who are individually responsible for the accuracy of the information. All TestCorp and GreenBlue Ingredients are fictional and are provided for demonstration purposes only.

If you experience technical difficulties or have any suggestions or comments, please let us know at info@cleangredients.org

CleanGredients®
Search Results

https://db.cleangredients.org - CleanGredients™ » Surfactant Search - Mozilla Firefox

Supplier	Product Name ID	Charge Class Chemical Class HLB / Form / Flash / CMC %Act / Sp. Gr. / Cloud / pH	Biodeg-radability ⓘ	Acute Aquatic Toxicity ⓘ L/I/EC_{50} ⓘ [mg/L]	DfE Screen† ⓘ
Uniqema	**Monatrope 1620**	Nonionic Alkyl Polysaccharide - / Liquid / 149°C / - 70% / 0.98 / - / 7	**Ready**	**>10 and ≤100**	**Meets DfE Screen**
Air Products & Chemicals (Tomah Products)	**Tomadol 400**	- - 8.9 / Liquid / 123.9°C / - 98% / 0.93 / - / -	**Ready**	**≤1**	**Meets DfE Screen**
Cognis Corporation	**Glucopon 625 UP**	Nonionic Alkyl glucosides 12 / Liquid / >100°C / 0.003 50% / 1.1 / >100°C / 12	**Ready**	**>1 and ≤10**	**Meets DfE Screen**
	Magnesium lauryl sulfate 3097-08-3 (CAS #)	Anionic Linear alkyl sulfate - / - / - / - - / - / - / -	**Ready**	**>10 and ≤100**	**Meets DfE Screen**
Stepan Company	**BIO-SOFT® N1-5** PF696	Nonionic Alcohol Ethoxylates 11.2 / Liquid / >94°C / - 100% / 0.971 / 18°C / 7.2	**Ready**	**>1 and ≤10**	**Meets DfE Screen**
CLER	**LAS** CLER Standard	Anionic Linear alkylbenzene sulfonate, sodium salt - / Solid / - / 0.1 100% / 1.06 / - / -	**Ready**	**>1 and ≤10**	**Meets DfE Screen**

DfE for Disinfectants

- Products may bear the logo starting in May
- DfE is accepting submissions
- Pilot will last three years
- EPA is working to address state concerns.

DfE for Disinfectants

- To qualify for the DfE logo a disinfectant-labeled product must meet the following conditions; in addition to FIFRA labeling requirements:
  - Whole-product Characteristics: Must meet the DfE Standard
    - pH
    - packaging
    - performance
    - auditing
  - Inerts: Every inert must meet the DfE Standard
  - Actives: Every ingredient must meet the DfE Master Criteria for Safer ingredients
- Follow the link for the:
  - DfE Standard for Safer Cleaning Products
  - DfE Criteria (Screen) for Safer Ingredients

http://www.epa.gov/dfe/pubs/projects/formulat/about.htm

What is SDSI - Surfactants?

- **Environmental stewardship program to encourage the use of safer surfactants**
- **Promotes the goals of EPA's Ambient Water Quality Criteria (AWQC) for Nonylphenol (NP)**
- **Harmonizes with international environmental protection efforts**
- **High-level Agency recognition for…**
  - Formulators
  - Chemical manufacturers
  - Retailers/Distributors
  - Institutional purchasers
  - Advocates

SDSI Champions

Auto-Chlor System
BASF Corporation
Barricade Fire Gel
Bissell Homecare Inc.
Chemco Corporation
ChemLink Laboratories LLC
Clean Control Corporation
Corporate Express, a Staples Company
Coverall Health-Based Cleaning System
Earth Friendly Products
Eco Concepts, Inc.
EcoDiscoveries
EPIC Cleaning Products
GEMTEK Products LLC
Georgia-Pacific Consumer Products LP
GreenBlue
ISSA -- The Worldwide Cleaning Industry Association
JohnsonDiversey, Inc.
Klipper Group
Method
Multi-Clean Inc.
Natural Soap Formulas
Naturell
PDQ Manufacturing
Pure & Gentle Soap Inc. Reckitt Benckiser, Inc.
SafeWash Technologies
S.C. Johnson & Son, Inc.
Seventh Generation, Inc.
Sierra Club
Spurrier Chemical Companies Inc.
State Chemical Solutions
SYSCO Corporation
Textile Rental Services Association of America
The Dial Corporation, A Henkel Company
The Procter & Gamble Company
US Formula Technology
U.S. Polychemical Corporation
Virox Technologies Inc.
VASKA

Thank you!

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