U.S. EPA
Design for the Environment Program

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EPA 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

Lisa Jackson, EPA Administrator

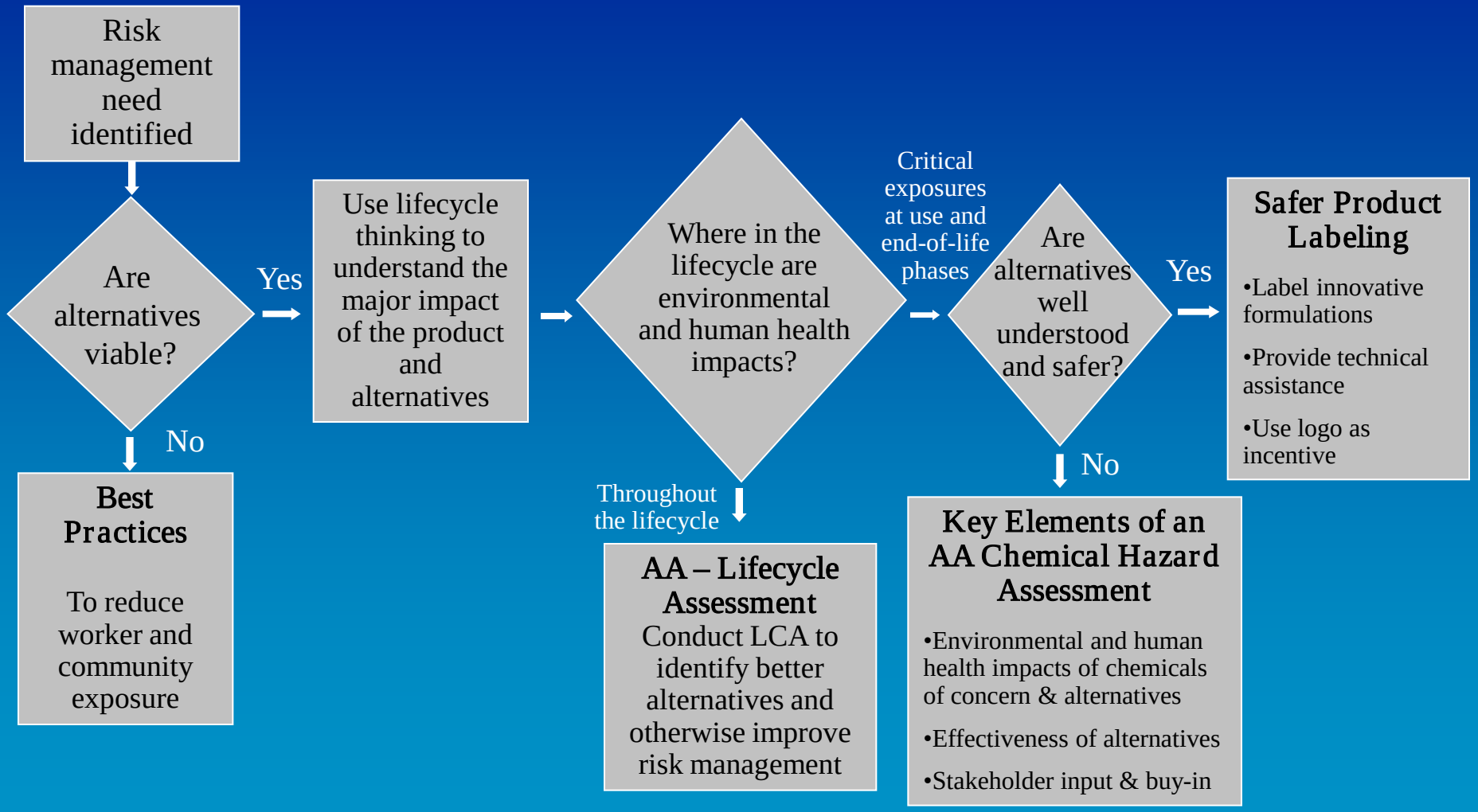
DfE Program History

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
Alternatives Assessments	
Lead-Free Solder for Printed Circuit Boards LCA	2002-2005
Furniture Flame Retardants Alternatives Assessment	2003-2006
Flame Retardants in Printed Circuit Boards	2007-Current
Phthalates, decaBDE, BPA	2010

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

Decision Logic for DfE Approaches



Seven Key Principles

- **DfE uses seven principles to ensure the value and usefulness of chemicals considered in an alternatives assessment**
- **Alternatives must:**
  - Be commercially available, or likely to become available
  - Be technologically feasible
  - Deliver the same or better value in cost and performance
  - Have potential for improved health and environmental profile
  - Consider economic and social factors
  - Have potential to result in lasting change
  - Interest stakeholders

Steps to Conducting an Alternatives Assessment (AA)

1) Determine need for alternatives assessment
2) Develop approach
3) Consult with stakeholders
4) Conduct hazard assessment
5) Develop the report
6) Apply the information in decision making

Step 1: Determine Need for AA

- Apply decision logic – flow chart
- Consider seven principles

Step 1: Furniture Example

- **Determine need for an alternative assessment**
  - PentaBDE found increasingly in human tissue, breast milk, and the environment
  - PentaBDE voluntarily phased-out at the end of 2004

Seven principles for alternatives:

✓Commercially available

✓Technologically feasible

✓Same or better value

✓Improved health and environmental profile

✓Economic and social factors

✓Lasting change potential

✓Stakeholders interested

Step 2: Develop Approach

- Gather information:
  - Functional uses
  - Alternatives – are they well characterized?
  - Chemical manufacturing
  - Feedstocks or contaminants and residuals from the production process
- Preliminary project design
  - Functional uses and life-cycle elements that may pose the highest level of concern
  - Availability of alternatives
  - Scope of report

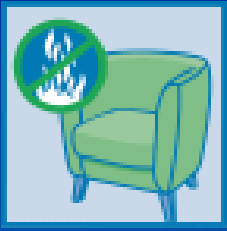
Step 2: Furniture Example

- Gather information:
  - Alternatives
    - Some available, others developed for the need
    - Some data rich, others poorly characterized
  - Functional uses – limited to drop-in replacements
  - Feedstocks or contaminants and residuals from the production process – similar across alternatives
- Preliminary project design
  - Functional use – flame retardants in low density flexible polyurethane foam
  - Evaluate proven alternatives
  - Report would include health and environmental profiles, foam manufacturing process and "out-of-the-box" thinking

Step 3: Convene Stakeholders, Refine Scope of Project, Consider Economic Realities

- **Stakeholder participation is critical:**
  - Help design project methodology
  - Monitor implementation
  - Use outcomes to move toward safer chemicals
- **Diverse representation:**
  - Chemical manufacturers
  - Product manufacturers
  - NGOs
  - Government agencies
  - Academics
  - End users
  - Waste and recycling companies

Step 3: Furniture Example



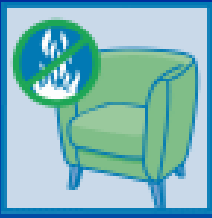
- **Stakeholders involved in the Furniture Flame Retardancy Partnership:**
  - Furniture manufacturers
  - Chemical manufacturers
  - Fabric/barrier manufacturers
  - Governmental organizations
  - Non-governmental organizations
- **Focused on alternative drop-in chemicals**
- **More expensive solutions such as barrier fabrics and inherently fire-safe materials were secondary**

Step 4: Conduct Hazard Assessment

- Combine information from five sources:
  - Test data from literature
  - CBI test data
  - Structure-Activity-Relationship- (SAR) based estimations
  - Professional judgment of EPA staff
  - Company-confidential data
- Assign a value of high, moderate or low for each human health and environmental endpoint

Step 4: Furniture Example

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

Step 5: Develop the Report

- Hazard Portion
  - Summary assessment of chemicals in flame retardant formulations
  - Tables summarizing EPA assessment for environmental and human health endpoints
  - Detailed hazard reviews
- Information for context and decision-making
  - Manufacturing process
  - Use patterns
  - Unconventional solutions
  - Decision-Making tools

Step 5: Furniture Example

- Volume 1:
  - Section 1 – Introduction
  - Section 2 – Types of flame retardants, their modes of action, and flame retardants currently used in foam
  - Section 3 – Exposures to flame retardant chemicals in foam
  - Section 4 – Assessments of chemical alternatives
  - Section 5 – Considerations to selecting a replacement for pentaBDE
  - Section 6 – References
- Volume 2:
  - Detailed chemical hazard reviews

Step 6: Apply the Information in Decision Making for Safer Substitutes

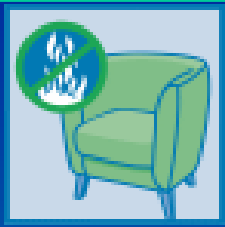
Alternatives assessments may:

- Complement regulatory action
- Show availability of safer, highly functioning alternatives
- Show that viable alternatives are not available for certain uses

Example of a complementary tool:

- Clean Production Action (CPA) developed *GreenScreen™ for Safer Chemicals* to assist manufacturers in selecting safer chemicals

Step 6: Furniture Example

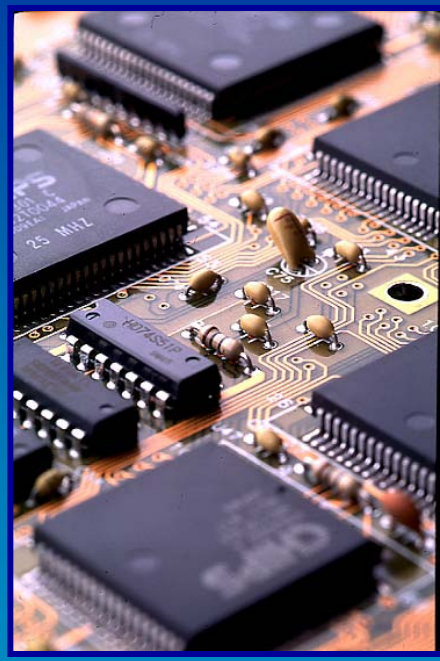


- Led to considered move to alternative flame retardant formulations
- Supported TSCA regulatory action that reinforced a voluntary phase-out of pentaBDE

Flame Retardants in Printed Circuit Boards

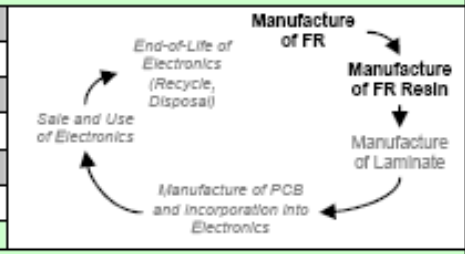
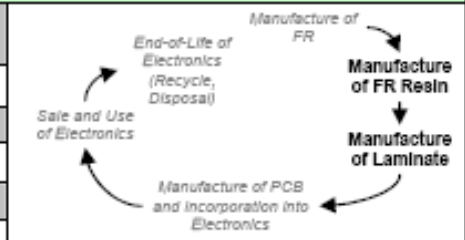
Same steps as Furniture Flame Retardancy Partnership

- 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

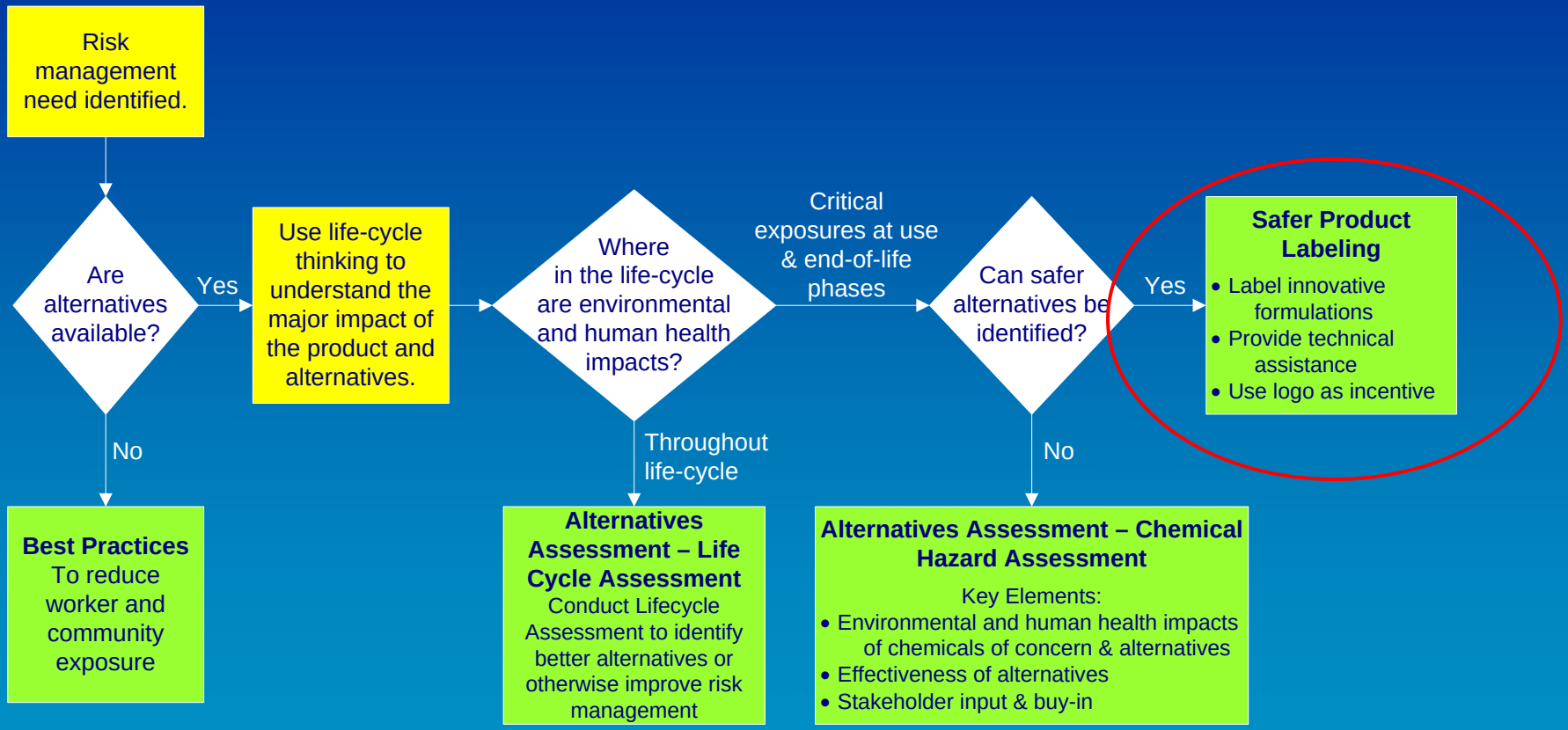


Flame Retardants in Printed Circuit Boards

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

Chemical	CASRN	Human Health Effects									Aquatic Toxicity		Environ-mental		Exposure Considerations
		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

Step 1: Is the work needed?

- Consumer Products – Safer for the environment & people
- Industrial & Institutional – Safer for workers & residents
- Link to priority chemicals is added incentive

Seven principles for alternatives:

✓Commercially available

✓Technologically feasible

✓Same or better value

✓Improved health and environmental profile

✓Economic and social factors

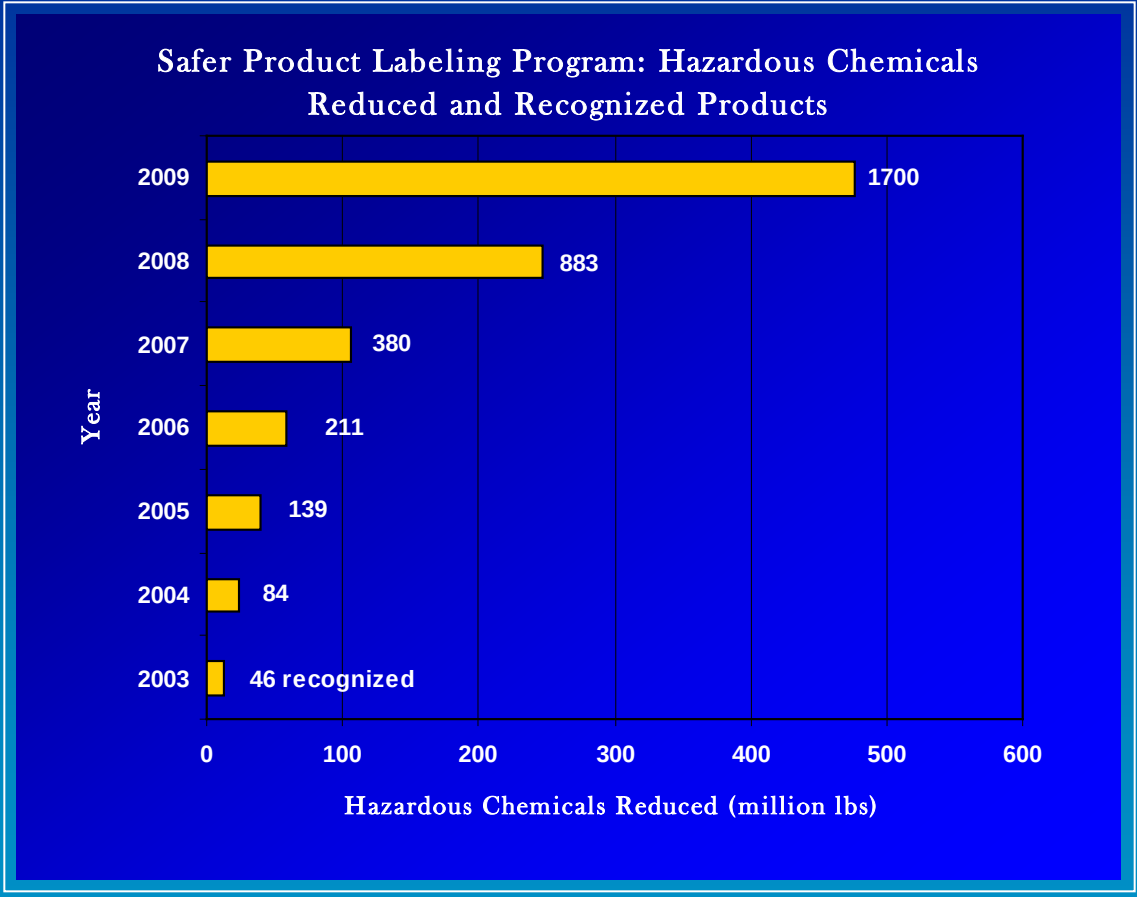
✓Lasting change potential

✓Stakeholders interested

DfE Safer Product Labeling

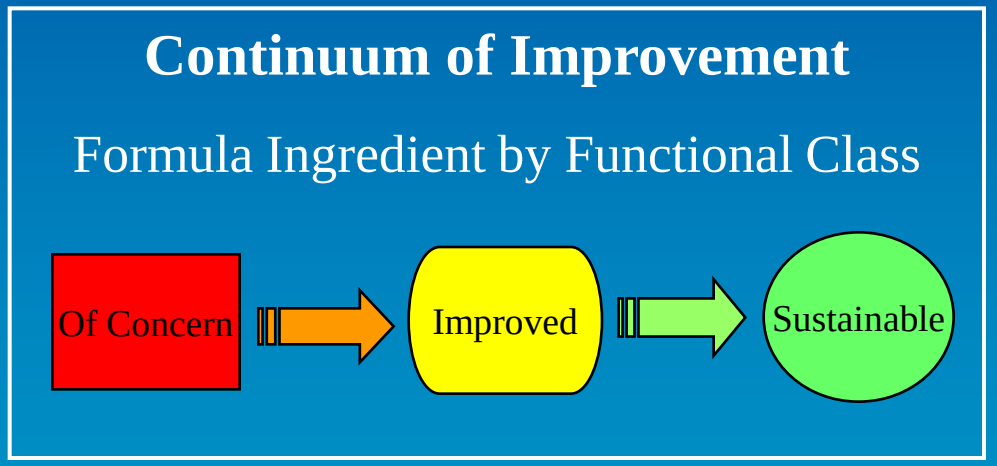
Current Sectors:

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



DfE Safer Product Labeling

- **Step 2: Develop Approach**
  - Functional use approach for every ingredient
    - Green Chemistry
    - Continuum of Improvement
  - Functional Use Classes
    - Surfactants
    - Solvents
    - Chelants
    - Builders
    - Colorants
    - Fragrances
    - Preservatives
  - Whole-product criteria



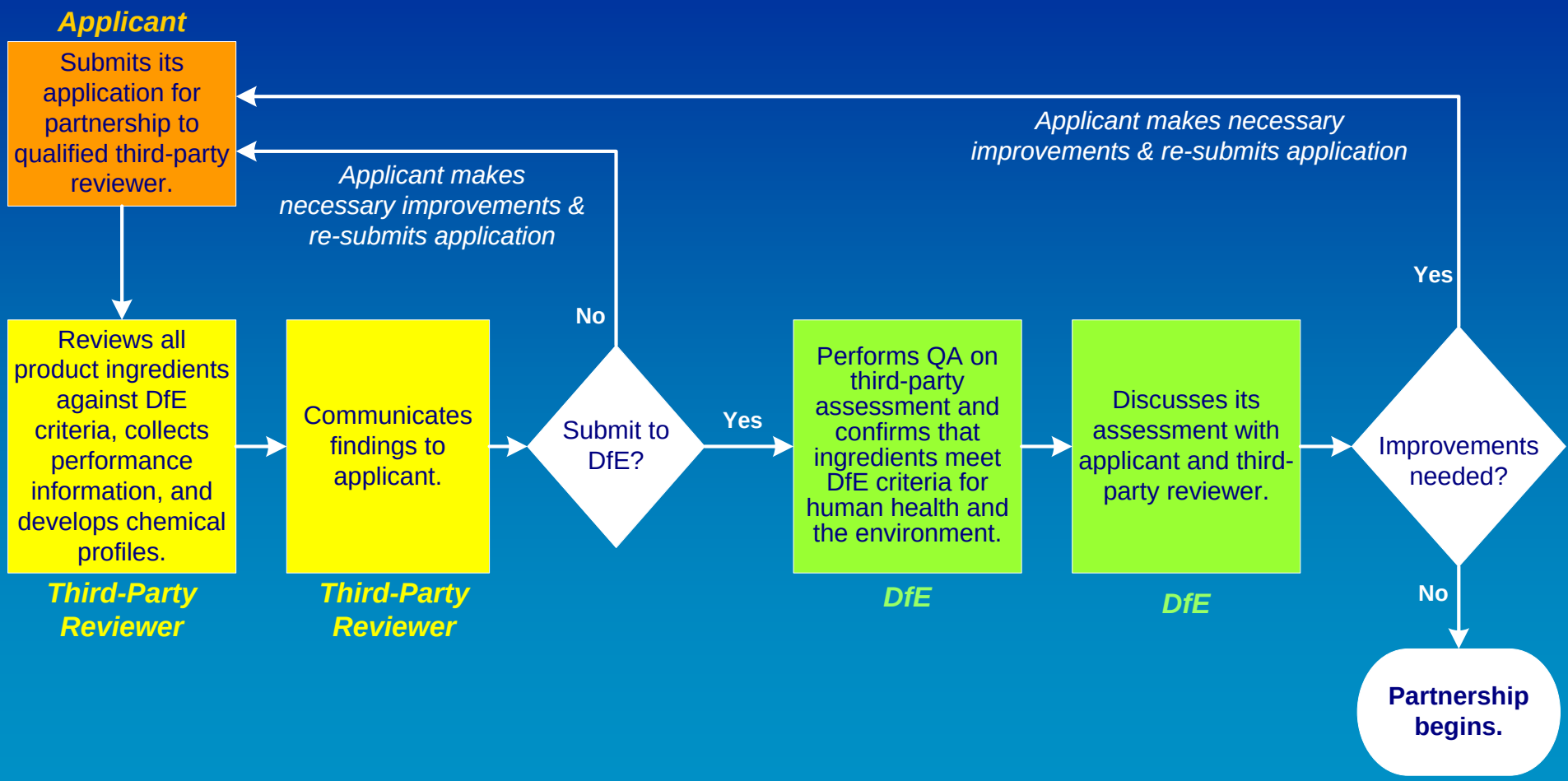
DfE Safer Product Labeling

- **Step 3: Stakeholder Input**
  - **Stakeholder groups:**
    - Continuing Technical Improvement & Transparency Group
    - Fragrances Technical Committee
    - Chelating Agent Technical Committee
  - Help define safer chemistry by functional class to ensure leadership
  - Provide perspective on performance and cost to ensure that products work well and are affordable

DfE Safer Product Labeling

- **Step 4: Hazard Assessment**
  - Third-party develops profiles and DfE provides quality assurance
    - Literature review
    - Structure-activity relationships (SAR)
    - Expert judgment

DfE Safer Product Labeling



Review: 3 Basic Components

1) Review every 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

DfE Safer Product Labeling

- **Step 5: Develop the report**
  - 3rd Party with DFE quality assurance
  - Evaluate each ingredient in product formulation
    - Criteria for Safer Chemical Ingredients
    - DfE Standard for Safer Cleaning Products
  - CleanGredients® provides list of chemicals that meet the DfE criteria
- **Step 6: Apply the information in decision-making**
  - For products that meet DfE criteria, formulators sign partnership agreement with DfE
  - Use DfE logo to differentiate products in marketplace

EPA Chemical Action Plans

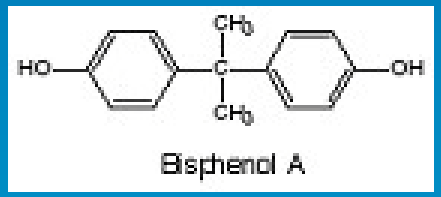
- Chemicals for which action plans have been prepared:
  - Bisphenol A (BPA)
  - Phthalates
  - Perfluorinated chemicals (PFCs)
  - Penta, octa, and decabromodiphenyl ethers (PBDEs)
  - Short-chain chlorinated paraffins
- Chemicals currently in the action plan development process:
  - Benzidine dyes
  - Diisocyantes
  - Hexabromocyclododecane (HBCD)
  - Nonylphenol and nonylphenol ethoxylates (NP/NPE)
  - Siloxanes

EPA Chemical Action Plans

- Of these action plan chemicals, DfE plans to conduct chemical alternatives assessments for the following:
  - Bisphenol A (BPA)
  - Decabromodiphenyl ether (decaBDE)
  - Phthalates
  - More?

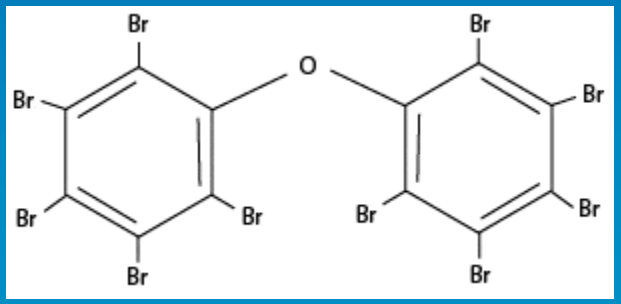
BPA Alternatives in Thermal and Carbonless Paper

- Kick-off meeting: July 15, 2010
- Likely stakeholders:
  - Specialty paper, chemical, and thermal printer manufacturers
  - Distributors, processors, and end users of thermal paper, such as retailers
  - NGOs
  - Government agencies
  - Academics
  - End users
  - Waste and recycling companies



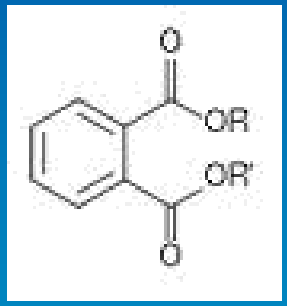
decaBDE Alternatives in Flame Retardants

- Will build on existing work on decaBDE
  - Plastics e.g., electronic enclosures
  - Textiles
- Kick-off in summer 2010
- Likely stakeholders:
  - Chemical manufacturers
  - Product manufacturers (throughout the supply chain)
  - NGOs
  - Government agencies
  - Academics
  - End users
  - Waste and recycling companies



Phthalates Alternatives

- Evaluation of 8 phthalates and alternatives
  - dibutyl phthalate (DBP)
  - diisobutyl phthalate (DIBP)
  - butyl benzyl phthalate (BBP)
  - di-n-pentyl phthalate (DnPP)
  - di (2-ethylhexyl) phthalate (DEHP)
  - di-n-octyl phthalate (DnOP)
  - diisononyl phthalate (DINP)
  - diisodecyl phthalate (DIDP)
- Functional uses are complex and varied
- Will build on existing work on phthlalates
- Case studies will explore how alternatives can be used
- Kick-off likely in fall 2010



Thank you!

For more information:

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