Session A - Alternatives Assessment for TUR

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Overview

- This morning (Session A)
  - Why Alternatives Assessment for TUR
  - Case Study presentation
  - Using Green Screen to assess alternatives for case study
- This afternoon (Session D)
  - Performance and economic considerations
  - Group research

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Why Use Alternatives Assessment?

- It's a process that emphasizes safer substitutes that are technically and economically feasible …. Sound familiar?
- Companies, governments and NGOs are increasingly using this as a pragmatic approach to long term positive change

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What's Different?

- Alternatives Assessment emphasizes the importance of identifying SAFER substitutes that are affordable and effective
- The process demands a more rigorous systematic approach to comparing the chemical hazards of substitutes (cannot rely purely on lists to determine if an option is safer)

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Overview of Case Study

- Regulatory Context
- Shipping Pallets
- Brominated Flame Retardants
- Concerns about decaBDE
- "Safer" Alternatives

Decabromodiphenyl Ether Flame Retardant in Plastic Pallets

A Safer Alternatives Assessment

Prepared for:

Maine Department of Environmental Protection

by:

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Gloucester, MA 01930
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Regulatory Context

- **2004** – Maine legislature banned products containing penta- and octa-PBDE – included a focus on risk mgmt or ban on decaBDE products if safer, nationally available alternatives identified
- **2007** – Maine banned sales of TV and computer housings with decaBDE
- **2009** – Environmental Health Strategy Center lobbied for ban of decaBDE in plastic pallets
- Effective **1/1/12** – ban mfg, sales or distribution of decaBDE-containing shipping pallets

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Shipping Pallets

- Currently the US uses approx. 3 billion pallets
- Made from a variety of materials
  - Wood, plastic, aluminum, steel, corrugated paper board, and composite wood
- Dominant material:
  - Wood, accounting for approx. 90% of total market
- Second largest material in use:
  - Plastic, 900 million in use, with projected increase in total market share through 2012 (projected 130M in use)

User Purchasing Patterns

Pallet Material	**% Purchasing Pallets Made of Each Material** (may buy multiple types)
Wood	92%
Plastic	33%
Engineered wood (e.g., plywood)	15%
Cardboard/corrugated	10%
Metal	6%
Other	3%

Uses of Shipping Pallets

- 30% of total pallet market– 48x40 pallets for grocery
- Others:
  - Telecom
  - Dept of Defense
  - Industry – drums for chemicals
  - Food - beverages, dairy
  - Automotive
  - Building products

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Pallet Use Models

- Closed Pool
  - End users manage and control the pallets at a single site or group of sites
- Open Pool
  - Leasing system, common among manufactures and distributors sending products to warehouses for retail and other companies
  - Common for rapid-turnover consumer goods such as groceries, cleaners, consumer electronics, etc

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Critical Performance Needs

- **Fire Safety** – risk of severe fires no greater than that posed by wood pallets
- **Load** – depends on the application, commonly set by appropriate trade association
- **Durability** – able to withstand multiple uses

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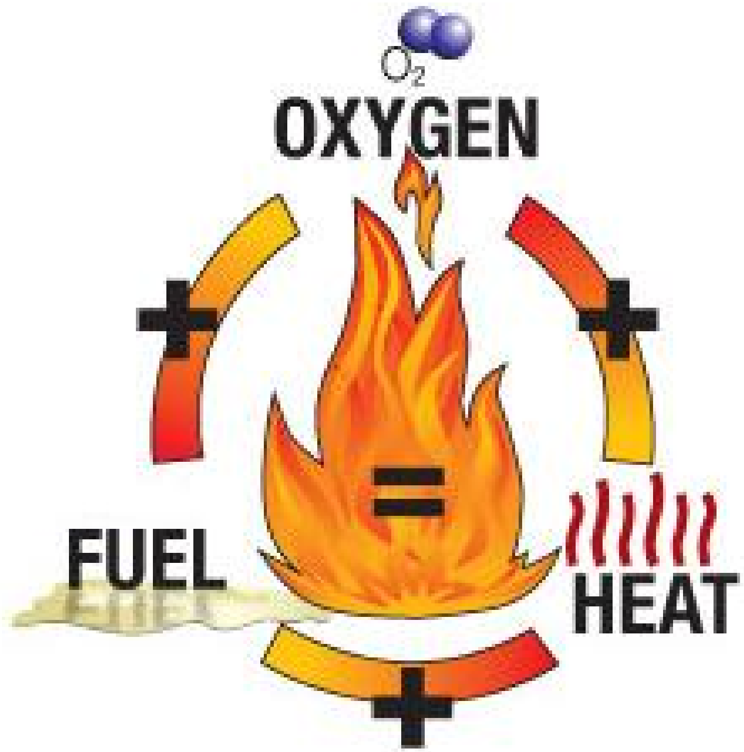
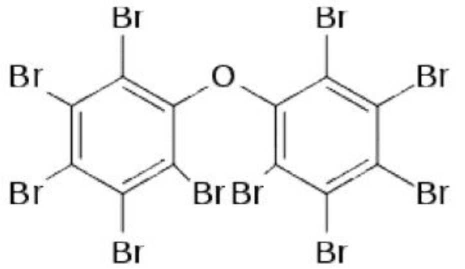
Mechanisms of Flame Retardancy

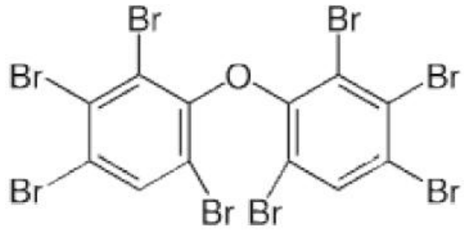
- Create barrier to isolate oxygen from fuel
- Cause chemical reaction that reduces heat
- Choose materials that do not act as fuel

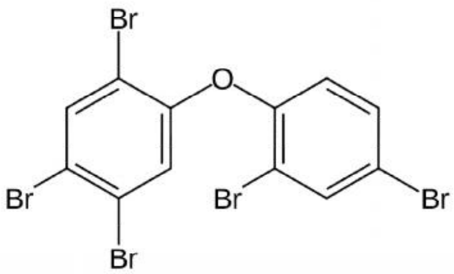


Brominated Flame Retardants

- Polybrominated diphenyl ethers (PBDEs)
- Deca (10), Octa (8), Penta (5)
- Used in a variety of plastic, electronic, textile, upholstery and building products







Concerns with DecaBDE

- PBT
- Targets liver, kidneys, spleen and fat
- Potential thyroid and neurodevelopmental toxicity
- On EU's priority list of endocrine disruptors
- Decomposes into octa and penta congeners – these show greater acute and chronic effects

Maine's Definition of "Safer" Alternatives

- Reduce potential for harm to human or environmental health
  - cannot be PBT, brominated or chlorinated
- Serve functionally equivalent purpose for fire safety and performance
- Are commercially available on national basis
- Are not cost prohibitive

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What Alternatives Can You ID?

- Considering Maine's definition of "safer alternatives" to decaBDE, let's get some ideas up on the flip chart

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Identifying and Prioritizing Alternatives

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Comparing Alternatives

- First: identify the critical hazard endpoints

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Comparative Chemical Hazard Assessment

- Focus at the chemical level
- More than one chemical to assess
- Focus on chemical hazard (environmental, health, and safety)

Business Reasons for Comparative Chemical Hazard Assessment

- **Reason #1**: Replacing materials multiple times is expensive and undesirable.
- **Reason #2**: Prioritizing material substitution focuses efforts on highest impact while considering the complexities of supply chain management and finite resources.
- **Reason #3**: Replacing materials with alternatives that have a better EH&S footprint makes sense.
- **Reason #4**: Clearly communicating across the supply chain lowers implementation costs

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Many Different Tools Available

- Lists
  - TUR reportable chemicals
  - Restricted Substance Lists
  - Phase-out lists
- Screening Methods
  - P2OASys
  - Green Screen
  - DfE

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HP Identifying safer substitutes for BFRs, CFRs and PVC

Platform for Walmart chemical screening program

Basis for alternative assessments in state regulatory programs

Aligning hazard thresholds with EPA

Green Screen Overview

- Comparative chemical hazard assessment tool
- Makes use of available toxicological data, quantitative structure activity relationships (QSAR), expert judgment and use of analogs; indicates weight of evidence (i.e. test data versus estimated values) (**H**, *h*)
- Looks at individual hazards and *combinations* of hazards for an overall chemical benchmark score

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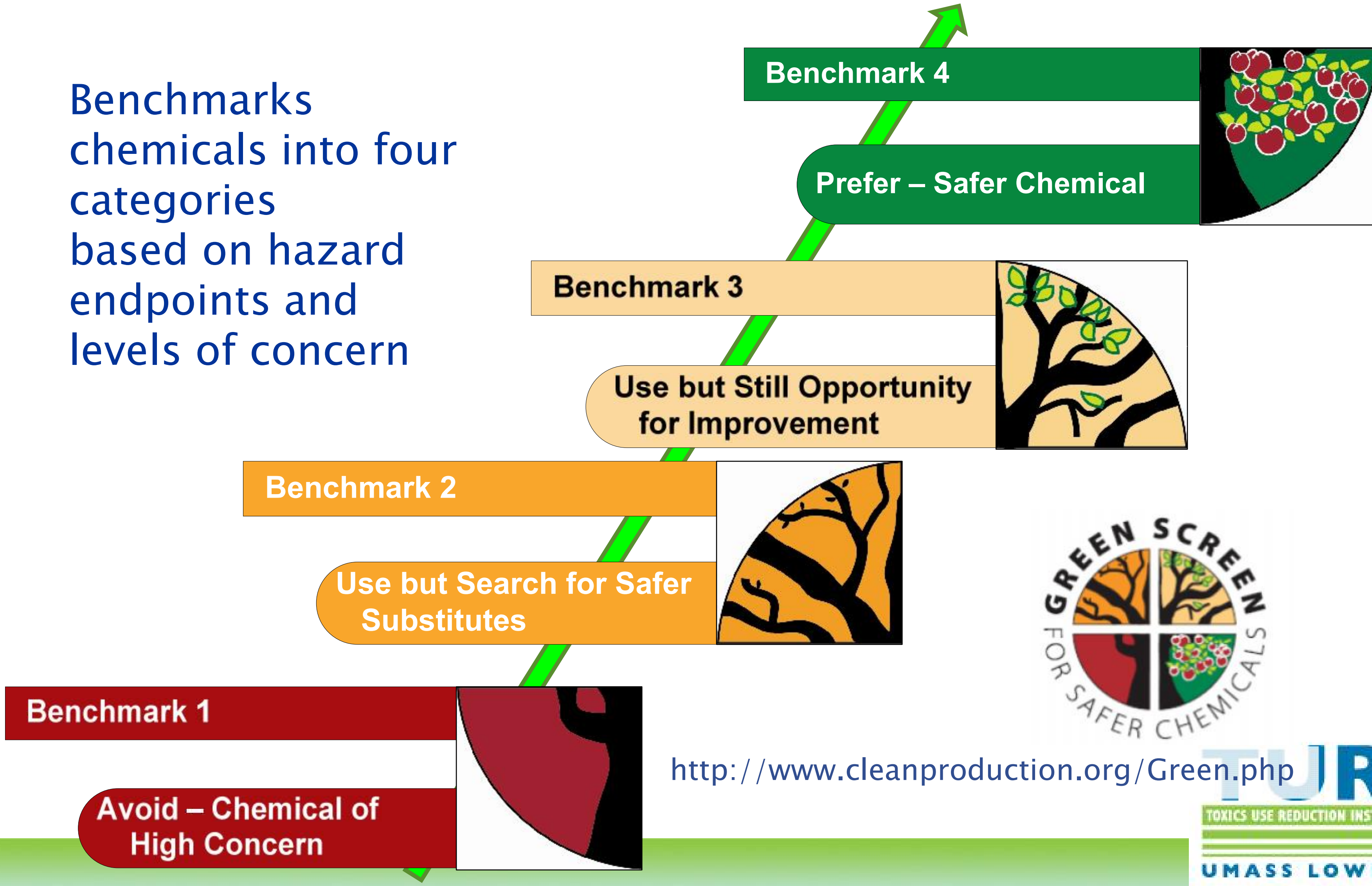
Green Screen for Safer Chemicals

Benchmarks chemicals into four categories based on hazard endpoints and levels of concern



http://www.cleanproduction.org/Green.php

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Green Screen Process

1. Collect data and fill out hazard summary table for parent chemical and feasible transformation products (degradation, metabolites, etc. depending on EOL)

2. Apply the benchmarks

3. Consider the context and compare alternatives

4. Take action based upon the results

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Green Screen Hazard Assessment Endpoints

Environmental Fate	Environmental Toxicity	**Human Health Priority Effects**	Human Health Non-Priority Effects	Physical Properties
Persistence (includes evidence of long range transport)	Acute Aquatic Toxicity	**Carcinogenicity**	Acute Toxicity	Explosivity
Bioaccumulation (includes bio-monitoring or env'l studies)	Chronic Aquatic Toxicity	**Mutagenicity – Genotoxicity**	Systemic or Organ Effects	Flammability
		Reproductive toxicity	Immune System Effects	*For v.2.0 – Particle size, form, (i.e. respirable)*
		Developmental toxicity	Corrosion or Irritation of Skin/Eyes	*For v.2.0 – Solubility*
		Endocrine Disruption	Sensitization of Skin/Respiratory System	
		Neurotoxicity / Neurodevel tox		

Assign L, M, H, vH Rating for Each Endpoint

Ecotoxicity	Very High (vH)	High (H)	Medium (M)	Low (L)
Acute Aquatic Toxicity 96 hr LC50 (fish) 48 hr EC50 (crustacea) 72 or 96 hr ErC50 (algae)	• GHS Category 1 (≤ 1 mg/L) • On specified lists	• GHS Category 2 (>1 to ≤ 10 mg/L) • On Specified Lists	• GHS Category 3 (>10 to ≤ 100 mg/L) • On Specified Lists	• Not classifiable as GHS Category 1-3 (>100 mg/L)
Chronic Aquatic Toxicity	• NOEC or ECx ≤ 0.1 mg/L	• NOEC or ECx > 0.1 to ≤ 1.0 mg/L	• NOEC or ECx > 1.0 to ≤ 10 mg/L • GHS Category 4	• NOEC or ECx > 10 mg/L

GHS: Globally Harmonized System of classification and labeling of chemicals.

Green Screen Template

Green Screen (v.1.0) Hazard Profile																		
		Human Health Effects											Ecotox.		Fate		P-Chem	
		Priority Effects																
Chemical	**CAS #**	Carcinogenic	Mutagenic	Reproductive	Developmental	Endocrine Disruption	Neurological	Acute Toxicity	Systemic/Organ Effects	Sensitization (skin or respiratory)	Irritation/Corrosion (skin or eyes)	Immune System	Acute	Chronic	Persistence	Bioaccumulation	Exposivity	Flammability
Chemical Formulation X																		
Chemical Constitutent A		M	M	L	L	M	M	L	L	H	H	L	H	L	M	M	L	L
Chemical Constitutent B																		
Chemical Constitutent C																		
Breakdown Products																		
Metabolite Y																		
Combustion Byproduct Z																		
Degradation Byproduct V																		

Benchmarking DecaBDE

			Human Health Effects													Ecotox.		Fate		Breakdown Products	
			Priority Effects																		
Chemical	CAS#	% in Formulation	Carcinogenic	Mutagenic	Reproductive	Developmental	Endocrine Disruption	Neurological	Acute Toxicity	Systemic/Organ Effects	Sensitization (skin)	Sensitization (respiratory)	Irritation/Corrosion (skin)	Irritation/Corrosion (eyes)	Immune System Effects	Acute	Chronic	Persistence	Bioaccumulation	Metabolites	Degradation Products
Decabromodiphenyl ether (decaBDE) - CAS# 1163-19-5																					
DecaBDE	1163-19-5	97	**M**	**L**	**L**	**M**	**M**	**M**	**L**	**L**	**L**	nd	**L**	**L**	nd	**L**	**L**	**vH**	**M**	penta- to nona-BDE	tri- to nona-BDE
Breakdown Products																					
PentaBDE	32534-81-9		nd	**L**	**M**	**M**	**H**	**M**	**L**	**H**	**L**	**L**	**M**	**M**	nd	**H**	**H**	**vH**	**vH**		
OctaBDE	32536-52-0		nd	**L**	**M**	**H**	**M**	**M**	**L**	**H**	**L**	nd	**L**	**L**	nd	**L**	**L**	**vH**	**M**	nd	lower PBDEs

Bold text = based on experimental data. ***Black italics text*** = based on analog data or expert judgment.

OCTOBER 2011

GreenScreen™ for Safer Chemicals v 1.2 Benchmarks

Start at Benchmark 1 (red) and progress to Benchmark 4 (green)

ABBREVIATIONS

- **P** Persistence
- **B** Bioaccumulation
- **T** Human Toxicity and Ecotoxicity

BENCHMARK 4

This chemical passes all of the criteria.

Low P* + Low B + Low T (Ecotoxicity, Group I, II and II* Human) + Low Physical Hazards (Flammability and Reactivity) + Low (additional ecotoxicity endpoints when available)

Prefer—Safer Chemical

BENCHMARK 3

If this chemical and its break-down products pass all of these criteria, then move on to Benchmark 4.

a. Moderate P or Moderate B
b. Moderate Ecotoxicity
c. Moderate T (Group II or II* Human)
d. Moderate Flammability or Moderate Reactivity

Use but Still Opportunity for Improvement

BENCHMARK 2

If this chemical and its breakdown products pass all of these criteria, then move on to Benchmark 3.

a. Moderate P + Moderate B + Moderate T (Ecotoxicity or Group I, II, or II* Human)
b. High P + High B
c. High P + Moderate T (Ecotoxicity or Group I, II, or II* Human)
d. High B + Moderate T (Ecotoxicity or Group I, II, or II* Human)
e. Moderate T (Group I Human)
f. Very High T (Ecotoxicity or Group II Human) or High T (Group II* Human)
g. High Flammability or High Reactivity

Use but Search for Safer Substitutes

BENCHMARK 1

If this chemical and its breakdown products pass all of these criteria, then move on to Benchmark 2.

a. PBT = High P + High B + [very High T (Ecotoxicity or Group II Human) or High T (Group I or II* Human)]
b. vPvB = very High P + very High B
c. vPT = very High P + [very High T (Ecotoxicity or Group II Human) or High T (Group I or II* Human)]
d. vBT = very High B + [very High T (Ecotoxicity or Group II Human) or High T (Group I or II* Human)]
e. High T (Group I Human)

Avoid—Chemical of High Concern

Presenting the Results -- Simple 1-4 score (1=bad, 4=good)

- Once generated, the simple score can be used by others <u>even if they have no technical training</u>
- All of the underlying hazard classification (H-M-L) data remains visible to help differentiate between two chemicals with the same score
- For official Green Screen assessments, expert knowledge is required to generate and peer review the score
- The method and guidance can be applied to get informal score for internal decision-making

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32

Material-Level Benchmarking

- Material score = lowest constituent or breakdown product score
- **Example: Material A**
- Ingredients:
  - 1% Chemical #1 = Benchmark 1
  - 39% Chemical #2 = Benchmark 3
  - 60% Chemical #3 = Benchmark 4

→ Material A is Benchmark 1

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Conduct Comparison

- Using information on handouts …
- ***Conduct Green Screen comparison of alternatives to decaBDE for plastic pallets***

Discussion

- So how did that go?
- After lunch we'll take what TUR Planners know so well – assessing technical and economic feasibility of options – and apply it to this case study

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