Using Pharos to Evaluate Safer Chemical and Material Options

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Today's Speakers

Greg Morose

Greg Morose is a Research Manager for the Toxics Use Reduction Institute and a Research Professor for the Zuckerberg College of Health Sciences at the University of Massachusetts Lowell. Greg works with various industries to address the use of toxic chemicals throughout the supply chain. He has conducted comprehensive investigations of safer chemical alternatives to products using mercury, lead, hexavalent chromium, phthalates, radioactive materials, toluene, methylene chloride, methanol and brominated flame retardants. Greg has a Bachelor's degree in Mechanical Engineering, a Master's of Science degree in Environmental Studies, a Master's of Business Administration degree, and a Doctoral degree in Cleaner Production and Pollution Prevention. Greg is also an ASQ certified Six Sigma Black Belt.

Today's Speakers

Michel Dedeo

Michel Dedeo, Manager of Chemical Data Systems, is responsible for leading the development of the Pharos Project's Chemical and Material Library. Michel received his doctoral degree from UC Berkeley and has worked on material health issues with the Green Science Policy Institute, Perkins+Will, GreenScreen for Safer Chemicals, and the UC Berkeley Center for Green Chemistry.

Poll Question

Where do you turn to for chemical hazard information?

Pharos and GHS

Globally Harmonized System (GHS) of Classification and Labeling of Chemicals, was developed by the United Nations to standardize chemical regulations and standards of different countries.

GHS includes criteria for the classification of health, physical and environmental hazards, as well as specifying what information should be included on labels of hazardous chemicals as well as safety data sheets.

Pharos data is consistent with GHS, and uses GHS hazard statements to help define the level of chemical hazard.

This following NIH webpage provides a listing GHS hazard statements:
https://pubchem.ncbi.nlm.nih.gov/ghs/

GHS Hazard Statements

Category	Hazard Rating	Acute Toxicity (Oral) Hazard Statements
1	Severe Hazard	H300: Fatal if swallowed
2	Serious Hazard	H300: Fatal if swallowed
3	Moderate Hazard	H301: Toxic if swallowed
4	Slight Hazard	H302: Harmful if swallowed
5	Minimal Hazard	H303: May be harmful if swallowed

GHS Hazard Example: Acute Toxicity

Substances are assigned to one of the five toxicity categories on the basis of LD50 (oral, dermal) or LC50 (inhalation).from acute toxicity studies. Some countries/region (i.e, EU) have not adopted acute toxicity category 5.

Exposure route	Category 1	Category 2	Category 3	Category 4	Category 5
Oral (mg/kg bodyweight) *See notes (a) and (b)*	5	50	300	2000	5000 *See detailed criteria in Note (g)*
Dermal (mg/kg bodyweight) *See notes (a) and (b)*	50	200	1000	2000	
Gases (ppmV) *See notes (a), (b) and (c)*	100	500	2500	20000	*See detailed criteria in Note (g)*
Vapours (mg/l) *See notes (a), (b), (c), (d) and (e)*	0.5	2.0	10	20	
Dusts and Mists (mg/l) *See notes (a), (b), (c) and (f)*	0.05	0.5	1.0	5	

Note: *Gases concentration are expressed in parts per million per volume (ppmV).*

Source: UN GHS Purple Book

Green Screen

GreenScreen® for Safer Chemicals, developed by the nonprofit organization Clean Production Action, is a comparative chemical hazard assessment method.

In this method, a range of human health, environmental toxicity, fate, and physical hazard endpoints are evaluated for each chemical.

Green Screen Chemical Hazard Assessment

Ecotoxicity and fate in the environment	Toxicity to humans (Group I)	Toxicity to humans (Group II)	Physical hazards
• Acute aquatic ecotoxicity • Chronic aquatic ecotoxicity • Other ecotoxicity studies (if available) • Persistence • Bioaccumulation	• Carcinogenicity • Mutagenicity and genotoxicity • Toxicity for reproduction • Toxicity for development • Endocrine activity	• Acute toxicity • Systemic toxicity and effects on organs • Neurotoxicity • Skin sensitisation • Respiratory sensitisation • Dermal irritation • Eye irritation	• Reactivity • Flammability

https://www.greenscreenchemicals.org/

Green Screen Hazard Scoring

C	M	R	D	E	AT	ST		N		SnS*	SnR*	IrS	IrE	AA	CA	P	B	Rx	F
						single	repeated *	single	repeated *										
L	*L*	**L**	**L**	DG	**L** (oral)	*H*	*L*	*M*	*M*	**L**	DG	**M**	**H**	**L**	*L*	**vL**	*vL*	*M*	*M*
					L (derm)														
					H (inh)														

Chronic human health impacts

Acute human health impacts

Environment and Fate impacts

Physical impacts

Ratings: very low, low, medium, high, very high, data gap

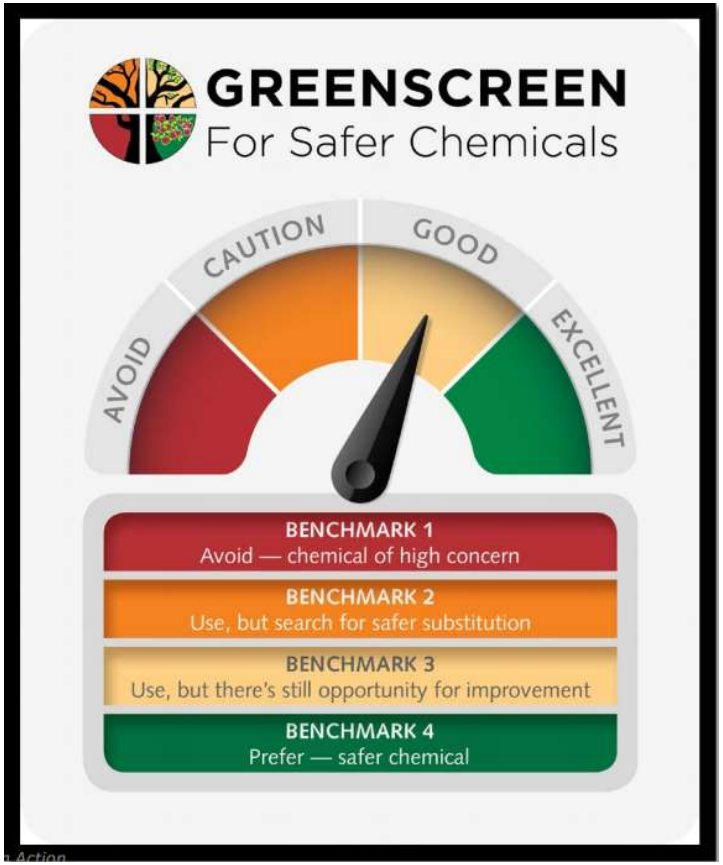
Determine Benchmark Scores

For example, Benchmark 1 criteria:

- PBT = High P + High B + [very High T (Ecotoxicity or Group II Human) or High T (Group I or II* Human)]
- vPvB = very High P + very High B
- vPT = very High P + [very High T (Ecotoxicity or Group II Human) or High T (Group I or II* Human)]
- vBT = very High B + [very High T (Ecotoxicity or Group II Human) or High T (Group I or II* Human)]
- High T (Group I Human)

GreenScreen Benchmark Scores

Upon completion of a GreenScreen assessment, the chemical receives one of four possible Benchmark scores.



Source: CPA, https://tcocertified.com/files/2015/11/Sustainable-it-summit-2015-presentation-nark-rossi.pdf

GreenScreen List Translator (LT)

BM-1	Verified BM-1	"Avoid - Chemical of High Concern" A GreenScreen assessment was performed to determine the Benchmark score of the chemical.
LT-1	Likely BM-1	An LT-1 score is based on clear agreement among Authoritative lists that the substance is a Chemical of High Concern and may be considered equivalent to a GreenScreen Benchmark-1. If a full GreenScreen assessment were conducted, the chemical would most likely be a Benchmark-1 chemical.
LT-P1	Possible BM-1	The chemical appears on a list that does not translate directly to a single Benchmark score and Benchmark-1 is included in the range of possible Benchmark scores.
LT-UNK	Unknown BM	LT-UNK ("unknown") indicates that a chemical is present on a GreenScreen Specified List but that there is insufficient information to classify the hazard as LT-1 or LT-P1. The LT-UNK score or the absence of a chemical on hazard lists does not mean it is safe. It may mean the chemical has not been reviewed by the body publishing the list or that the chemical has not yet been well tested.

Questions?

Use the chat box to ask a question

Poll Question

How familiar are you with the Pharos tool?

Evaluating Pharos Data

Example: Identifying safer alternatives to methylene chloride and NMP for paint stripping products.

Performance: a paint stripper that can work in approximately 20 minutes for most multi-layer applications.

EHS: Contains safer chemicals than methylene chloride and NMP.

Initial Screen

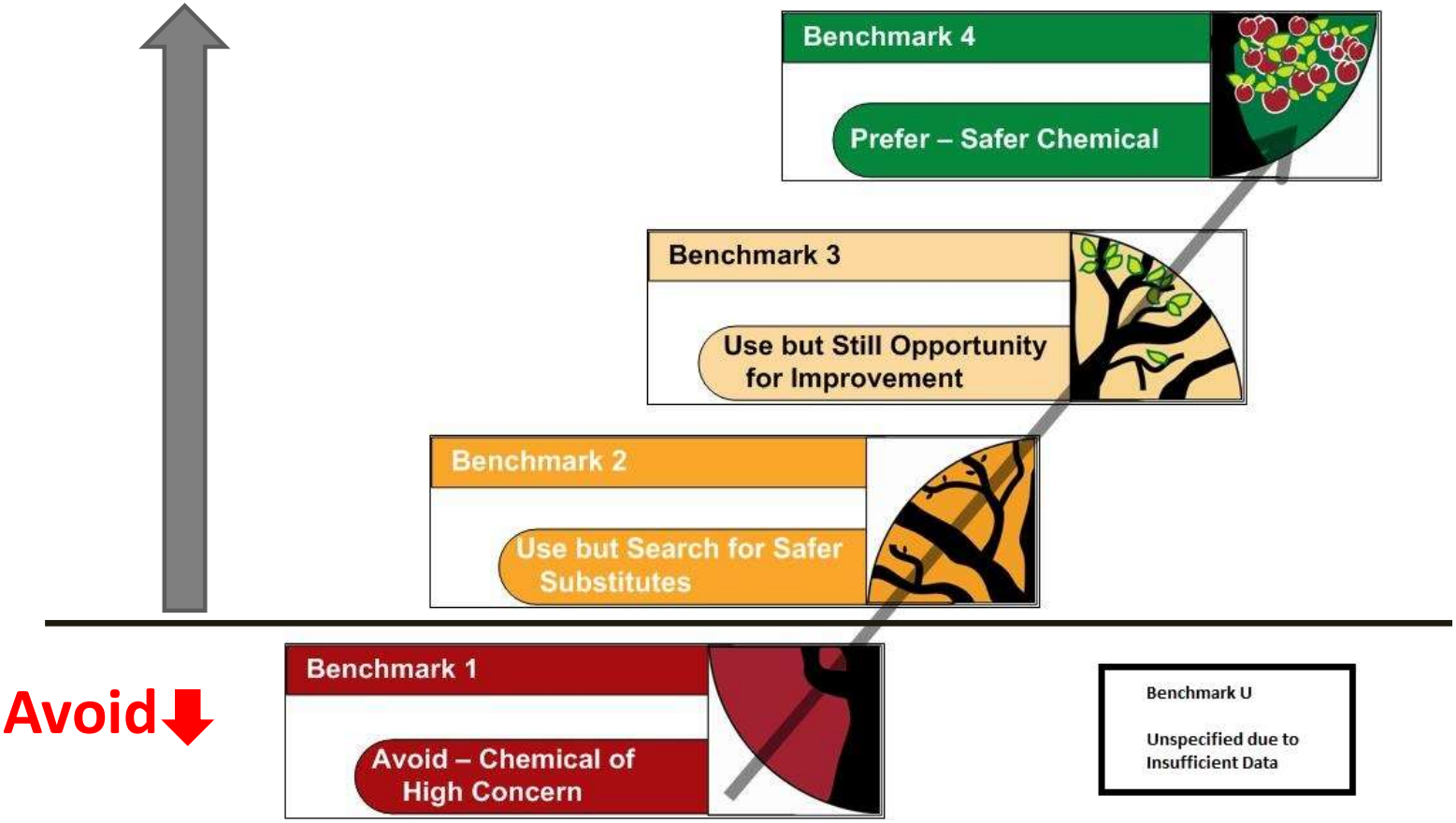
	Unacceptable	Potentially Acceptable
Establish GreenScreen Benchmark Levels of acceptability	BM-1, LT-1, LT-P1	BM-2, BM-3, BM-4

If a chemical has a BM-1, LT-1, LT-P1 score, then exclude this chemical from further consideration as a safer alternative.

If a chemical has a BM-2, BM-3, BM-4 score, then conduct further evaluation.

Initial Screen

Potentially Acceptable



Avoid

Also LT-1 and LT – P1

Chemical Evaluation

Understand your application (e.g. paint stripping), and identify hazards endpoints of concern for particular application:

- Potential for repeated dermal exposure: Skin sensitization endpoint, Unacceptable if “H317 May cause an allergic skin reaction”, Category 1

- Metal substrate damage (corrosivity): Reactivity endpoint, Unacceptable if “H290 May be corrosive to metals”, Category 1

If a chemical has BM-2, BM-3, or BM-4 score, then review hazard statements for each hazard endpoint to ensure there are no other issues of concern.

For example, d-Limonene (CAS# 5989-27-5) is a BM-2 chemical. However, it is a Category 1 high hazard for skin sensitization and has several data sources. Therefore, exclude this chemical from further consideration as a safer alternative.

Use

Avoid

Chemicals Used in Paint Strippers	Green Screen Benchmark	EPA HAP, EPA TRI & MA TURA	California Prop 65 Listed	California Chemical Candid. List
Water	4			
DMSO	3			
Acetone	2			
DEGME	2			
Dimethyl adipate	2			
Dimethyl glutarate	2			
Dimethyle succinate	2			
1,3 Dioxolane	2			
Formic acid	2			
Methyl acetate	2			
D-Limonene	2			
Ethyl benzene	LT-1	✓	✓	✓
Methanol	1	✓	✓	✓
Methylene chloride	1	✓	✓	✓
NMP	LT-1	✓	✓	✓
Toluene	1	✓	✓	✓
Xylene	1	✓		✓