Alternatives Assessments and the GreenScreen for Safer Chemicals

A GLOBAL LEADER IN PUBLIC HEALTH AND SAFETY

2015 Michigan Green Chemistry & Engineering 101 Workshop
November 3, 2015
Nancy Linde, Managing Toxicologist, linde@nsf.org

An Introduction

Our Values

NSF's Mission and History

Today

NSF Around the World

Capabilities

Services from NSF International

Our Mission

NSF International is dedicated to being the leading global provider of public health and safety-based risk management solutions while serving the interests of all stakeholders, namely the public, the business community and government agencies.

NSF International is a global, independent, public health and safety organization.

Our mission and focus has always been protecting and improving human health.

NSF helps people live safer.

We carry out this human health and safety mission by:

STANDARDS

Writing standards to promote food, drinking water, indoor air, dietary supplements, consumer products and environmental safety

CERTIFICATION

Certifying products to these standards

AUDITING

Conducting safety audits for the food, water and consumer goods industries

SUSTAINABILITY

Developing sustainability solutions

ISO

Certifying to ISO standards

TRAINING

Developing training and education programs

NSF International Hazard Assessment Services

12 Principles of Green Chemistry*

The GreenScreen™ focuses on 3 key principles of Green Chemistry

1. Prevention
2. Atom Economy
3. Less Hazardous Chemical Syntheses
4. Designing Safer Chemicals
5. Safer Solvents and Auxiliaries
6. Design for Energy Efficiency
7. Use of Renewable Feedstocks
8. Reduce Derivatives
9. Catalysis
10. Design for Degradation
11. Real-time analysis for Pollution Prevention
12. Inherently Safer Chemistry for Accident Prevention

* Anastas, P. T.; Warner, J. C.; Green Chemistry: Theory and Practice, Oxford University Press: New York, 1998, p.30. By permission of Oxford University Press

Clean Production Action – GreenScreen™

- An easy to use Benchmark Scoring System
- Allows easy comparisons
- Builds on US EPA, GHS and other international approaches
- Transparent
- Ties into Life Cycle Assessments and other sustainability tools

Who is Using the GreenScreen™

Manufacturers
NGO's
Retailers
Certification bodies
State Governments

The GreenScreen is a Hazard Assessment

It is NOT a risk assessment

Hazard is an inherent property that may result in harm

Exposure is a measure of duration and frequency

Risk reflects the probability of harm if exposure occurs

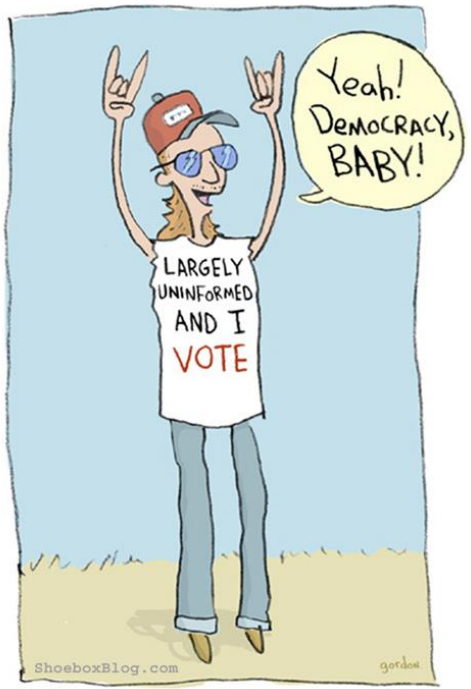
Risk = *ƒ* (hazard, exposure)

Risk and Hazard are Different Questions

A risk assessment answers the question “is it safe enough for the intended use?”

A hazard assessment answers the question “which is inherently safer?”

Goal to Avoid Regrettable Substitutions



We don’t want to replace a chemical of concern with an unknown!

Clean Production Action – GreenScreen™

- An easy to use Benchmark Scoring System
- Allows easy comparisons
- Builds on US EPA, GHS and other international approaches
- Transparent
- Ties into Life Cycle Assessments and other sustainability tools

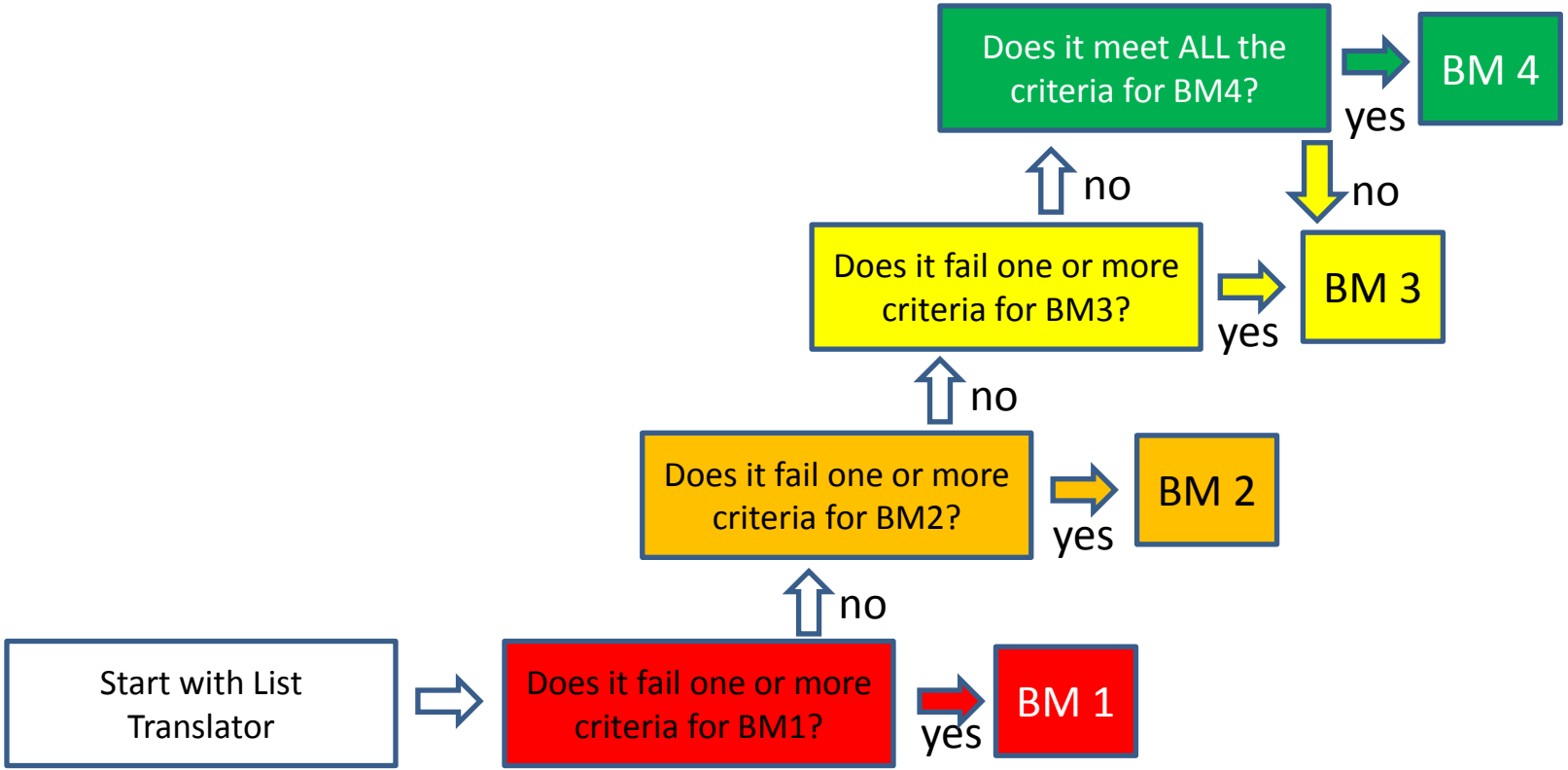
GreenScreen™ Hazard Summary Table

Green Screen Hazard Endpoints and Ratings

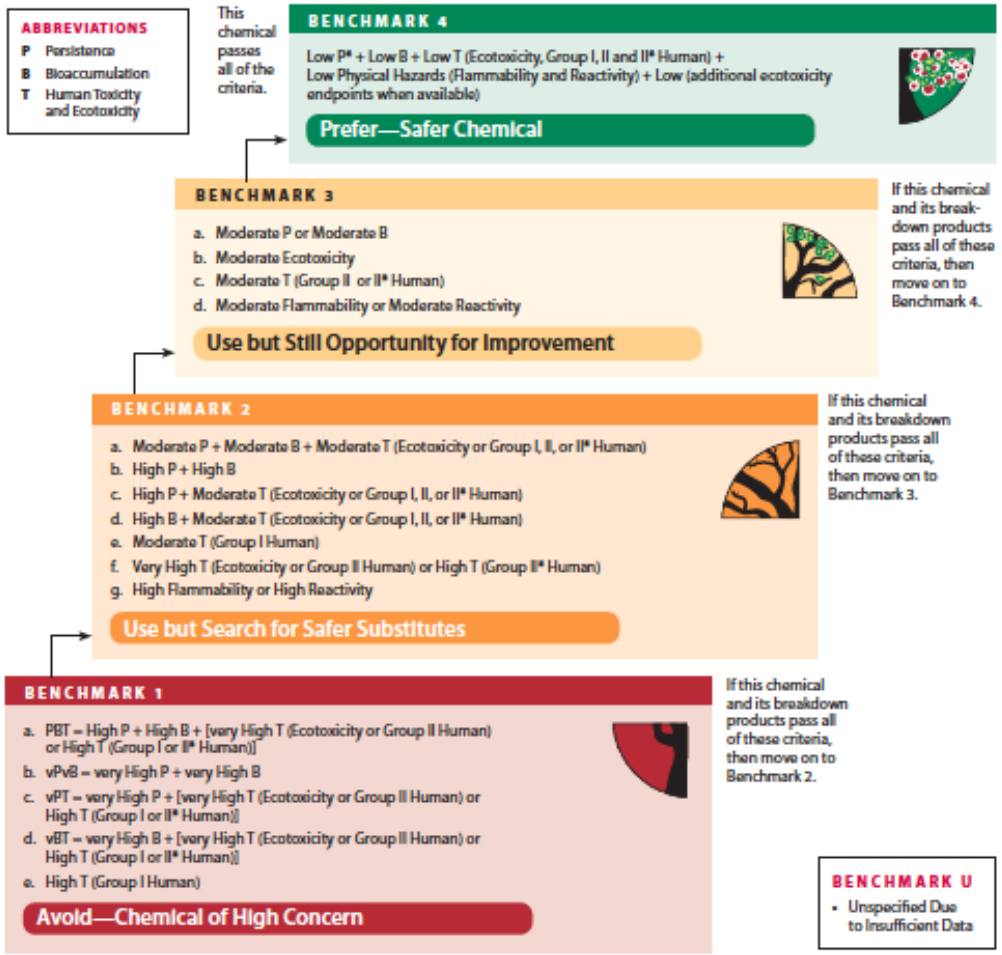
Group 1 Human					Group II and II* Human									Ecotox		Fate		Physical	
Carcinogenicity	Mutagenicity	Reproductive toxicity	Developmental toxicity	Endocrine activity	Acute toxicity	Systemic toxicity		Neurotoxicity		Skin sensitization*	Respiratory sensitization*	Skin irritation	Eye irritation	Acute aquatic toxicity	Chronic aquatic toxicity	Persistence	Bioaccumulation	Reactivity	Flammability
						S	R	S	R										
L	**L**	**L**	**M**	*M*	**L**	**L**	**L**	**vH**	*H*	**L**	**L**	**L**	**L**	**H**	**H**	**vL**	**L**	M	*L*

Endpoints are scored as very low (vL), low (L), moderate (M), high (H), or very high (vH). Bold letters represent greater confidence in the hazard ranking.

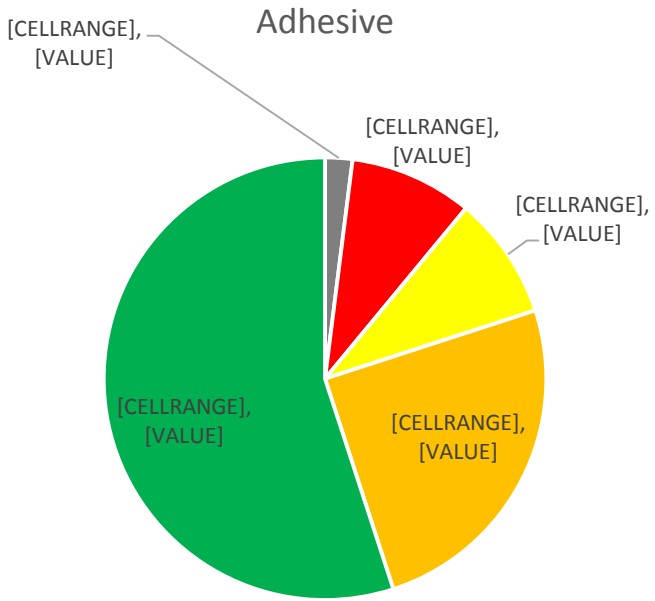
GreenScreen List Translator



Use Hazard Summary Table to Determine Benchmark Score



Mixtures



- No overall Benchmark
- Must include all constituents
- Disclosure best practices = 100 ppm (0.01%)

Mixtures

Chemical	CAS	% by weight	Benchmark	BM by %
Calcium carbonate	1317-65-3	30-45%	4	30-45%
Acetone	67-64-1	5-20%	2	5-20%
Petroleum distillates	64742-89-8	5-20%	1	10-46%
Toluene	108-88-3	5-20%	1	
Dichloromethane	75-09-2	0-5%	1	
Methyl ethyl ketone	78-93-3	0-1%	1	

Special Case Impurities

Chemical	CAS	Concentration in final product (ppm)	LT Results	Reason for Inclusion
Sulfur	7704-34-9	20	LT-U	Impurity in petroleum distillates
Nickel	7440-02-0	20	LT-1	Impurity in petroleum distillates

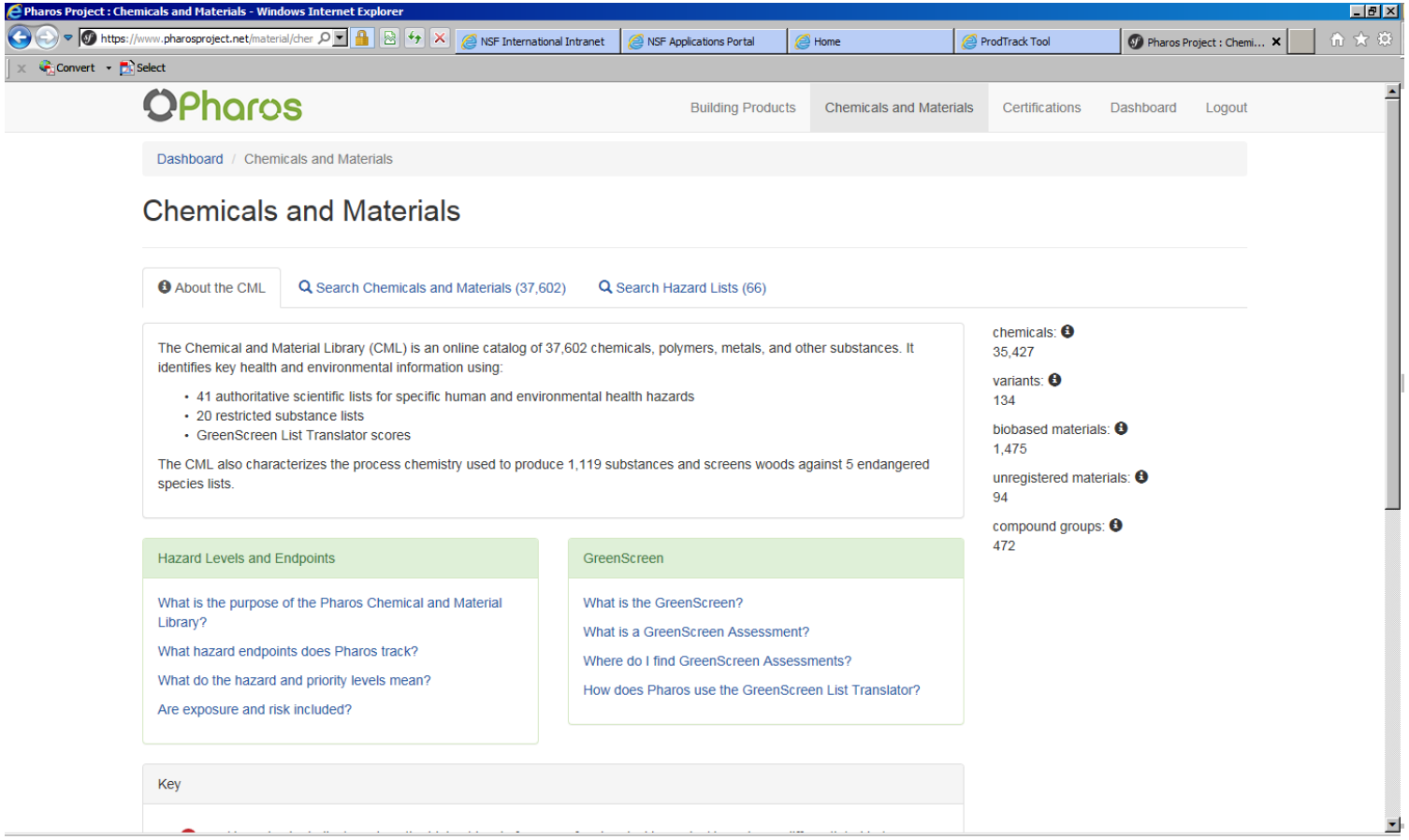
Known and special case impurities < 100 ppm in the parent product should also be reported with their List Translator Results (or full GreenScreen)

GreenScreen™ List Translator

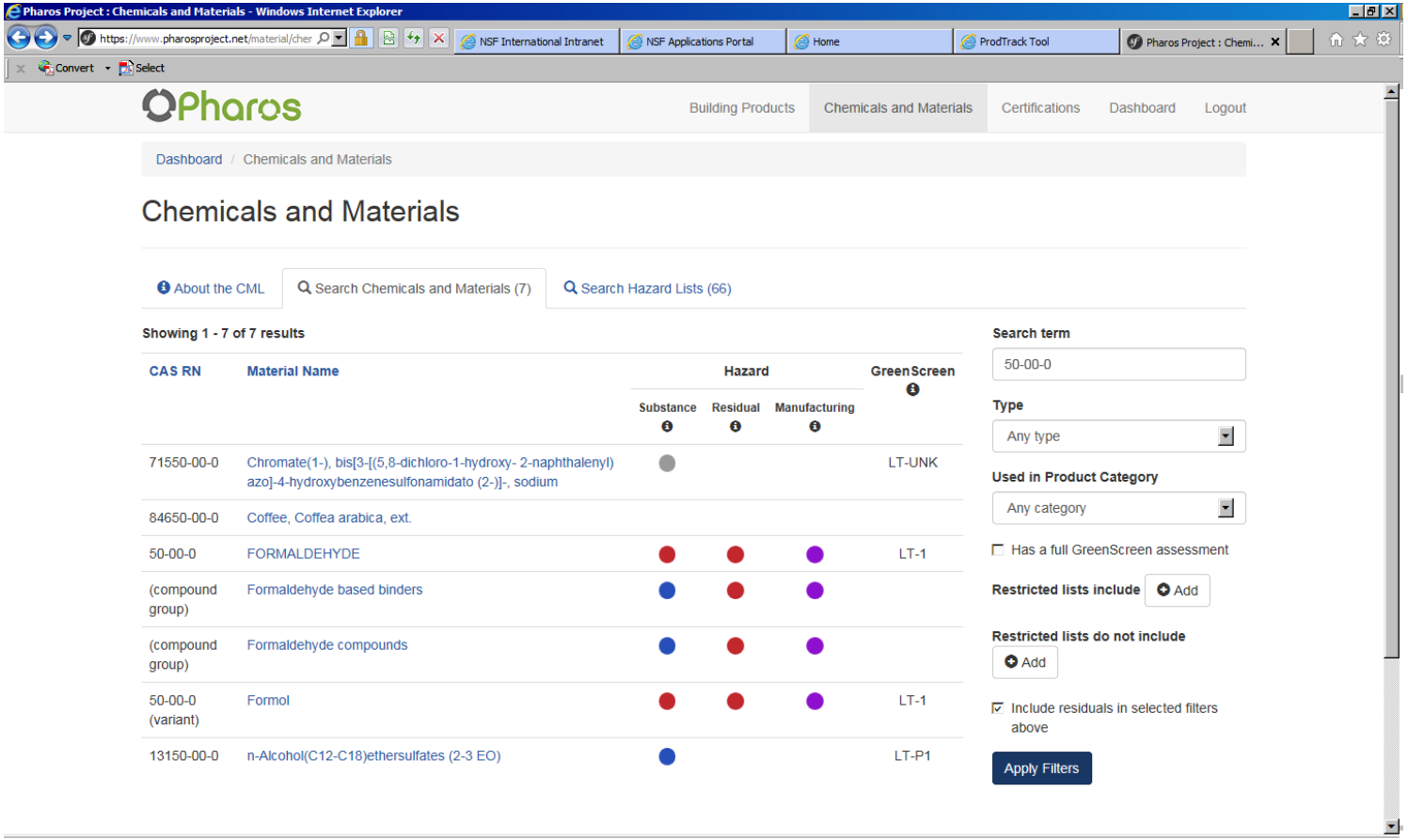
- The List Translator (LT) tool tells if a chemical is a known or possible Benchmark 1 chemical, based on authoritative lists.
- Automated
- LT results can include:
  - LT-1 (expected BM1)
  - LT-P1 (possible BM1, list crossover)
  - LT-U (undetermined from the lists)
- Only a full GreenScreen™ can tell you if a chemical is better than BM1 (i.e. BM2, BM3, or BM4)

Authoritative lists include:
AOEC
DOT
EPA-AMT
EU-CMR
EU-PBT
EU-Hazard statements
IARC
Prop 65
MAK
…and more (see full list on CPA website)

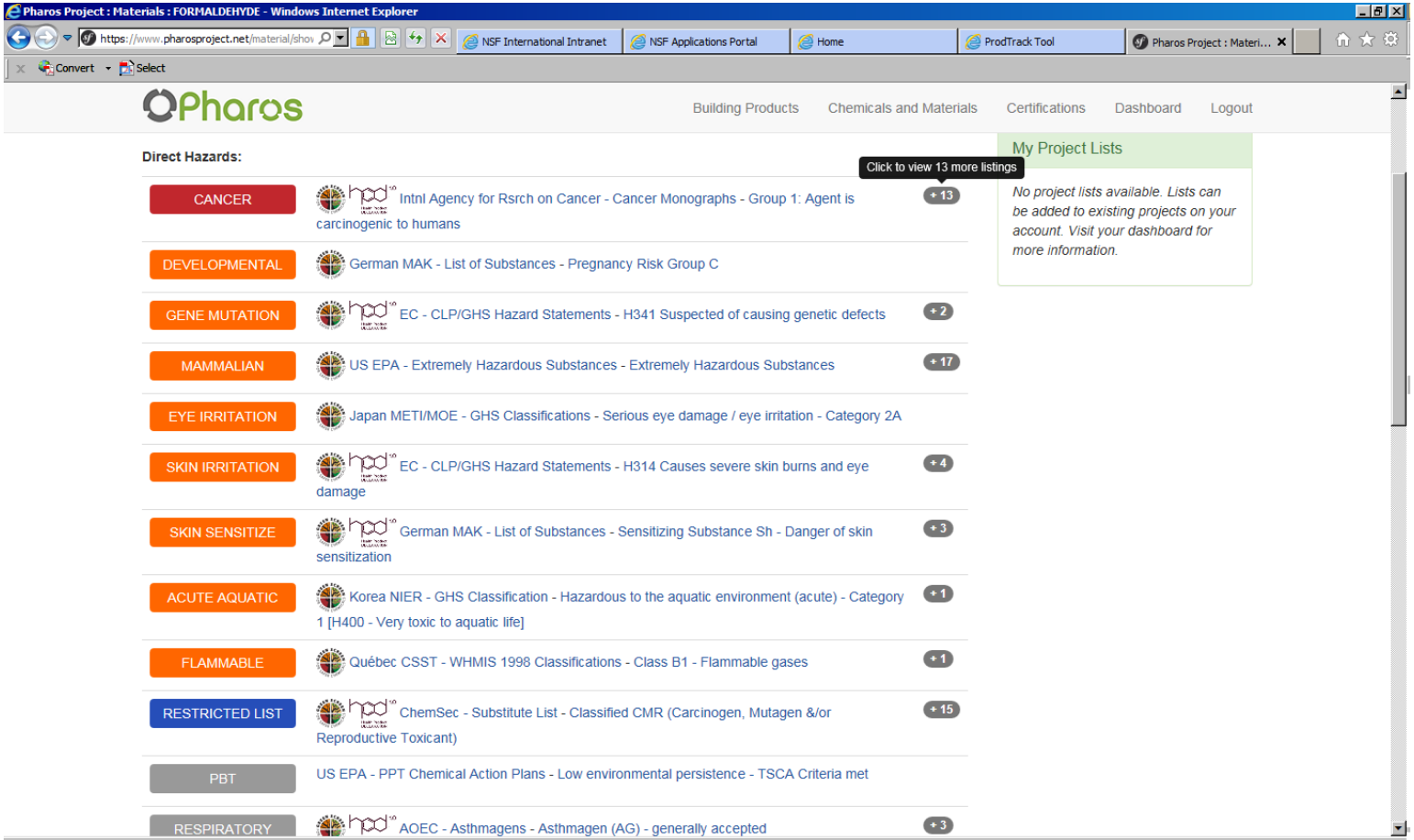
Pharos – Automated List Translator



Pharos – Automated List Translator

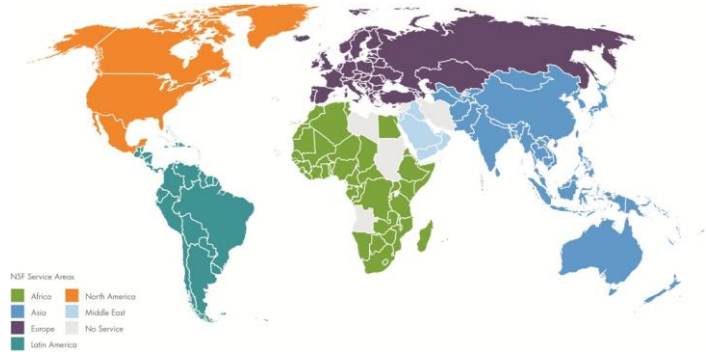


Pharos – Automated List Translator



Drivers for the GreenScreen™

- Preferred purchasing plans (electronics, textiles, automotive, building products)
- Corporate responsibility / due diligence
- International sales
- Voluntary Standards
  - LEED certification – materials optimization credits
  - Health Product Declarations (HPDs)
  - TCO Certification for IT products
- State regulations
  - California, Maine, Washington
- Customers want transparency



Challenges for Using the GreenScreen™

Issues

1. Getting supplier disclosures can be challenging
2. Doing full GreenScreens requires training or outsourcing
3. Knowing what to do if your product has BM1 chemicals in it
4. It's not always practical to run GreenScreen on an entire inventory

Solutions

1. Suppliers are more comfortable disclosing formulations to a third-party under NDA
2. Training is offered by Clean Production Action and licensed profilers
3. Licensed profilers can help find data, identify analogs, perform modeling
4. Licensed profilers can help prioritize efforts and take "family" approaches

Exercise – Making Informed Decisions

SCENARIO: You have a Benchmark 1 chemical of concern that you need to replace. You are considering two alternatives that are both Benchmark 2 chemicals. The chemical of concern is an additive in a polymer.

OBJECTIVE: Determine the best substitute for the chemical of concern.

INSTRUCTIONS: Review the Hazard Summary Table below and answer the three questions on the next page.

Chemical	CAS#	%	GS BM	Group I Human					Group II and II* Human								Ecotox		Fate		Physical	
				C	M	R	D	E	AT	ST		N		SnS*	SnR*	IrS	IrE	AA	CA	P	B	Rx	F
										single	repeat*	single	repeat*										
Chemical 1	XXX-XX-X	100%	1	*H*	*H*	**M**	**M**	DG	*vH*	*L*	*M*	*L*	*M*	**H**	**H**	**H**	**H**	*vH*	*vH*	*vH*	*vH*	*L*	*L*
Alternative 1	XXX-XX-X	100%	2	L	**M**	*L*	*L*	DG	*L*	*M*	*M*	*M*	*M*	*M*	L	*M*	**M**	**M**	L	L	*M*	**M**	**M**
Alternative 2	XXX-XX-X	100%	2	*M*	DG	*L*	*L*	*M*	*H*	DG	DG	*M*	*M*	*M*	*M*	*M*	*H*	*M*	*M*	*H*	*M*	**M**	**M**

L = low hazard, M = moderate hazard, H = high hazard, vH = very high hazard, DG = data gap