Northwest Green Chemistry

PPRC Roundtable

Alternatives to Cu-Based Antifouling Boat Paints

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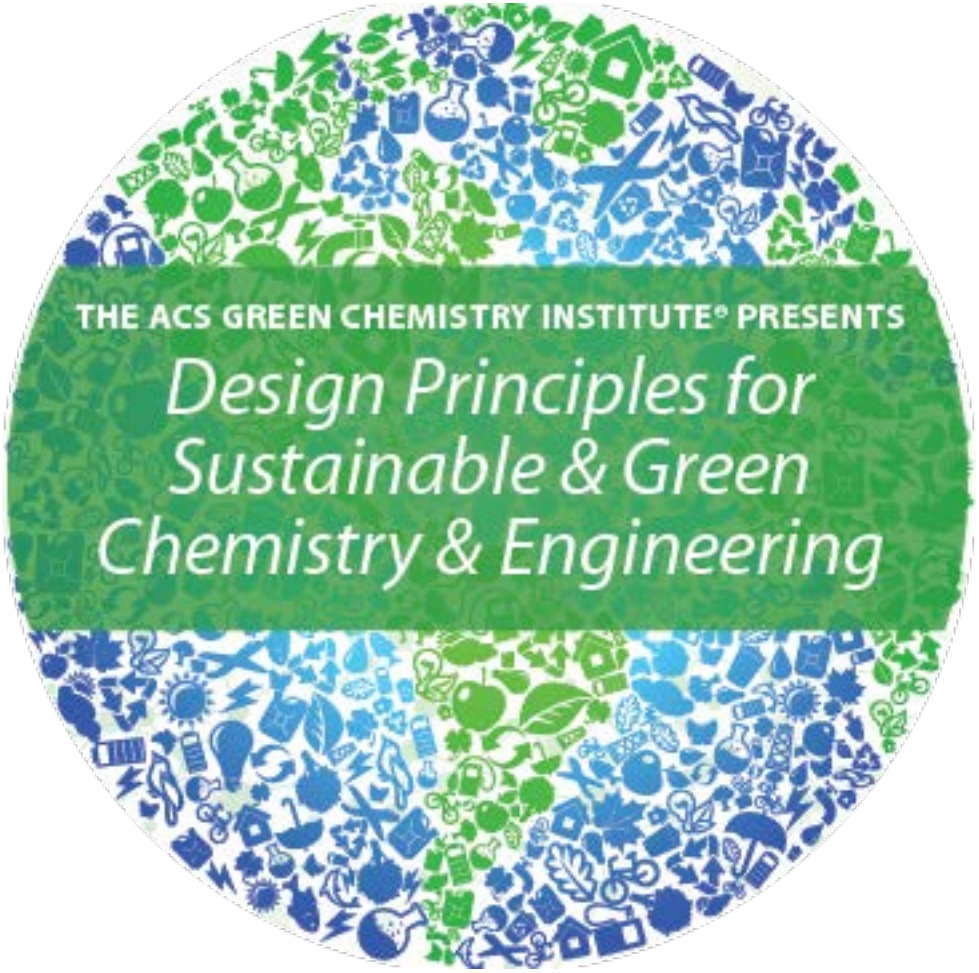
Our mission is to enhance human and environmental health by fostering innovation and economic opportunities through sustainable and green chemistry and engineering solutions.

Northwest Green Chemistry

Seed funding from the EPA National Estuary Program and the Bullitt Foundation to develop an independent center; Initial operations and management to independence through June 2016 via contract with TechLaw, Inc.

How can we reduce both waste and toxic chemicals across the life cycle?



Eliminate & minimize hazards & pollution

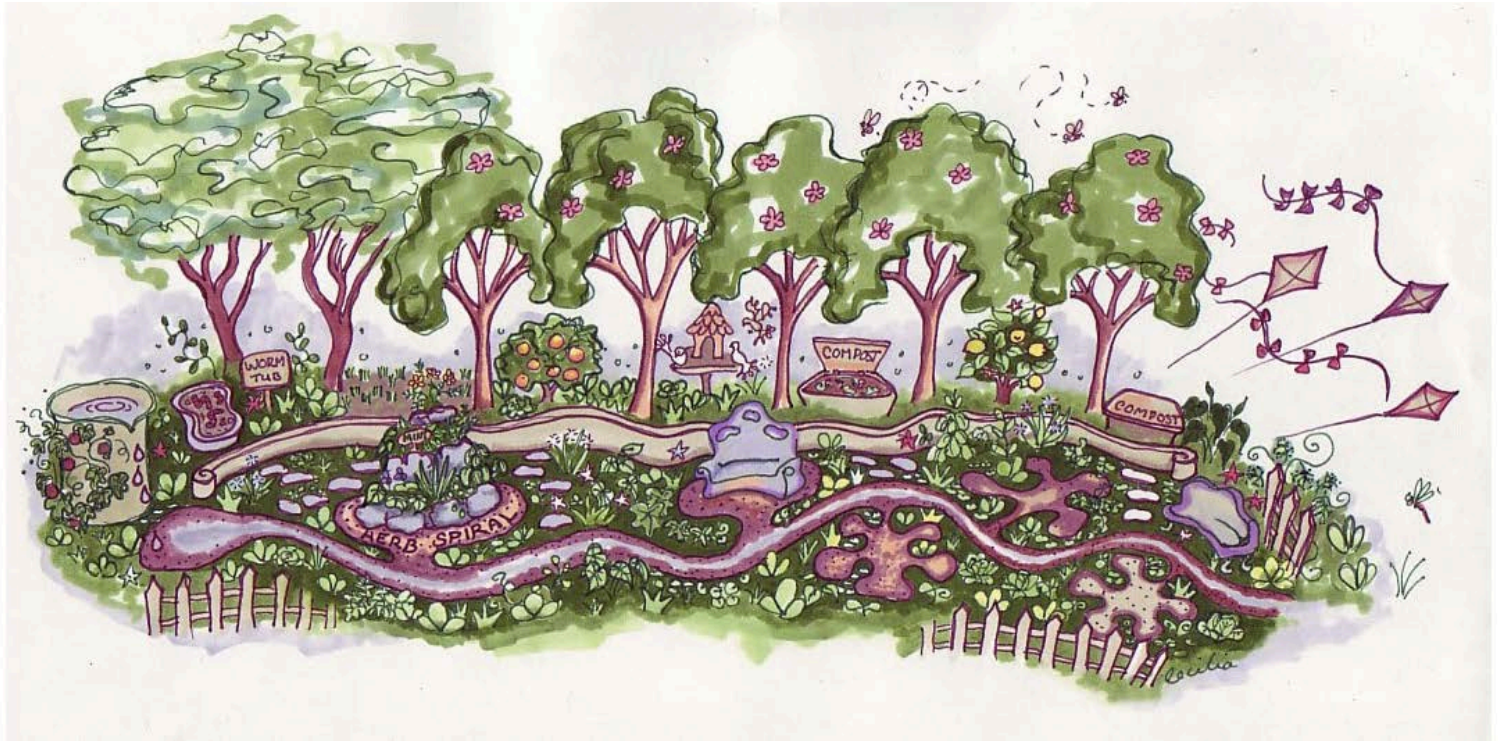
Maximize resource efficiency

Design systems holistically & use life cycle thinking

http://www.acs.org/content/dam/acsorg/greenchemistry/resources/2015-gci-design-principles.pdf

NGC Focuses on Growing the Supply:

Three Approaches



1. Harvest the best existing options
2. Cultivate existing options
3. Plant and nurture new options

Washington State Antifouling Boat Paint Alternatives Assessment

Northwest Green Chemistry

Chapter 70.300 RCW, Recreational Water Vessels-Antifouling Paints

http://apps.leg.wa.gov/Rcw/default.aspx?cite=70.300&full=true

- Beginning January 1, 2018, no new recreational boats under 65 feet may be sold in the state of Washington if their bottom paint contains copper.

- Beginning January 1, 2020, no bottom paint that contains more than 0.5% copper may be sold for application to recreational boats under 65 feet in the state of Washington.

Why do an alternatives assessment?

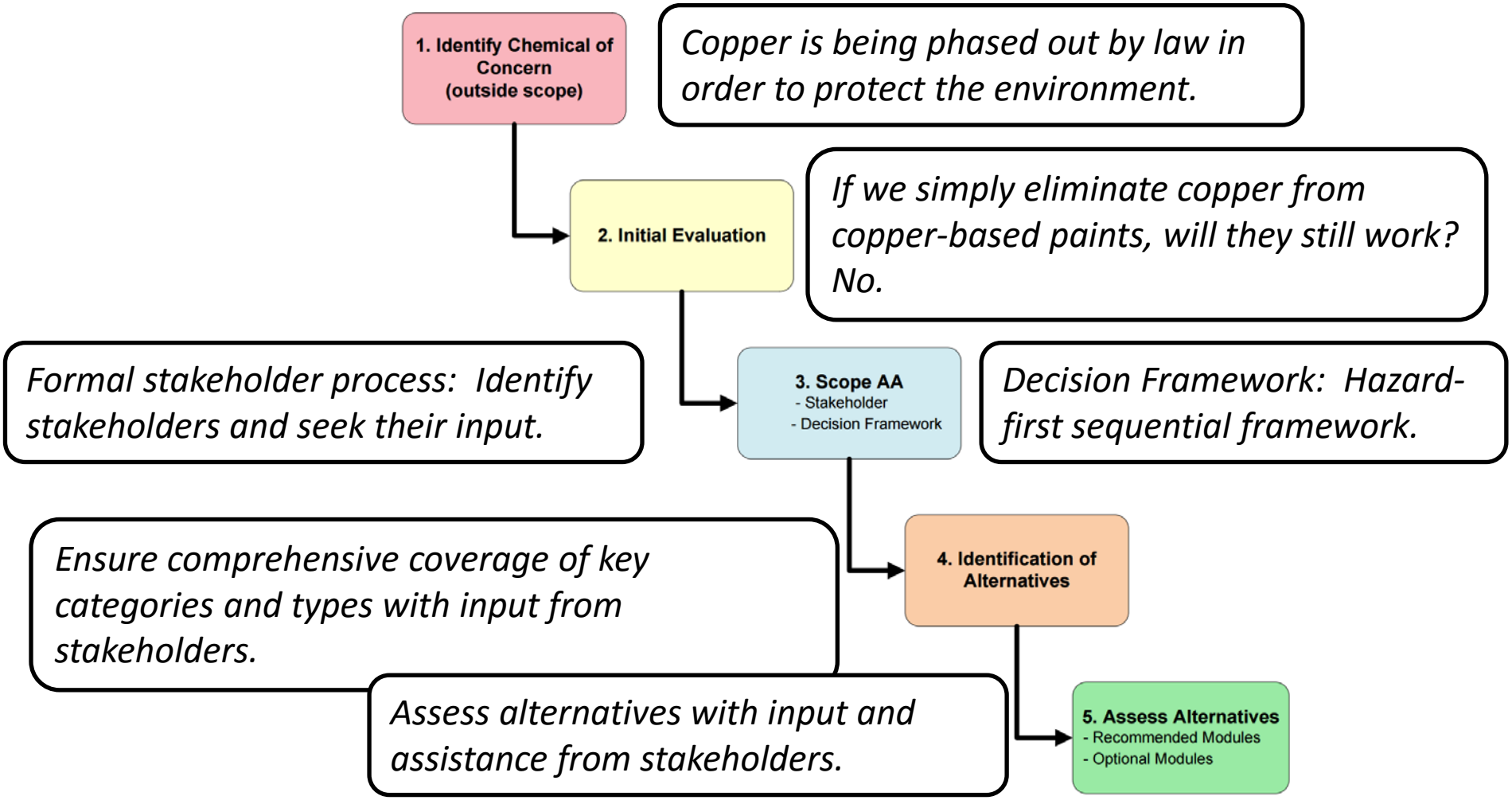
Alternatives Assessment: process for identifying and comparing potential chemical and non-chemical alternatives that can be used as substitutes to replace chemicals or technologies of high concern. (IC2 AA Guide)

Saves $$$ & time

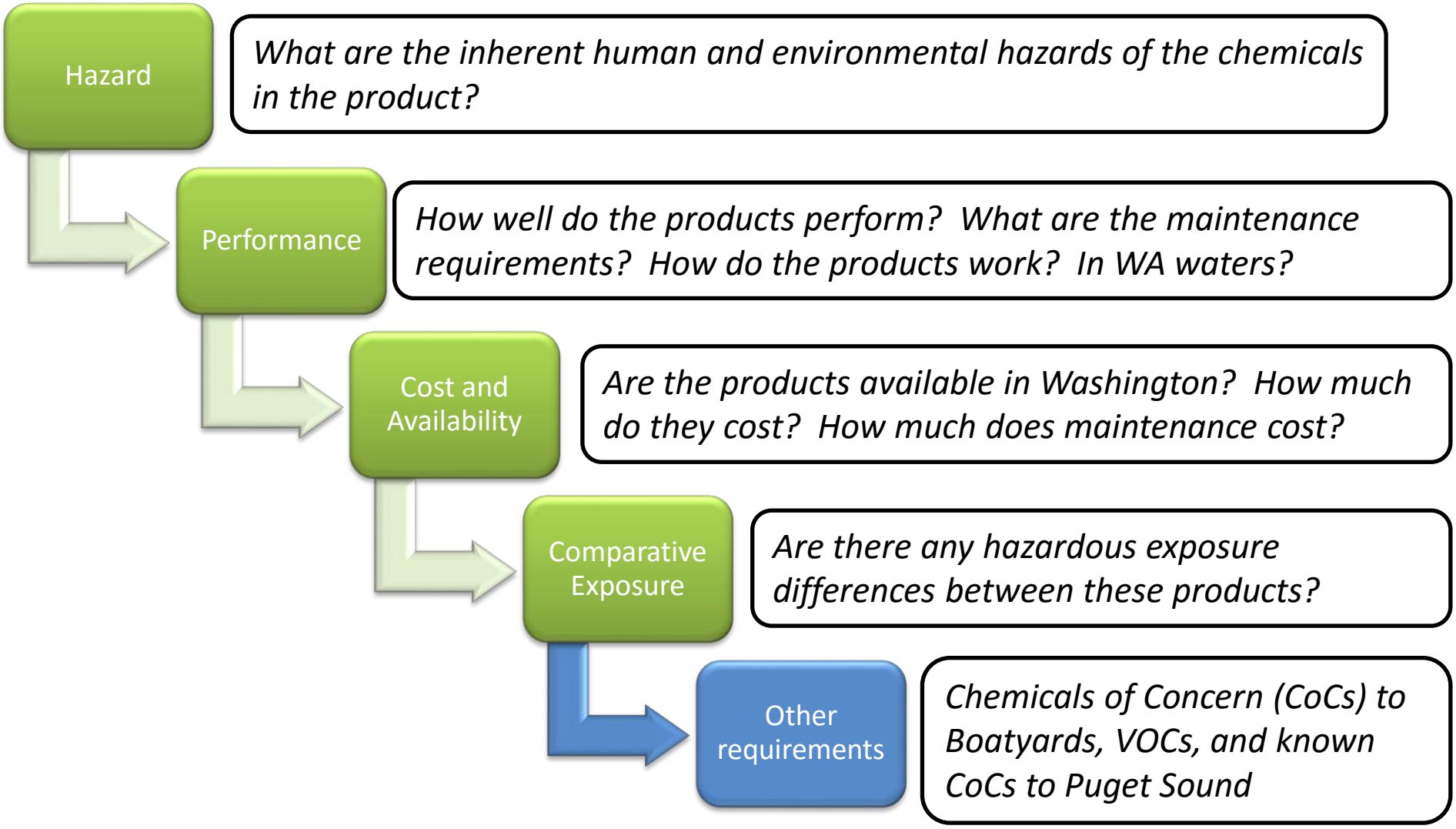
Prevents Regrettable Substitutions

Five Steps: Alternatives to Copper-based Antifouling Boat Paint

Figure 1: Five AA Steps



What modules will we assess?



Step 3: Stakeholder Engagement

Stakeholder Call #1
28 September 2016 at 10 PT

Do we have the right stakeholders?

- Audience of almost 50 stakeholders recommended another dozen.

Do we have the right products?

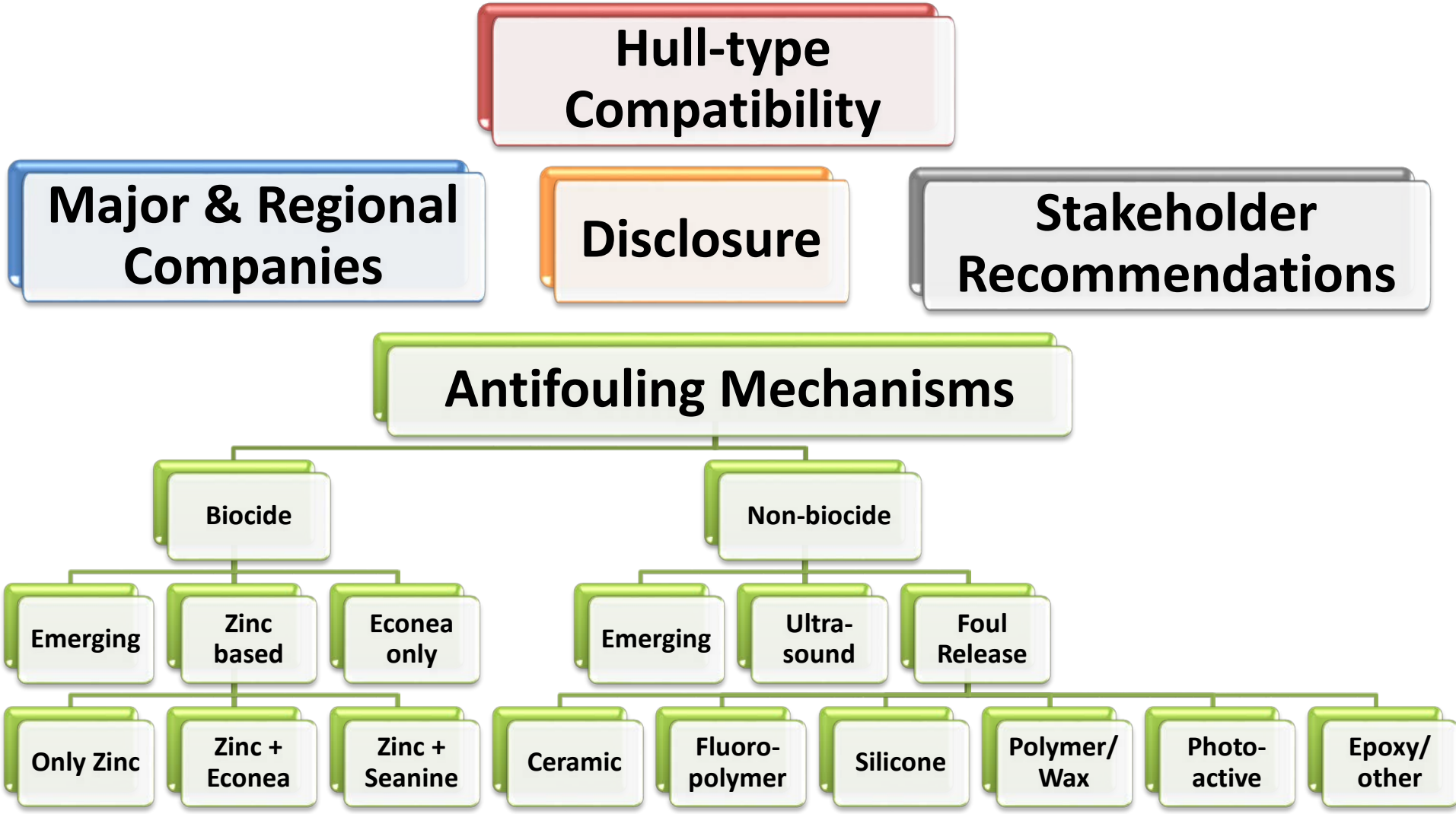
- Yes.

How do we improve data completeness?

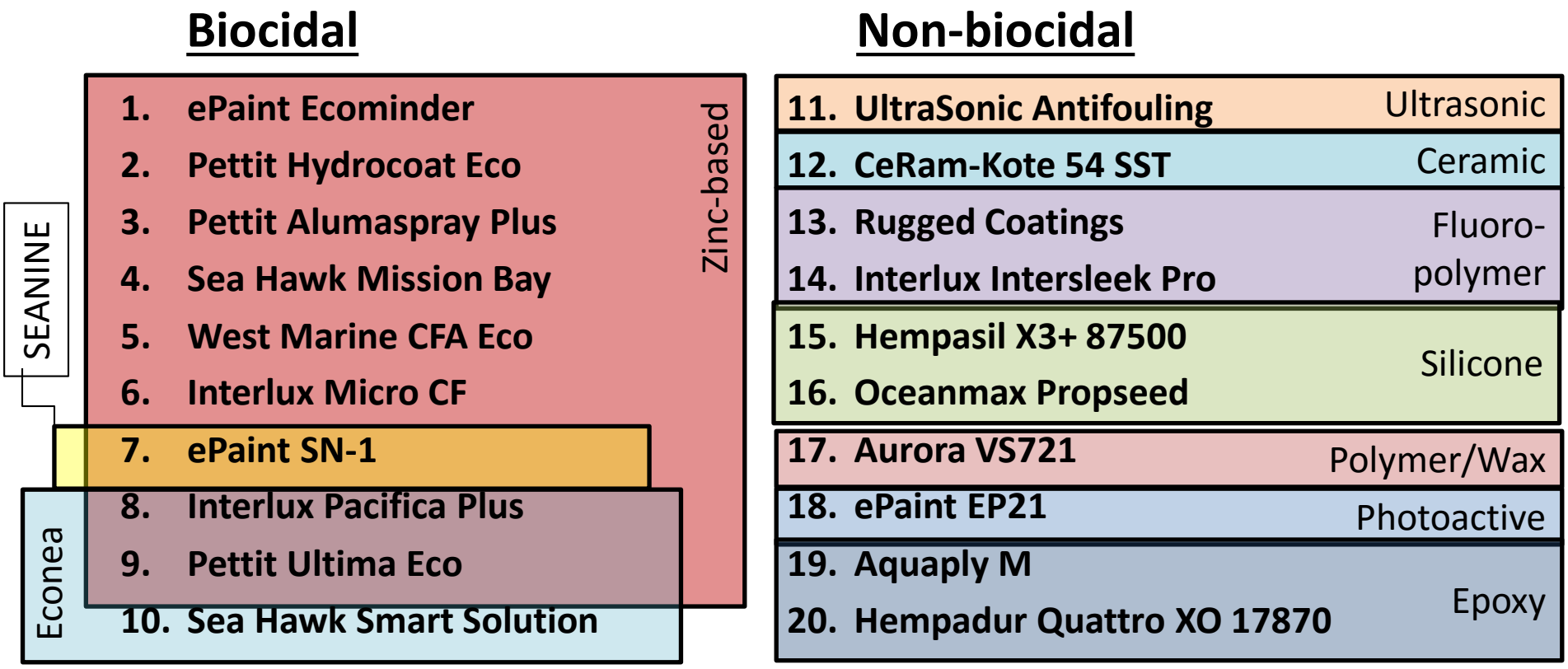
- Stakeholders recommended third-party disclosure of formulations.

Step 4: Identify Alternatives

Ensuring coverage of key copper-free antifouling technology categories



Existing Product List



Emerging Product List

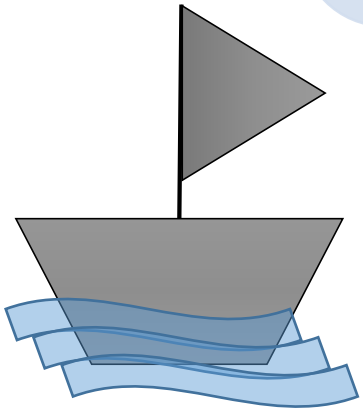
- **Biocide**
  - Medetomidine (Selektope)
  - Capsicum
  - Aequor
- **Non-biocide**
  - Hull-covering tarps
  - Small molecules (Aequor)
  - Novel polymers
  - Biomimicry

If you would like to recommend additional emerging products or technologies, please email us at: cuboatpaint@northwestgreenchemistry.org

OTHER REQUIREMENTS MODULE

- Boatyards monitor copper, zinc, and lead
- Report which products contain these chemicals, % formula

CoCs to Boatyards



- Volatile Organic Chemicals (VOCs) are a large concern in paints
- Report “no” or “low” VOC, report total VOC Content

VOCs

- List of 17 known **chemicals of concern (CoCs)** to Puget Sound
- Report presence, % formula

CoCs to Puget Sound

HAZARD
General Approach

Identify Chemical Ingredients → Assess Ingredients for Inherent Hazard → Evaluate the Hazard Profile of the Product

Name	Product identifier	%
Solvent naphtha(petroleum), light aromatic	(CAS No) 64742-95-6	10-25
Ethylbenzene	(CAS No) 100-41-4	0.01 - 1
Zinc oxide	(CAS No) 1314-13-2	35-50
Zinc pyrithione	(CAS No) 13463-41-7	4-10
Carvone	(CAS No) 98-82-8	0.1-1
Pseudocumene	(CAS No) 95-63-6	5-10
Xylene	(CAS No) 1330-20-7	0.1-1
Rosin x50	(CAS No) 8050-09-7	5-10
Toluene	(CAS No) 108-88-3	Trace
Benzene	(CAS No) 71-43-2	Trace
Amorphous Silica	(CAS No) 7631-86-9	0.1-1
Arsenic	(CAS No) 7440-38-2	0.1-1
Nickel	(CAS No) 7440-02-0	0.1-1
C18-28 Long Chain Chlorinated Paraffins	(CAS No) 63449-39-8	0.1-1
Talc	(CAS No) 14807-96-6	5-10
Crystalline silica (quartz)	(CAS No) 14808-60-7	0.1-1
Lead	(CAS No) 7439-92-1	0.1-1
2-Pyridol, 1-Oxide	(CAS No) 13161-30-3	0.1-1

GREEN SCREEN FOR SAFER CHEMICALS

QUICK CHEMICAL ASSESSMENT TOOL

toxnot PBC

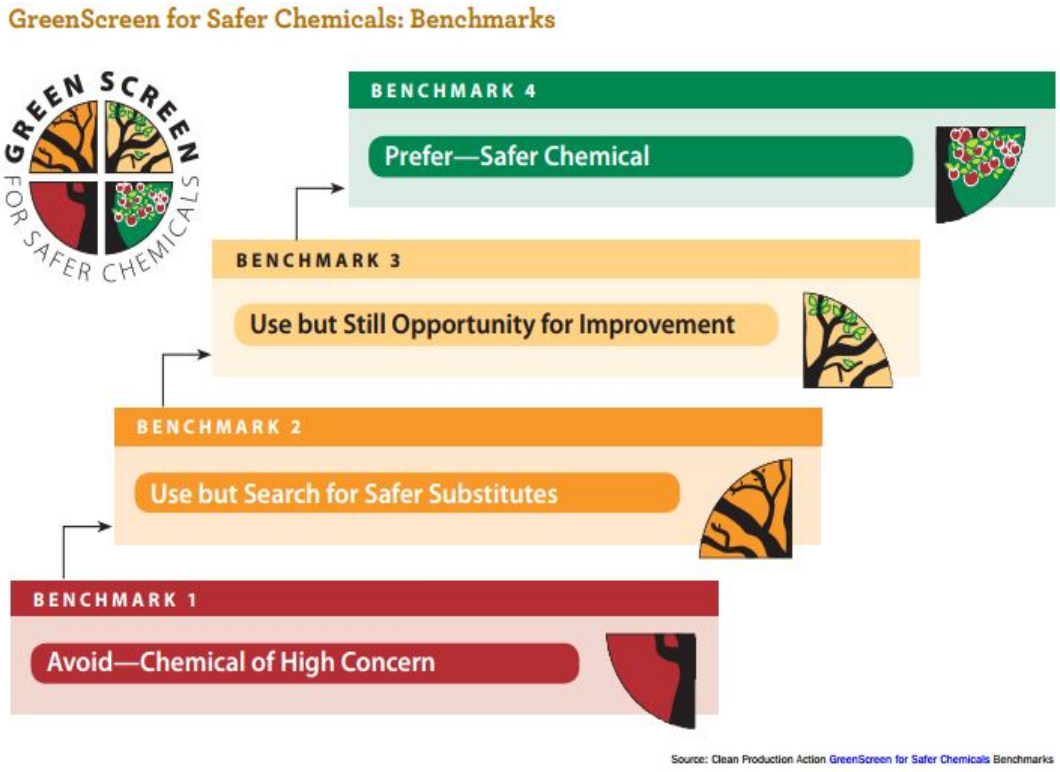
Pharos

How do we assess human and/or environmental hazard?

Design for the Environment
U.S. EPA
Recognized for Safer Chemistry
www.epa.gov/dfe

SAFER CHOICE
Meets U.S. EPA Safer Product Standards
epa.gov/saferchoice

QUICK CHEMICAL ASSESSMENT TOOL



QUICK CHEMICAL ASSESSMENT TOOL

Crowdfunding QCATs toxnot.com

toxnot PBC

What's popular

Crowdfunding | Most Viewed | Almost Funded | Upvotes | Complete Profiles

Copper and Salmon - A Toxic Mix

6% of $1,300 funded

View Project | Back this Project

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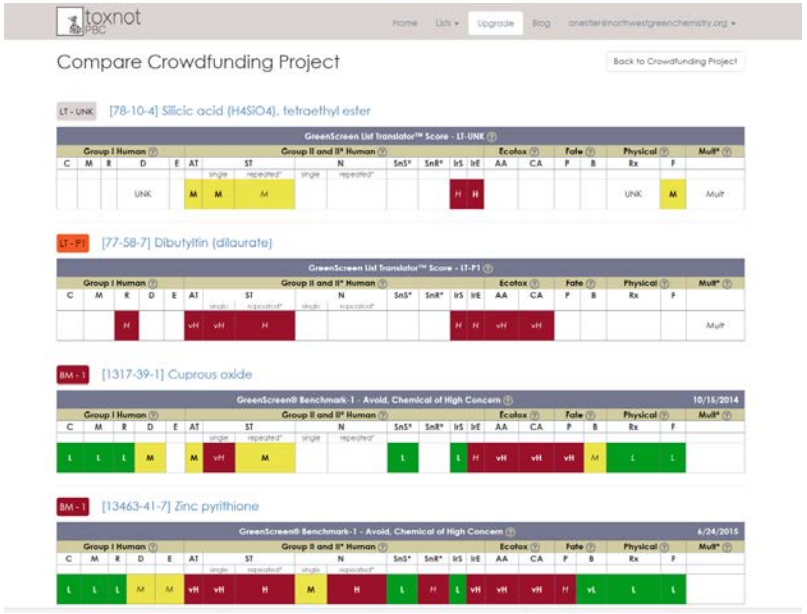
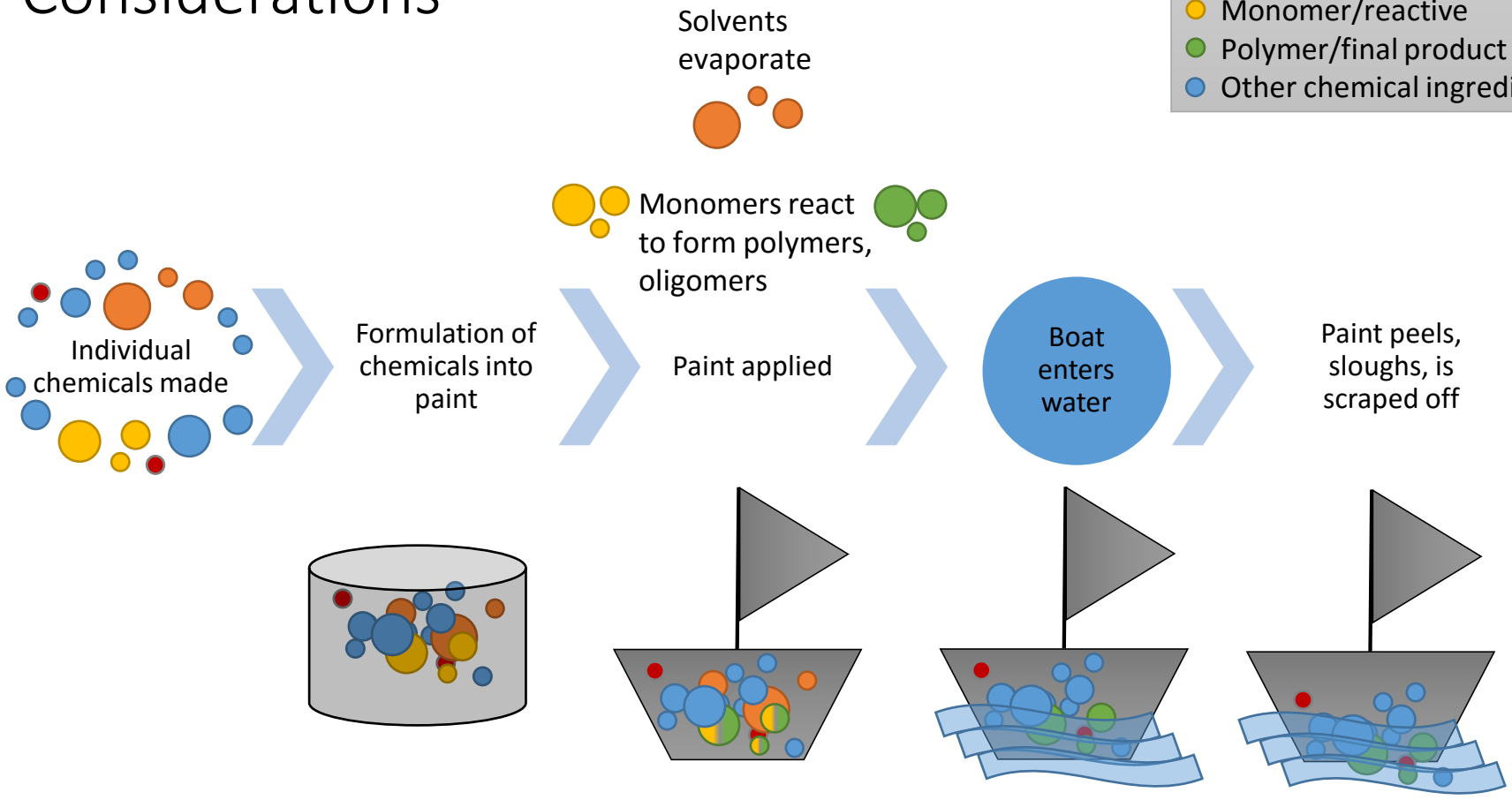
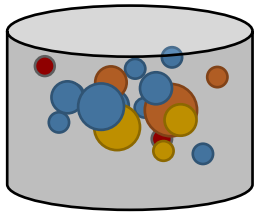


Hazard, Exposure & Life Cycle Considerations

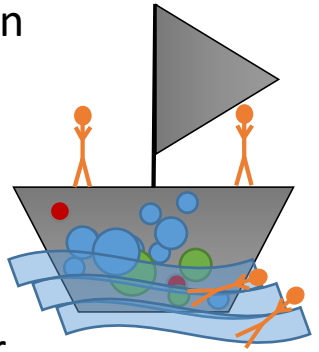


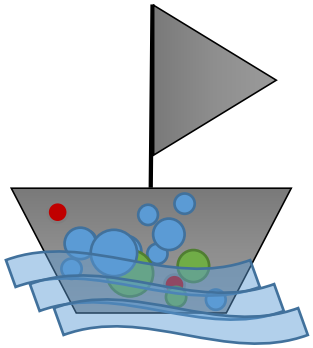
Which chemicals matter most for human & environmental hazards?

- Actives
- Solvent
- Monomer/reactive
- Polymer/final product
- Other chemical ingredient

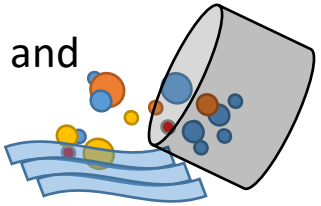


- HUMAN: Chemicals on the ingredient list: Worker/human hazard primarily
  - Actives
  - Solvent
  - Monomer/reactive
  - Other chemical ingredient
- HUMAN, secondary: Humans recreate (swim, dive, fish) near boats in the water.





- ENVIRONMENT: Chemicals on the boat in the water: Aquatic hazard primarily
  - Actives
  - Polymer/final product
  - Other chemical ingredient
- ENVIRONMENT, secondary: Accidents happen. Solvents and monomers/reactive chemicals must also be assessed.



Washington State Antifouling Boat Paint Alternatives Assessment Stakeholder Meeting #2

11/18/2016, 10:00 AM – 11:30 AM PT

Northwest Green Chemistry

UPCOMING WEBINAR

Northwest Green Chemistry

Green Marine Products: Dock fenders and boat paints

December 7th, 10 AM – 11 AM PT (1 PM – 2 PM ET)

Peter Schrappen (Clean Boating Foundation & NW Marine Trade Association)

Andries Breedt (Breedt Production Tooling & Design)

Amelia Nestler (Northwest Green Chemistry)

Register at www.northwestgreenchemistry.com/upcoming-webinars.html

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Green Chemistry

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Crowdfunding QCATs
TEOS, Dibutyltin

QUICK CHEMICAL ASSESSMENT TOOL

LT - UNK [78-10-4] Silicic acid (H4SiO4), tetraethyl ester

GreenScreen List Translator™ Score - LT-UNK																			
Group I Human					Group II and II* Human										Ecotox		Fate		Physical		Mult*
C	M	R	D	E	AT	ST		N		SnS*	SnR*	IrS	IrE		AA	CA	P	B	Rx	F	
						single	repeated*	single	repeated*												
			UNK		M	M	M					H	H						UNK	M	Mult

TEOS is a versatile form of silicone used as a crosslinking agent, in the manufacture of semiconductor chips, and more. A QCAT could inform future research and development into greener and more sustainable uses of silicone.

LT - P1 [77-58-7] Dibutyltin (dilaurate)

GreenScreen List Translator™ Score - LT-P1																			
Group I Human					Group II and II* Human										Ecotox		Fate		Physical		Mult*
C	M	R	D	E	AT	ST		N		SnS*	SnR*	IrS	IrE		AA	CA	P	B	Rx	F	
						single	repeated*	single	repeated*												
		H		M	vH	vH	H					H	H		vH						Mult

Dibutyltin is an organotin compound uses as a catalyst and as a PVC stabilizer. A QCAT could inform future R&D into greener and more sustainable catalysts for the production of polyurethane and silicone gels and films, and improved stabilizers for PVC.

Other: CoCs to Puget Sound
What are the 17 chemical types?

1. Arsenic
2. Cadmium
3. Copper
4. Lead
5. Mercury
6. Zinc
7. Petroleum-related compounds
   - e.g. gas, diesel, jet fuel, motor oil, hydraulic fluid
8. PDBEs (Polybrominated diphenyl ethers)– flame retardants
9. Phthalates
10. PCBs (Polychlorinated biphenyls)
11. DDT (Dichlorodiphenyltrichloroethane)
12. PCDD/Fs dioxins (polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans)
13. Triclopyr
14. Nonylphenol
15. to 17. PAHs (Polycyclic aromatic hydrocarbons)
    - Low molecular weight, carcinogenic, and other high molecular weight.

http://www.ecy.wa.gov/puget_sound/toxicchemicals/effects.html