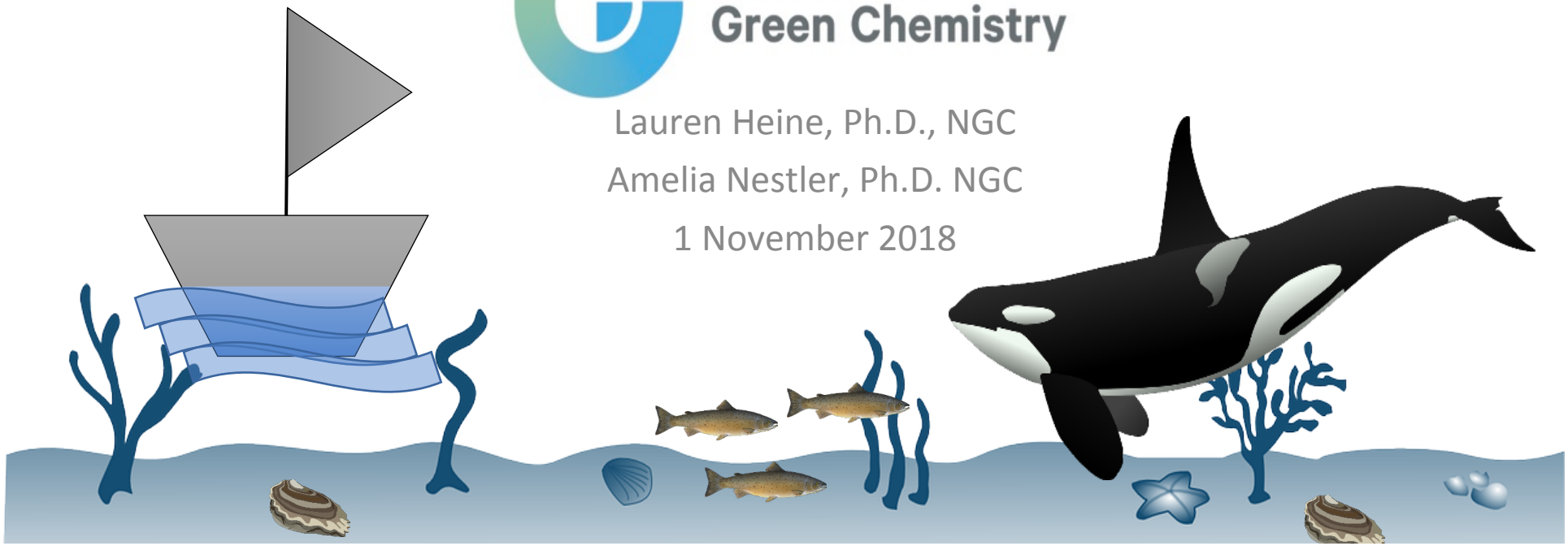
Promising Practices for AA: Perspectives from the bottom of a boat

Northwest Green Chemistry

Lauren Heine, Ph.D., NGC
Amelia Nestler, Ph.D. NGC

1 November 2018



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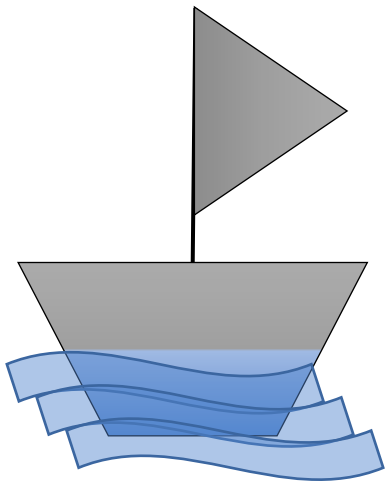
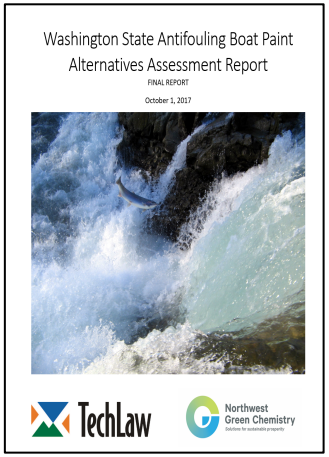
Promising practices and unexpected challenges WA State Antifouling Boat Paint AA

- Scoping
- Performance assessment
- Consumer preference & behavior



State of Washington copper phase-out in recreational antifouling boat paints

- Legislation in Washington calls for a phase-out of copper-based recreational antifouling boat paint
  - Chapter 70.300 RCW, Recreational Water Vessels-Antifouling Paints: http://apps.leg.wa.gov/Rcw/default.aspx?cite=70.300&full=true
  - Called for an alternatives assessment
  - Result
    - Two-year delay to study impacts of biocides and to do modeling work. Now comes into effect January 1, 2021 unless further legislation is passed.
    - Exception for wooden boats



Five steps of an AA Using the IC2 AA Guide: Which Modules?

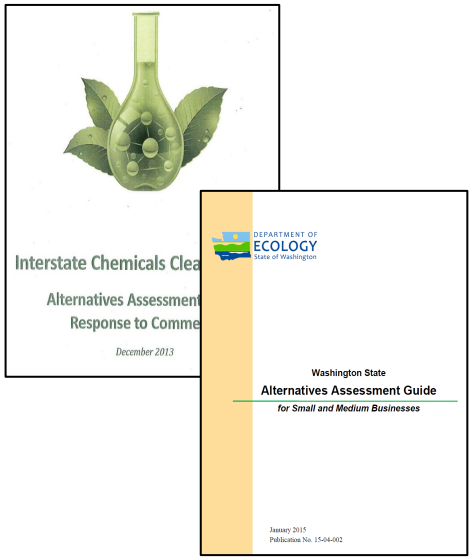
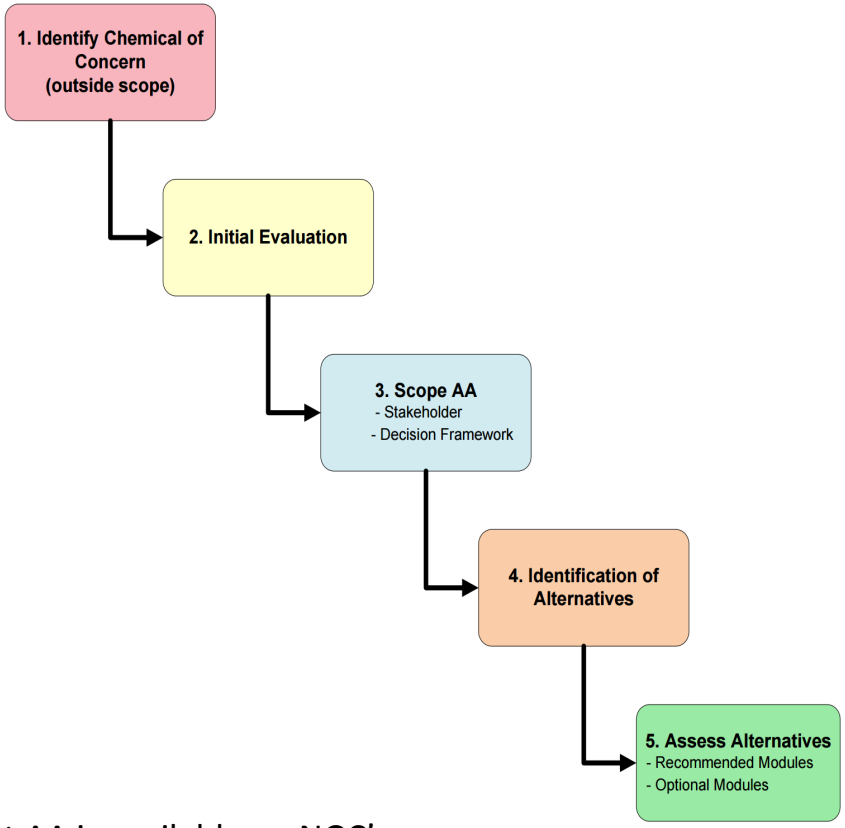


Figure 1: Five AA Steps

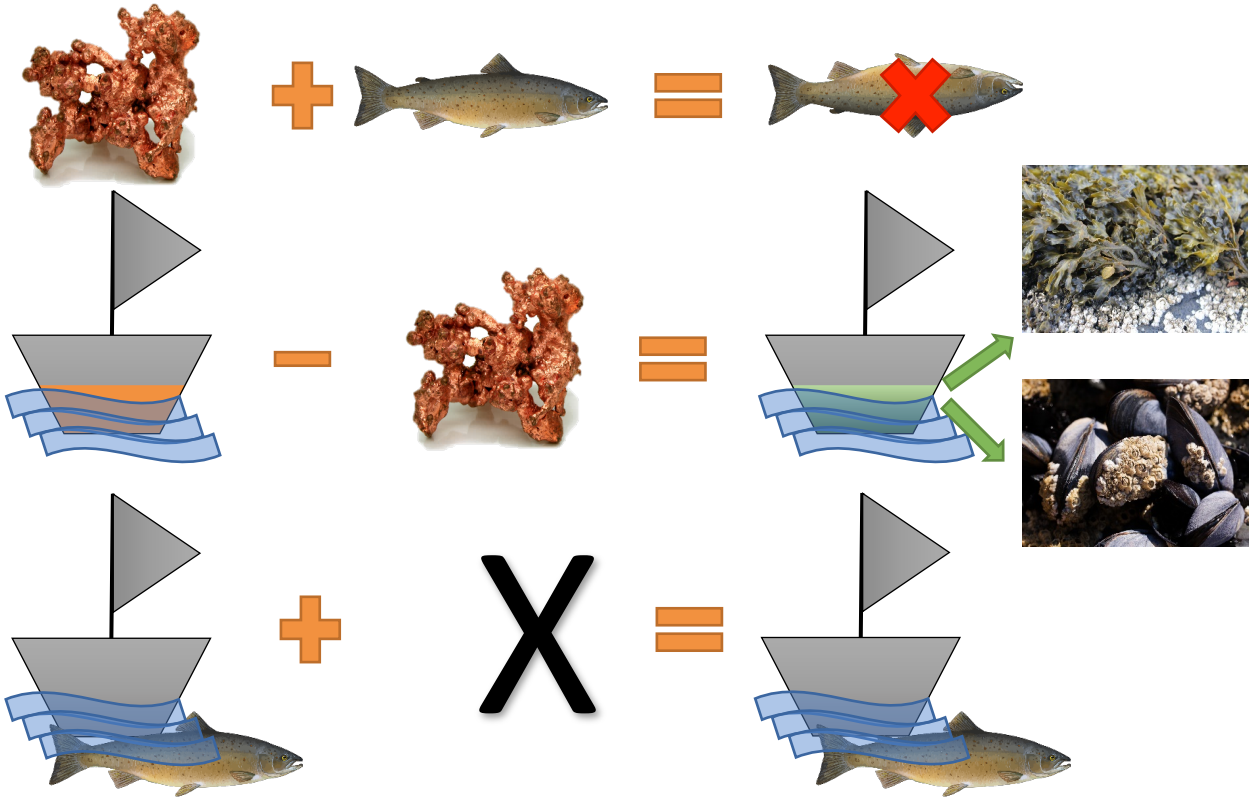


- ***Stakeholder involvement***
- **Hazard**
- **Exposure**
- **Cost & Availability (in WA)**
- **Performance**
- *Materials Management*
- *Social Impact*
- *Life cycle*

Full WA State Antifouling Boat Paint AA is available on NGC's website

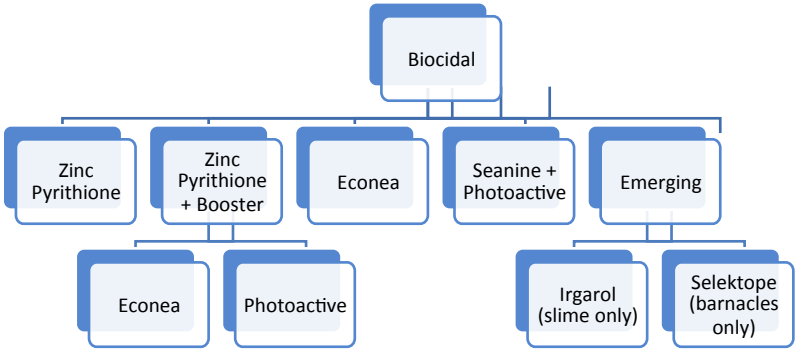
Scoping: Alternatives Assessments (AA) solve for X: WA State Antifouling Boat Paint AA

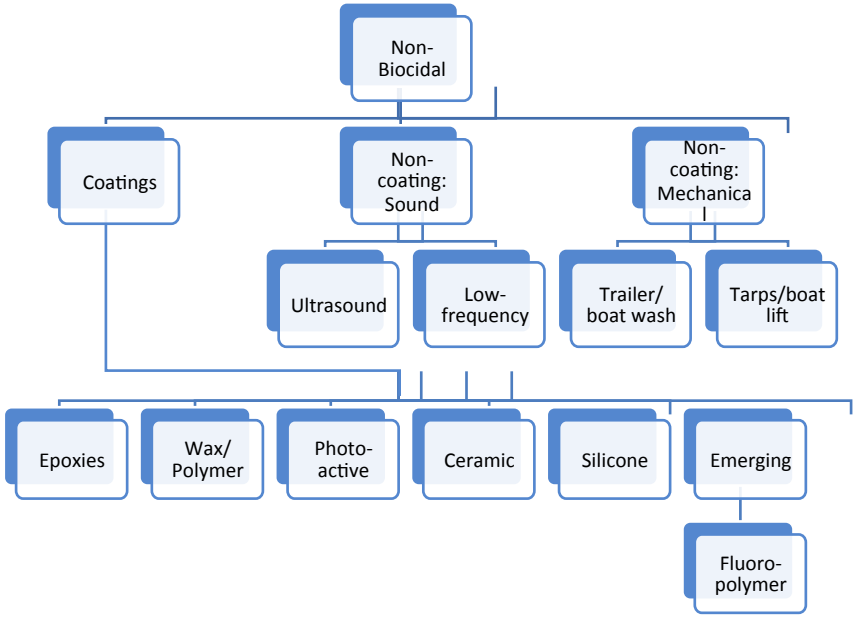
Alternatives Assessment: process for identifying and comparing potential chemical and non-chemical alternatives that can be used as substitutes to replace chemicals or technologies of high concern. (IC2 AA Guide)



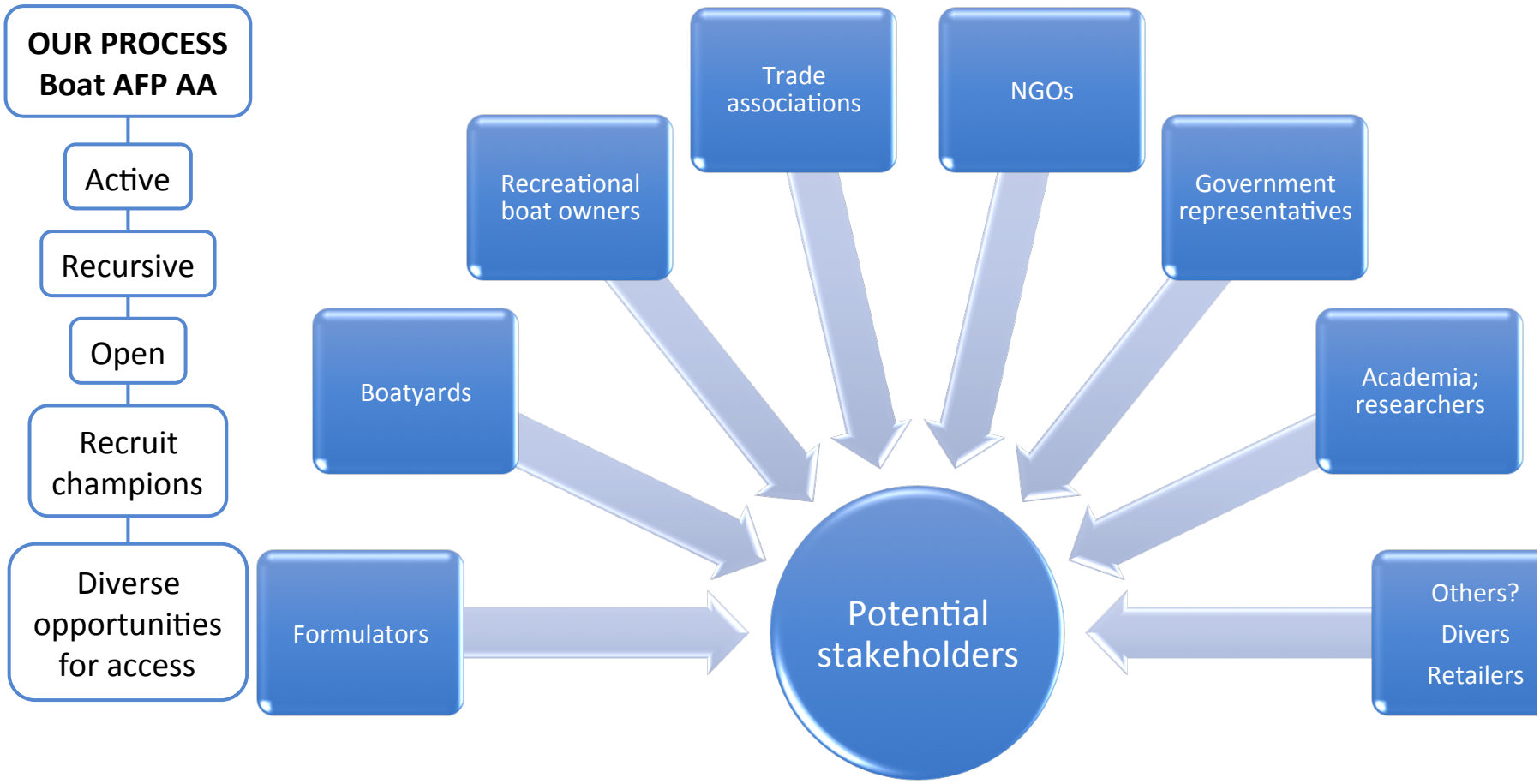
IC2 AA Guide: http://theic2.org/alternatives_assessment_guide

Scoping: which products?

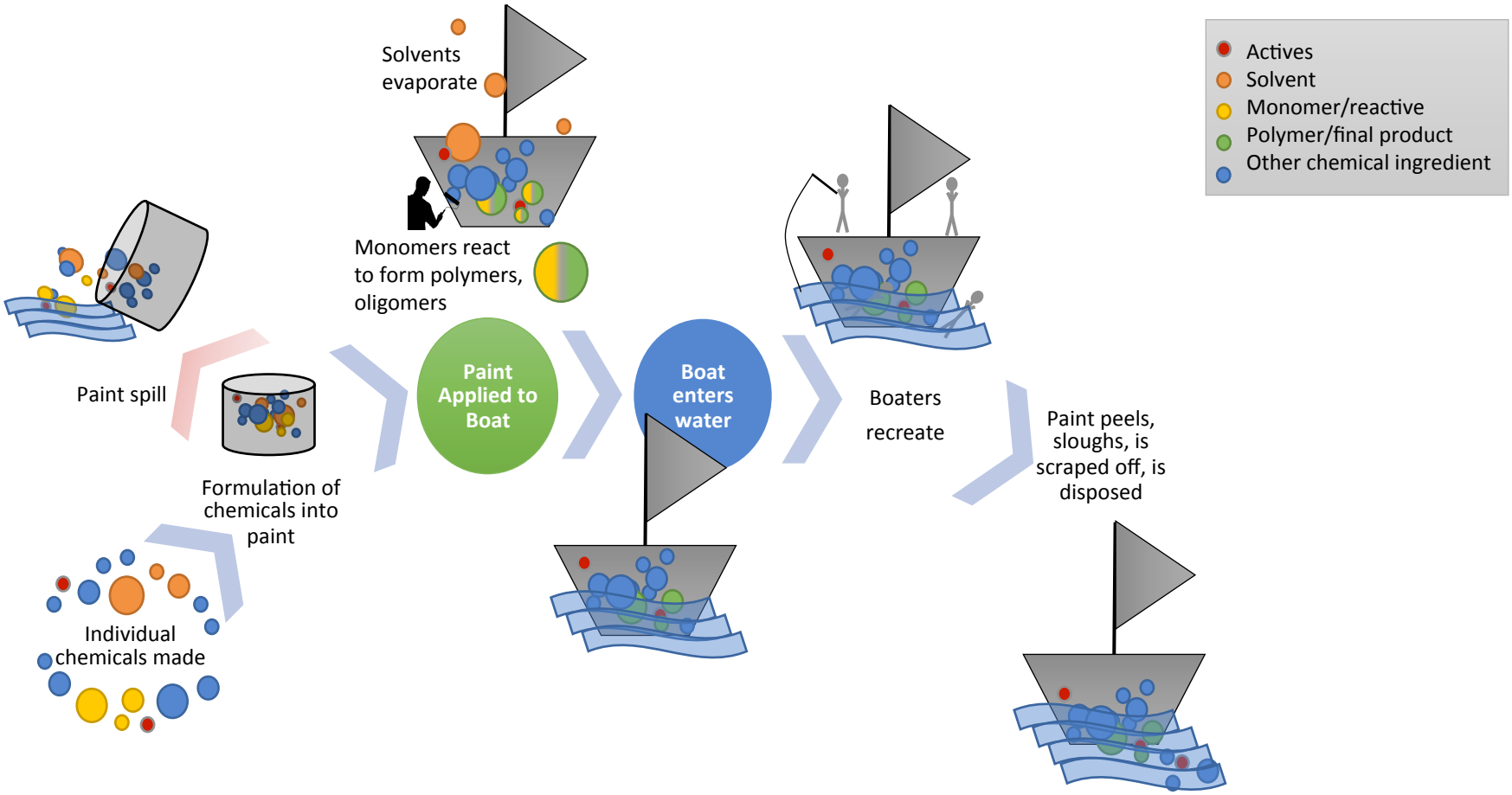




Scoping: which stakeholders?

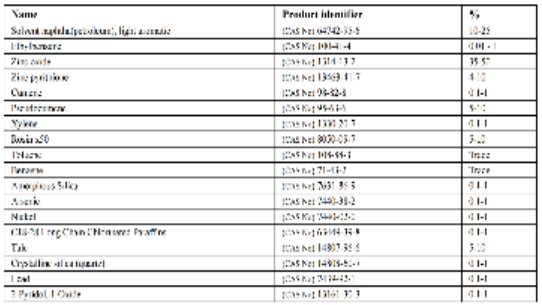


Customizing the modules: which life cycle stages?



Customizing the modules: which hazard traits?

Level of Disclosure → Assess Ingredients for Inherent Hazard → Report



Name	Product identifier	%
Solvent naphtha(petroleum), light aromatic	(CAS No) 64742-95-6	10-25
1,2,4-Trimethylbenzene	(CAS No) 95-63-6	0.01 - 1
Zinc oxide	(CAS No) 1314-13-2	35-55
Zinc phosphate	(CAS No) 13463-41-7	5-10
Quartz	(CAS No) 14808-60-7	0.1-1
Pseudocumene	(CAS No) 95-63-6	5-10
Xylene	(CAS No) 1330-20-7	0.1-1
Basalt	(CAS No) 8012-95-1	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
Chlorinated Long Chain Hydrocarbon Paraffin	(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

Pharos

GREEN SCREEN FOR SAFER CHEMICALS

QUICK CHEMICAL ASSESSMENT TOOL

toxnot PBC

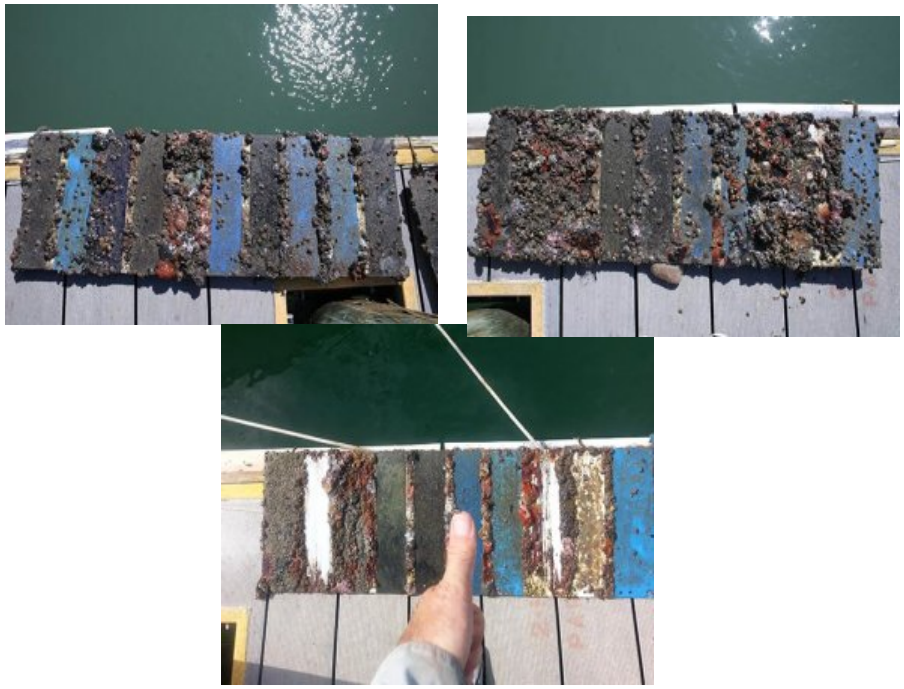
Supplemental Research

Disclosure Level

% Chronic Human (CMRDEs)
% Neuro/Respiratory

% PBTaq combos
% Puget Sound CoCs
% Boatyard CoCs
VOC Content

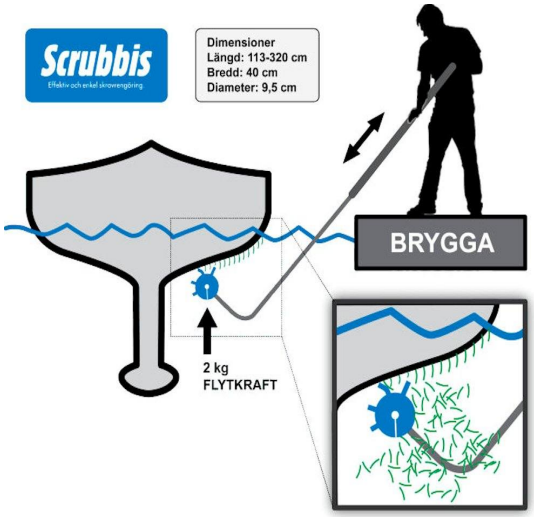
Understanding performance



https://www.practical-sailor.com/blog/Barnacles-Consume-Test-Panels-at-18-Months-11646-1.html
https://www.mby.com/maintenance/tried-tested-antifoul-81351

Safer alternatives and adoption: different test methods and practices may be necessary

Effectiveness of maintenance methods



Dynamic versus static tests will be necessary

https://www.boatandboats.com/magazine/stoppani-antifouling-paints.html
https://marinestore.co.uk/SCRUBBIS_HULL_CLEANING_TOOL.html

Consumer preference and behavior: moving away from biocidal antifouling coatings?

May be easier to go to Oregon or Canada to get favorite paints than to switch

Disruptive alternatives like a boatwash require coordination at the marina level or beyond

Poorly understood impacts of widespread adoption of sound and light technologies

Challenges with transitioning between coating types: Complete scrub down and removal of old coating.

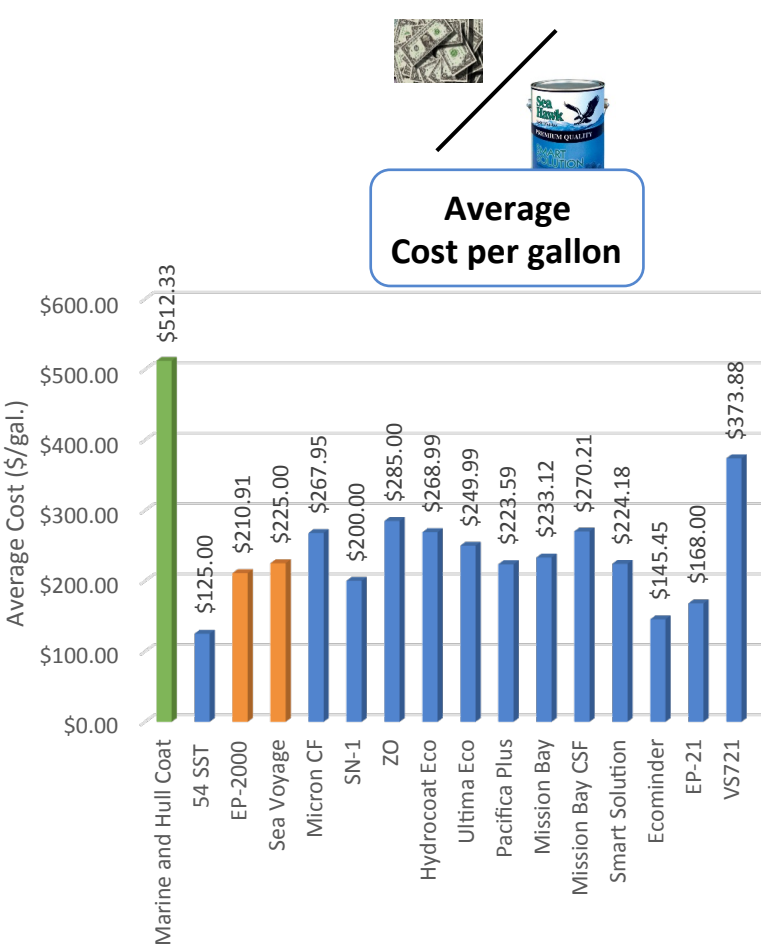
https://330dustlessblasting.com/hull-cleaning-service/

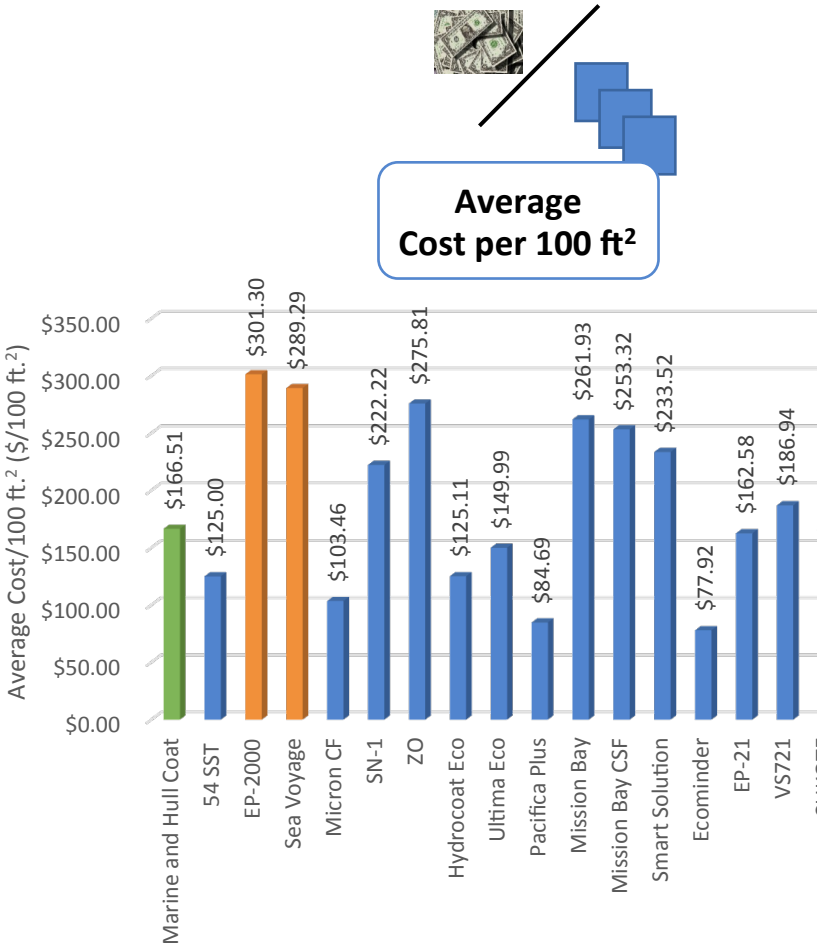
By NASA - http://spaceflight.nasa.gov/gallery/images/station/crew-35/html/iss035e017335.html

http://driveinboatwash.com/en/

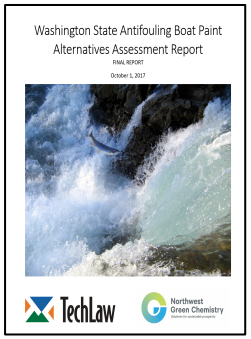
https://www.hotfrog.com.au/business/qld/bribie-island/barnacle-guard-australia_1480088

Consumer preference and cost





Consumer preference and decision support: Selection Guide approach

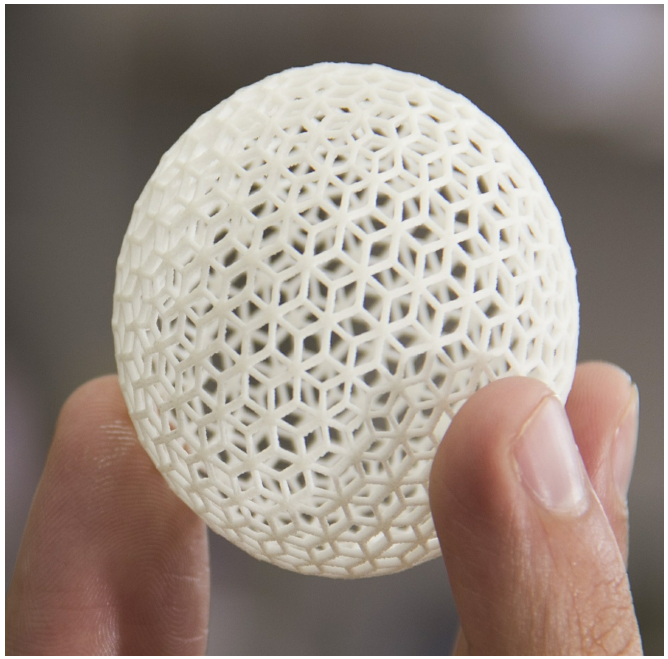


- IC2 AA Guide includes sequential, simultaneous, and hybrid decision frameworks
- No one-size-fits-all solution
  - Hull type
  - Recreational user type
  - Waters travelled
  - When can cost be absorbed
- Solution: Selection Guide
  - Eliminate ‘showstoppers’
  - Think Consumer Reports
  - Who will decide?

Product Information				Hazard								Cost			Performance	Exposure								
Product Identity			General	Human Hazard		Biocide				Environment		Regulatory		Initial/DIY		Cumulative	Assumes manufacturer longevity	Longevity		Gallons to cover 100 ft²			Grams Biocide to cover 100 ft²		Fate		Grams VOCs to cover 100 ft²	
Company	Product	Mechanism	Disclosure	Chronic human (CMRDE)	Neuro/ Resp	Biocide	Amount	Persistence	Bioaccumulation	PBTsq combos	Puget Sound CoCs	Boatyard CoCs (Zn)	VOC content (g/L)	Per gallon	Per 100 ft²	15' boat over 5 years	Overall Recommendation	Manufacturer longevity (years)	# of applications over 5 years	Initial (gallons)	5 year (gallons)	Biocide	Initial (grams)	5 years (grams)	Leach (Y/N)	Abate (Y/N)	Initial (grams)	5 years (grams)
Coval	Marine and Hull Coat	Foul release, ceramic	Full	0%	0%	none	0%	-	-	0%	0%	0%	< 100	$512.33	$166.51	$6,019.44	Data Gap / further testing needed	5	1	0.3	0.3	N	0	0	N	N	< 123	< 123
CeRam-Kote	54 SST	Foul release, ceramic	SDS	26% - 53%	0%	none	0%	-	-	0%	0%	0%	< 197	$125.00	$125.00	$5,871.25	Data Gap / further testing needed	5	1	1.0	1.0	N	0	0	N	N	< 746	< 746
ePaint	EP-2000	Photoactive and Biocidal, ZnPy	Full	5% - 10%	5% - 5%	ZnPy	4.8%	*H*	**vL**	35% - 45%	29% - 38%	29% - 37%	< 100	$210.91	$301.30	$25,921.28	Likely to meet expectations	3	2	1.4	2.9	Y	6.9	13.7	Y	Y	< 541	< 1083
Sherwin Williams	Sea Voyage	Biocidal, ZnPy and Econea	Full	9% - 9%	37% - 37%	ZnPy / Econea	6.4% / 7.35%	*H / H*	**vL / vL**	27% - 27%	32% - 32%	23% - 23%	< 340	$225.00	$289.29	$25,835.49	Likely to meet expectations / further testing needed	3	2	1.3	2.6	Y	17.7	35.3	Y	Y	< 1654	< 3308
Interlux	Micron CF	Biocidal, ZnPy and Econea	SDS Plus	1% - 16%	9% - 18%	ZnPy / Econea	4.12% / 3.9%	*H / H*	**vL / vL**	21% - 61%	19% - 47%	9% - 21%	330	$267.95	$103.46	$24,508.67	Likely to NOT meet expectations	3	2	0.4	0.8	Y	3.1	6.3	Y	Y	487	974
ePaint	SN-1	Photoactive and Biocidal, Seanine	Full	11% - 34%	11% - 11%	Seanine	2.9%	**L**	*vL*	20% - 50%	17% - 41%	16% - 40%	< 400	$200.00	$222.22	$11,094.98	Meets expectations	2	3	1.1	3.3	Y	3.2	9.7	Y	Y	< 1681	< 5042
ePaint	ZO	Photoactive and Biocidal, ZnPy	Full	6% - 20%	16% - 16%	ZnPy	4.8%	*H*	**vL**	35% - 50%	32% - 51%	29% - 41%	< 400	$285.00	$275.81	$28,368.89	Borderline	2	3	1.0	2.9	Y	4.7	14.0	Y	Y	< 1469	< 4406
Pettit	Hydro-coat ECO	Biocidal, ZnPy and Econea	Full	<0.5%	11% - 11%	ZnPy / Econea	4.8% / 6%	*H / H*	**vL / vL**	9% - 14%	5% - 6%	5% - 6%	< 150	$268.99	$125.11	$26,754.93	Borderline	2	3	0.5	1.4	Y	5.1	15.2	Y	Y	< 267	< 801
Pettit	Ultima ECO	Biocidal, ZnPy and Econea	Full	14% - 27%	45% - 49%	ZnPy / Econea	4.8% / 6%	*H / H*	**vL / vL**	13% - 23%	13% - 28%	6% - 8%	320	$249.99	$149.99	$27,021.39	Likely to NOT meet expectations	2	3	0.6	1.8	Y	6.5	19.4	Y	Y	727	2180
Interlux	Pacifica Plus	Biocidal, ZnPy and Econea	SDS Plus	10% - 26%	8% - 8%	ZnPy / Econea	4.12% / 3.9%	*H / H*	**vL / vL**	11% - 41%	10% - 32%	9% - 21%	330	$223.59	$84.69	$26,322.03	Borderline	2	3	0.4	1.1	Y	3.0	9.1	Y	Y	475	1424
SeaHawk	Mission Bay	Biocidal, ZnPy	SDS	11% - 31%	14% - 24%	ZnPy	3.8%	*H*	**vL**	35% - 53%	39% - 68%	29% - 42%	298	$233.12	$261.93	$28,220.27	Likely to meet expectations	2	3	1.1	3.4	Y	4.3	12.8	Y	Y	1263	3790
SeaHawk	Mission Bay CSF	Biocidal, ZnPy	SDS	<0.5% - 3%	4% - 4%	ZnPy	4.02%	*H*	**vL**	35% - 52%	29% - 43%	29% - 42%	150	$270.21	$253.32	$28,128.06	Does NOT meet expectations	2	3	0.9	2.8	Y	3.8	11.3	Y	Y	534	1601
SeaHawk	Smart Solution	Biocidal, Econea	SDS	10% - 30%	18% - 28%	Econea	2.9%	*H*	**vL**	<0.5% - 2%	10% - 26%	0%	328	$224.18	$233.52	$27,915.95	Borderline	2	3	1.0	3.1	Y	3.0	9.0	Y	Y	1291	3874
ePaint	ECO-MINDER	Photoactive and Biocidal, ZnPy	Full	<0.5%	5% - 5%	ZnPy	4.8%	*H*	**vL**	20% - 50%	17% - 41%	17% - 41%	< 10	$145.45	$77.92	$30,095.87	Meets expectations	1	5	0.5	2.7	Y	2.6	12.8	Y	Y	< 20	< 101
ePaint	EP-21	Photoactive foul release	Full	15% - 17%	15% - 15%	none	0%	-	-	20% - 60%	19% - 27%	4% - 12%	< 399	$168.00	$162.58	$31,607.05	Likely to meet expectations	1	5	1.0	4.9	N	0	0	N	N	< 1465	< 7325
Aurora Marine	VS721	Foul release, polymer/wax	SDS	0%	0%	none	0%	0	0	0%	10% - 25%	0%	unlisted	$373.88	$186.94	$15,341.88	Likely to NOT meet expectations / further testing needed	1	5	0.5	2.5	N	0	0	N	Y	unlisted	unlisted
Coatings for outdrives/running gear Coverage area calculations assume use of 1 kit per application																												
Oceanmax	Prop-	Foul release,	SDS	10% -	0%	none	0%	-	-	0%	0%	0%		$529.99	-	-	Likely to	1	5	0.26	1.59	N	0	0	N	N	unlisted	unlisted

Questions for the AA community

- Will AAs drive adoption of safer alternatives?
- How will AAs drive innovation?
- When is full disclosure necessary?
- Are selection guides preferable to the prescribed decision frameworks?



Thank you!

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lheine@northwestgreenchemistry.org
Amelia Nestler, Ph.D.
anestler@northwestgreenchemistry.org