

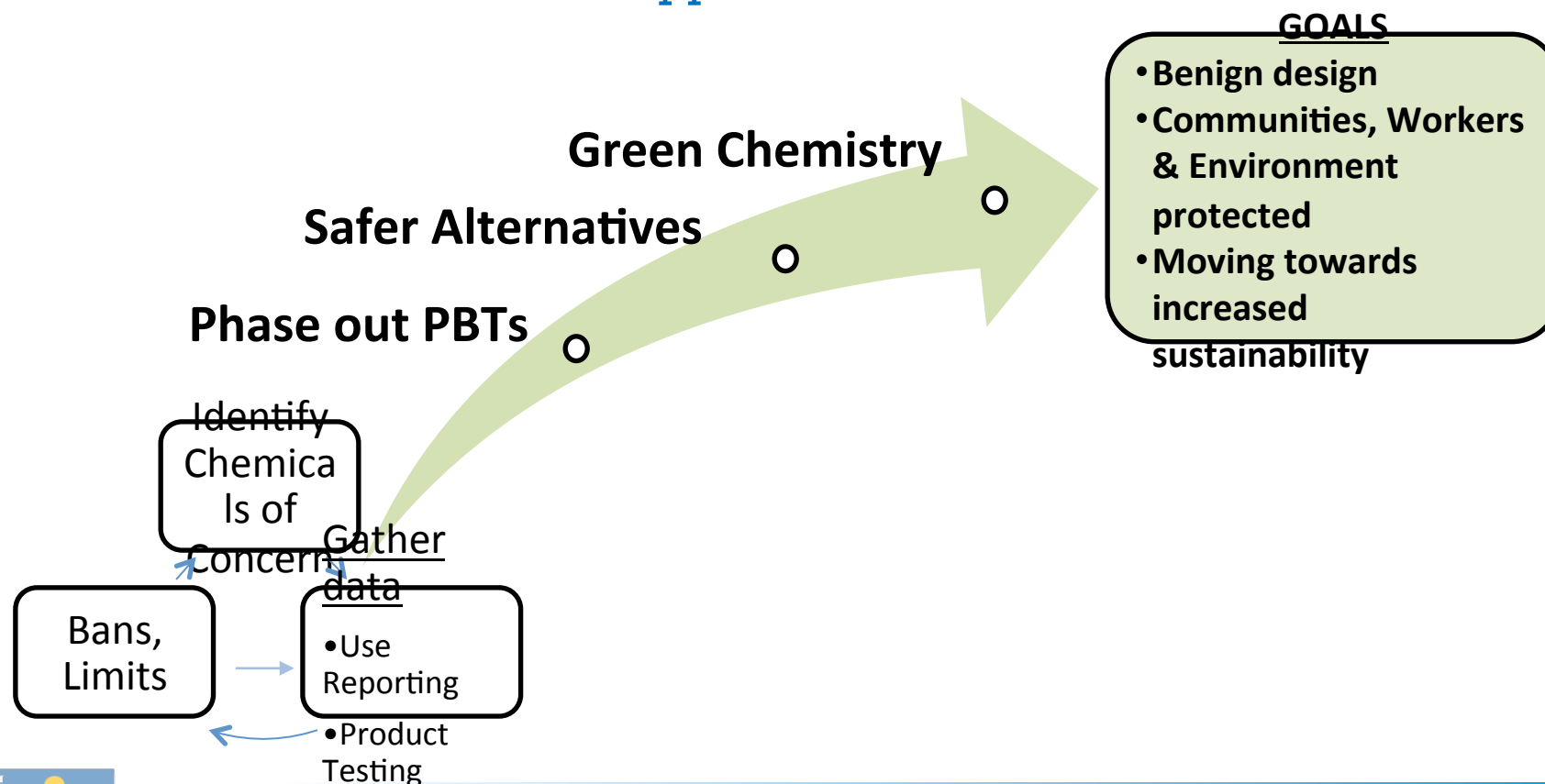
Alternatives Assessment at Ecology

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1 November 2018



Preventing & Reducing Toxic Threats

Averting toxic exposure is the smartest, cheapest, and healthiest approach!



Ecology Experience with AAs

- 2004-08 Ecology/Health directed to investigate/reduce PBDEs.
 - Mix of Executive Order & state law ([RCW 70.76](#)).
 - AA focus on decaBDE.
- Policy: 2006 PBT Rule & Chemical Action Plans ([WAC 173-333-420](#)).
 - Directs investigation of substitutes & promotion of safer alternatives.
- 2014 Alternatives to Copper Antifouling Paint.
 - Pilot of the IC2 Alternatives Assessment Guide v1.0 (ToxServices).
- 2017 WA Antifouling Boat Paint Alternative Assessment.
 - Northwest Green Chemistry & TechLaw.
- 2018-19 PFAS in Food Packaging (currently in process).



2008 decaBDE AA

- Culmination of a decade of work worldwide (abundant DATA).
- Experience with the multicriteria decision challenge.
- Incorporating life-cycle thinking

Final PBDE CAP
January 19, 2006

Table 12. Summary of use, persistence, bioaccumulation potential and toxicity information for Deca-BDE and Deca-BDE alternatives.

Deca and Alternative	Product name	Use	Reactive or Additive	Human Health Effects						PBT			
				Cancer hazard	Non-cancer effects	Mutagenicity	Acute or chronic	ADAM Bio-toxicity	Information on potential routes of exposure		Persistence	Bioaccum. Potential	
Halogen-containing													
1	Decabromodiphenyl ether (Deca-BDE) (CAS# 1163-19-3)	SAVTEX 102E, DIELIR	HIPS	Additive	L	M	L	L,H	M,H	Yes	Yes (ortho)	Yes	Yes
2	Bis(pentafluorophenyl) ether (CAS# 14833-31-9)	SAVTEX 8010, Firemaster 1100	HIPS, ABS, PC, ABS	Additive	L	L	L	L	L	Yes	NI (diab)	NI	No
3	1,2-bis(pentafluorophenyl) ether (CAS# 13188-76-4)	SAVTEX BT 93 and BT-93U	HIPS, ABS, PC, ABS	Additive	L	L	L	L	L	NI	NI (diab)	NI	No
4	Tetrahydrophthalon A epichlorohydrin polymer (brominated epoxy resin) (CAS# 40209-81-8)	EPON Resin 1165, SYARON	RPS, Polyurethane	?	NI	L (ND)	L (ND)	NI	L	NI	NI	NI	NI
5	Bis(trifluoromethyl) ether (CAS# 37831-79-1)	FF-680	Mainly ABS	Additive	L	L	L	L,M	L	NI	Yes	Yes	No
6	Hexafluoroisobutylene (HFBI) (CAS# 3194-51-6 and 15637-89-4)	SAVTEX HP 900, 900L, SP-5, CDE-7P	Polyurethane foam	Additive	L (ND)	NI	L	L,H	L	Yes	Yes	Yes	Yes
7	Tetrahydrophthalon A (THBPA) (CAS# 78-84-3)	SAVTEX CP, 2000, BA-29P	ABS, HIPS	Additive	L	M	L	M,H	M	Yes	Yes	Yes	Yes
8	Tetrahydrophthalon A bis(2,3-dibromopropyl ether) (CAS# 11830-44-2)	SAVTEX HC 800A, 800AG, PE-88, 403AF	Polypropylene	Additive	M	L	H	NI	L	NI	NI	Yes	NI
Non-halogen													
9	Resorcinol bis (diphenylphosphate) (DPP) (CAS# 57583-54-7 and 115997-21-9)	Fyralite2DP, Resolin RDP	HIPS, PPO, PC, ABS	Additive	NI	L	L	M,H	L	NI	No	No	No
10	Bisphenol A diglycidyl ether (BADGE) BPADP or Bisphenol A bis(diphenyl phosphate) (BDP) (CAS# 110121-79-5 and 3945-33-7)	Resolin BA-PP, FyraliteBDP, NovacX F-30	HIPS, PPO, PC, ABS	Additive	NI	L	L	L,M	L	NI	Yes	NI	NI
11	Diphenyl ether phosphate (DCEP) (CAS# 16444-49-5)	Novatec CDP, Phosden CDP	Maybe HIPS, PPO	Additive	NI	M	L	M,H	L,M	Yes	Yes	Yes	Maybe (NI)
12	Tripentyl phosphate (TPP) (CAS# 111-86-6)	Resolin TPP, Phosden TPP	HIPS, PPO, PC, ABS	Additive	L	L,M	L	M,H	L,M	Yes	No	No	No
Related chemicals													
13	Zinc Borate (CAS# 1321-07-6)	Fenbrake ZB-401, -312, -237, -100	Systemic fire use in HIPS, anti-drip agent	Additive	NI	L	NI	M,H	L	Yes	NI	NI	NI (no-DBP)
14	Polytetrafluoroethylene (PTFE) (CAS# 8001-82-6)	Teflon	anti-drip agent	?	NI	H	NI	NI	M	Yes (if heated)	NI	NI	NI
15	Antimony trioxide (CAS# 1309-64-6)	TB65/Tmaxco Red Star	Systemic w/ HIPS	Additive	L,M	L	M,H	L,M	M,H	Yes	NI	NI	Maybe (NI)

2006 WA ad hoc assessment of hazards

Table 3: Excerpted from Table 5 in The Green Screen, Evaluating Flame Retardants for TV Enclosures (Clean Production Action, 2007).

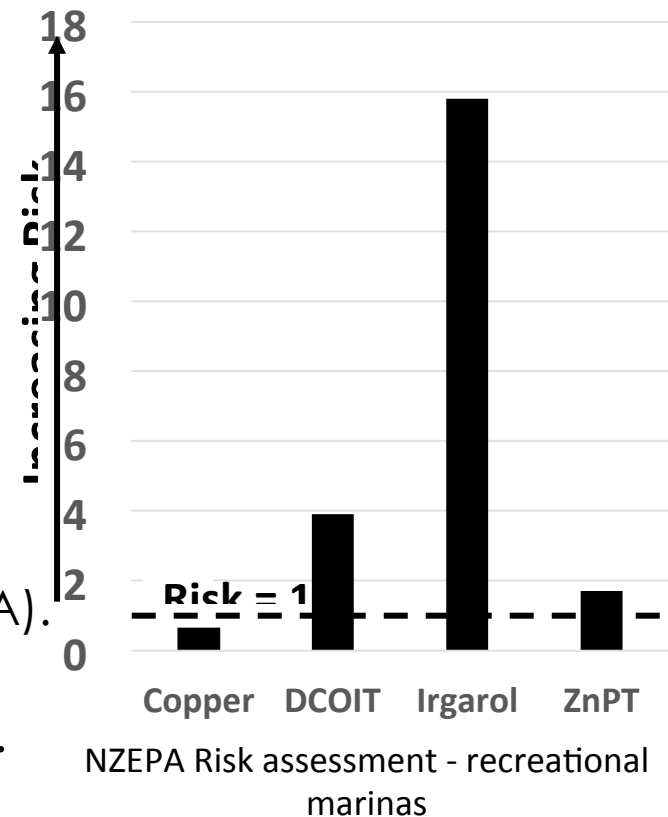
	CAS #	% in formulation	Human health effects													
			carcinogen	mutagen	reproductive toxicity	developmental toxicity	endocrine disruption	neurotoxicity	acute toxicity	systemic toxicity	skin sensitivity	respiratory sensitivity	skin irritation	eye irritation	immune system	
Chemical (Flame retardants)																
RDP Mixture (mixture of following 3 components)	125997-21-9															
RDP (Resorcinol bis(diphenylphosphate))	65-80	57583-54-7	L	L	L	L	L	ND	L	L	M	L	ND	L	M	L
Phosphoric acid bis [3-[(diphenylphosphoryl)oxy]phenyl] phenyl ester	15-30	98165-92-5	L	L	L	L	L	ND	L	L	M	L	ND	L	M	L
TPP (Triphenylphosphate)	<5	115-86-6	L	L	L	L	L	ND	L	L	M	L	ND	L	M	L
Breakdown products:																
Phenol	108-95-2		L	M	L	L	L	L	M	M	H	L	L	H	H	M
Resorcinol	108-46-3		L	L	L	L	L	M	M	M	ND	M	ND	M	M	ND
Diphenylphosphate (DPP)	838-85-7		Insufficient Data													
deca-BDE	97	1163-19-5	M	L	L	M	M	M	L	L	L	L	ND	L	L	ND
penta-BDE		32534-81-9	ND	L	M	M	M	H	M	L	H	L	L	M	M	ND
octa-BDE		32536-52-0	ND	L	M	H	M	M	L	H	L	L	ND	L	L	ND

2008 GreenScreen (Clean Production Action)



2017 Alts to Copper Antifouling (NGC)

- 2011 WA bans copper in AF paint.
 - Effective for new vessels 1/1/2018.
 - No requirement for alternatives assessment.
- 2017 NGC assessment of alternatives.
 - Challenge of assessing performance.
 - What's sufficient to assess "impact"?
- Limited innovation/new products.
 - Washington State a small market.
 - AF paints are registered pesticides (FIFRA).
- 2017 Ecology requests delay in ban to further consider impact of alternatives.



2018-19 PFAS Food Packaging AA

- 2018 Legislature bans PFAS in food packaging.
 - PFAS is banned as a CLASS.
 - Ban effective when Ecology identifies safer alternatives.
 - Specifies use of Interstate Chemicals Clearinghouse Guide.
- RCW 70.95G definitions & criteria specify “safer alternatives”:
 - Meet improved hazard & exposure considerations.
 - Be practicably & economically substituted.
 - Readily available in sufficient quantity & at comparable cost.
 - Perform as well as or better than PFAS.
- No allowance for tradeoffs!



Summary

- We still struggle with multicriteria decisions.
 - But we have tools that help, like GreenScreen.
 - Hazards of mixtures (i.e., products) – another multicriteria decision.
 - Legislatures can help 😞
- We have a strong tendency to undercomplexification.
 - Oversimplification serves many masters – resist!
- Little experience going beyond the four (hazard, performance, cost and exposure).
- Policy - Don't ban without an accompanying AA.
- Need for model legislation?

