



Lowell Center for Sustainable Production

UNIVERSITY OF MASSACHUSETTS LOWELL

Alternatives Assessment 113 Webinar:

Addressing Trade-offs in Alternatives Assessment Processes



JUNE 11, 2013

FACILITATED BY: JOEL TICKNER, SCD

JOEL_TICKNER@UML.EDU
LOWELL CENTER FOR SUSTAINABLE PRODUCTION,
UMASS LOWELL

** If you would like to ask a question or comment during this webinar please type your question in the Q&A box located in the control panel.*

Goals



Lowell Center for Sustainable Production
UNIVERSITY OF MASSACHUSETTS LOWELL



- Continuing education and dialog
- To advance the practice of alternatives assessment for informed substitution across federal, state, and local agencies through networking, sharing of experiences, development of common approaches, tools, datasets and frameworks, and creation of a community of practice.

Purpose of this call



Lowell Center for Sustainable Production
UNIVERSITY OF MASSACHUSETTS LOWELL



- Policies to restrict a chemical of concern to a particular population or media may result in substitutions that shift the risks to another population or media (even at different phases of a lifecycle).
- Lack of communication/coordination of government agencies that regulate different media or stages of a supply chain can enhance this challenge.
- Chemical restriction policies often focus on avoiding chemicals on lists of chemicals of concern and fail to consider how chemical changes may change process chemistries, work practices, or exposure patterns, possibly leading to “uninformed substitution”.
- By focusing on elimination of chemicals of concern, such efforts often fail to consider the “functional use” of the chemical.

Purpose of this call



- Examples abound where well-intentioned policies have led to trade-offs, without clear guidance, plans, or requirements to evaluate alternatives.
- Alternatives assessment is a critical element of informed substitution – a considered transition from chemicals of concern to less hazardous alternatives.
- We will explore the challenges of addressing possible unintended consequences in substitution decisions, discuss the distinction between real and hypothetical risk trade-offs, and outline approaches for identifying and minimizing unintended consequences of safer chemicals decisions from a manufacturing, product, and lifecycle perspective.

Speakers



Lowell Center for Sustainable Production
UNIVERSITY OF MASSACHUSETTS LOWELL



- Adam Finkel, UMDNJ School of Public Health
- Kathy Hart, US EPA
- Ann Blake, Environmental and Public Health Consulting



Discussion Questions



- How can one distinguish between real and hypothetical risk trade-offs in chemical substitution decisions?
- What are some tools decision-makers can use to more thoughtfully consider potential unintended consequences in chemical substitution decisions?
- How can agencies more effectively collaborate to avoid risk shifting in chemicals decision-making?



Webinar Discussion Instructions



- Due to the number of participants on the Webinar, all lines will be muted.
- If you wish to ask a question, please type your question in the Q&A box located in the drop down control panel at the top of the screen.
- All questions will be answered at the end of the presentations.

Distinguishing Bogus Tradeoffs from Real Ones, and Acting Accordingly

U-Mass Lowell Webinar—
*Alternatives Assessment 113: Addressing Trade-offs in
Alternatives Assessment Processes*
June 11, 2013

Adam M. Finkel, Sc.D., CIH

Executive Director, Penn Program on Regulation, University of Pennsylvania Law School
Professor of Environmental and Occupational Health, UMDNJ- School of Public Health
(Director of Health Standards, OSHA (1995-2000); Regional Administrator (2000-2004))

afinkel@law.upenn.edu

Five Themes for this Talk:

1. To assess the net risk from a risk-reducing action that might have other consequences, you need to be able to distinguish the real from the “opportunistic” (a.k.a. bogus) trade-offs;
2. When we (OSHA) regulated methylene chloride circa 1997, we were treated to a smorgasbord of false claims of adverse substitution;
3. But ironically, the one *truly* perverse consequence was one that no one anticipated at the time;
4. In general, it’s hard to compare alternatives sensibly without quantifying uncertainty in risk (and in cost);
5. A “solution-focused” decision framework allows society to ask bolder and more ambitious questions than “which substance is least risky?”



bo·gos'ity

***n.* the state or
condition of being
bogus**

Landmark Risk-versus-Risk References:

- Ralph Keeney and Detlof von Winterfeldt, “Why Indirect Health Risks of Regulations Should be Examined.” *Interfaces*, **16**: 13-27 (1986).
- John Graham and Jonathan Wiener, eds, **Risk Versus Risk: Tradeoffs in Protecting Health and the Environment**. Harvard Univ. Press, 1995.
- Cass Sunstein, “Health-Health Tradeoffs.” *Univ. of Chicago Law Review*, **63**: 1533-71 (1996).
- Jonathan Wiener. “Managing the Iatrogenic Risks of Risk Management.” *RISK: Health, Safety & Environment* **9**: 39-82 (1998).
- Samuel Rascoff and Richard Revesz, “The Biases of Risk Tradeoff Analysis: Towards Parity in Environmental and Health-and-Safety Regulation.” *Univ. of Chicago Law Review*, **69**: 1763-1836 (2002).

Graham-Wiener Typology, with Examples:

Risk

Same Type

Different Type

Population

Same

Risk Offset

stronger car roofs
(reduce severity, increase
(?) probability of a rollover)

Risk Substitution

chlorination/cholera

Different

Risk Transfer

**intermedia pollutant
transfers**

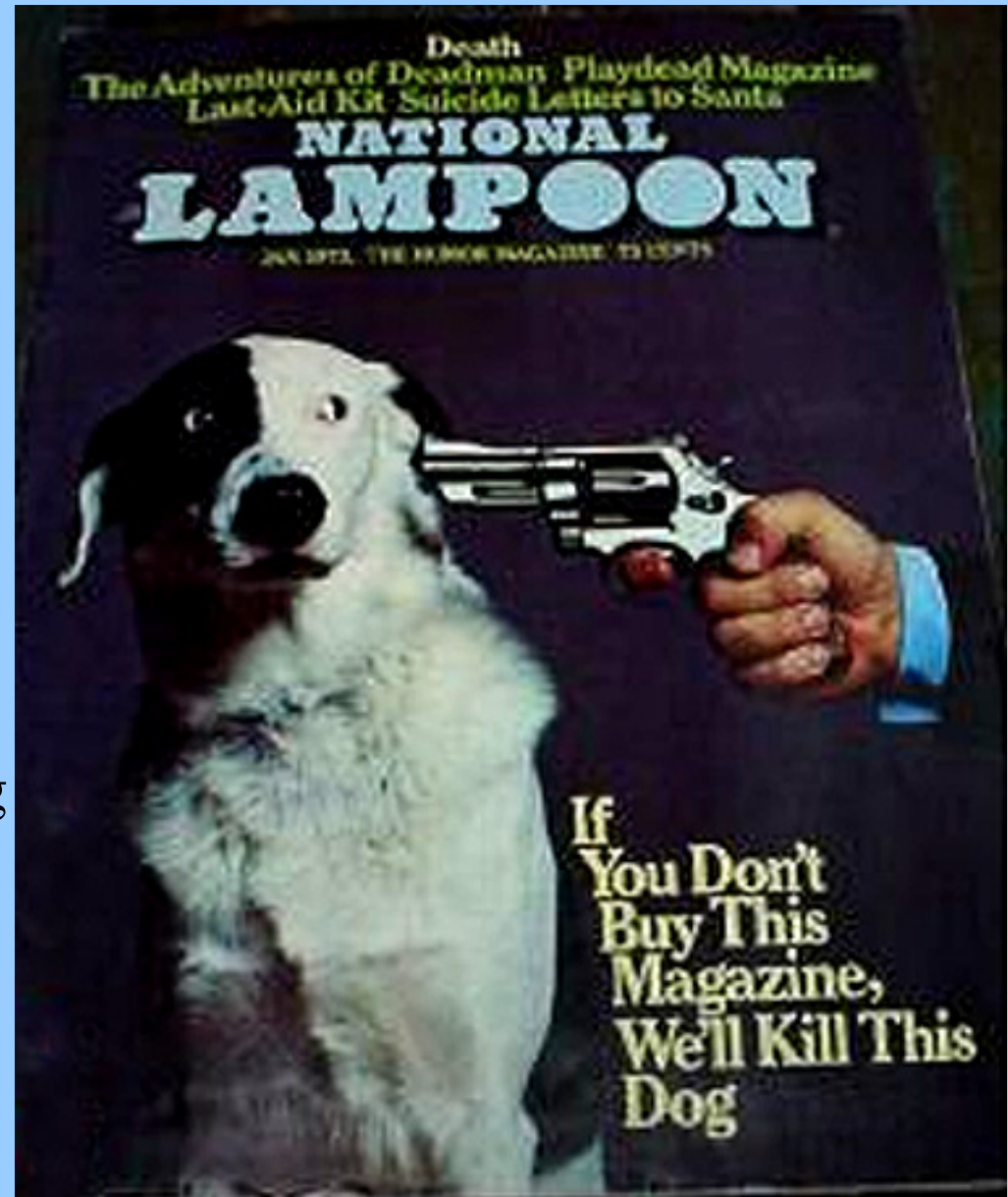
Risk Transformation

CAFE standards/ crashes

(Jan. 1973)

“If you don’t allow us to spray methylene chloride all over our plants, we’ll switch to a flammable substitute and play with matches”

(46 accidents in U.S. involving acetone between 1990 and 2004— **none** in MC-using applications; overall rate has gone **down** since MC rule)



Hindsight: Patterns of Risk-Risk Interactions

Secondary risk is *de minimus* under business-as-usual (BAU) or the intervention (“sham tradeoffs”):

- **acetone substituted for MeCl_2 ?**
- **aircraft not airworthy after repainting?**

Secondary risk is large under either BAU or the intervention (“risk inevitability”):

- **Peru’s experience with water chlorination?**
- **Truck driver fatalities moving goods or moving dirt?**

Primary risk small under BAU (“risk overkill”):

- **upholstered furniture fires?**

Hindsight: Patterns of Risk-Risk Interactions (cont.)

Primary intervention can be calibrated to minimize secondary risk increase:

- **third-generation airbags?**

Primary intervention can be targeted to vulnerable subgroup:

- **warnings about Hg in fish?**

Primary intervention motivates secondary intervention(s):

- **substitute inks in shower curtain manufacture**
- **Omega-3 supplements?**
- **concurrent exposure limits on MeCl_2 and 1-bromopropane**

Hierarchy of Risk-Risk Effects, From Most to Least Compelling

(from A.M. Finkel, Chapter 7 in **Does Regulation Kill Jobs?**,
Univ. of Pennsylvania Press, forthcoming Sept. 2013)

Amount of Attenuation

Example

Inherent and Inevitable	Ground-level ozone (controls will reduce respiratory risk but increase skin cancer risk)
Adverse substitution that is hard to avoid	More fuel-efficient cars may inevitably be (slightly) less crash-worthy
Inherent but amenable to a technological win/win	First-generation auto airbags did save large occupants but place smaller occupants at risk; redesign eliminated this dilemma
Needless, even malicious, decisions to substitute	1-bromopropane replacing perchloroethylene in dry cleaning, rather than materials safer than either solvent
Indirect and causally ambiguous	The “richer is safer” theory of regulatory costs harming citizens

The risk assessment should include a comparison of the baseline risk against the risk associated with the alternative mitigation measures being considered, and describe, to the extent feasible, any significant countervailing risks caused by alternative mitigation measures.

(proposed OMB risk assessment bulletin)

Adding mandates (for example, expanding the scope and complexity of risk assessments) would necessitate reallocation of resources and would probably negatively affect the number of risk assessments produced by federal agencies ... and the ability of the agencies to complete non-risk-assessment work.

Section IV(7b)'s requirement to “assess, to the extent feasible, countervailing risks caused by alternative mitigation measures” could lead, for example, to having to evaluate occupational risks posed by environmental interventions ... this could result in an extremely broad-based analysis much larger in scope than currently undertaken.

(NAS denunciation of OMB proposal)

CASE REPORT

Severe neurotoxicity associated with exposure to the solvent 1-bromopropane (n-propyl bromide)

JENNIFER JUHL MAJERSIK, M.D.¹, E. MARTIN CARAVATI, M.D. M.P.H.², and JOHN D. STEFFENS, M.D.³

¹Department of Neurology, University of Michigan, Ann Arbor, Michigan, USA

²Utah Poison Control, Salt Lake City, Utah, USA

³Department of Neurology, University of Utah, Salt Lake City, Utah, USA

Background. 1-Bromopropane was recently substituted for traditional ozone-depleting solvents in the industrial setting. **Case series.** We report a cohort of six cases of 1-bromopropane neurotoxicity occurring in foam cushion gluers exposed to 1-bromopropane vapors from spray adhesives. Patients 1–5 were exposed 30–40 hours per week over three years; patient 6 had been employed for the previous three months. Exposure had peaked over the previous month when ventilatory fans were turned off. All patients complained of subacute onset of lower extremity pain or paresthesias. Five of six complained of difficulty walking and on examination had spastic paraparesis, distal sensory loss, and hyperreflexia. Three patients initially had nausea and headache. Serum bromide concentrations ranged from 44 to 170 mg/dL (reference 0–40 mg/dL). Apparent hyperchloremia was present with serum chloride concentrations of 105 to 139 mmol/L (reference 98–107 mmol/L). Air samples taken at the workplace during gluing operations revealed the mean air concentration of 1-bromopropane to be 130 ppm (range 91–176 ppm) with a seven hour time-weighted average of 108 ppm (range 92–127 ppm), well above the EPA-proposed limit of 25 ppm. Two years after exposure, the two most severely affected patients had minimal improvement of function and they, with a third patient, continued to experience chronic neuropathic pain. **Conclusion.** This report supports the growing recognition of 1-bromopropane neurotoxicity in humans consisting most commonly of headache, nausea, and subacute spastic paraparesis with distal sensory loss. The pathogenesis of 1-BP neurotoxicity in humans has yet to be fully elucidated but may reflect a central distal axonopathy syndrome.

1-Bromopropane: no PEL, TLV=10 ppm

- CDC *Morbidity and Mortality Weekly Report* (12/5/08) published a case report of a 43-year-old man in NJ who had recently begun dry cleaning with “DrySolv”(1-BP)– hospitalized with headaches, fatigue, visual disturbances, twitching, and joint pain– also a PA man hospitalized with ataxia and neuropathy (1-BP levels in his degreasing operation approx. 175 ppm);
- *Journal of Env't'l and Occup'l Medicine* (9/07) reported on 4 furniture workers using 1-BP glue (18 - 254 ppm in air) who developed inability to walk, pain, numbness, vomiting– persisting for up to 8 years after leaving workplace;
- Majersik et al (2007) reported that 6 workers exposed to roughly 100 ppm 1-BP while gluing furniture developed chronic neuropathic pain, persisting for years after leaving their workplaces.
- *European J Endocrinology* (1998) reported on 16 Korean workers using 2-BP who developed primary ovarian failure.

From draft ACGIH TLV Basis Document for 1-Bromopropane,
11/18/2010: (note: current TLV is 10 ppm)

- “A TLV-TWA of **0.1 ppm** should provide protection against the potential for neurotoxicity, ... in 1-bromopropane exposed workers.”
- “A study of 60 female workers in four 1-BP factories demonstrated dose-dependent neurological and hematological effects of 1-BP exposure with a LOAEL of 1.28 ppm for loss of vibration sense in toes (Li et al 2010b).”

My comments: 0.1 ppm is a laudably protective level compared to the current TLV, to EPA's 25 ppm recommendation, and to OSHA's “TSTL”* recommendation, but as a quantitative exercise...

1. Huh?!
2. $1.28 \div 10$ (LOAEL to NOAEL) $\div 10$ (intraspecies susceptibility) = 0.013 ppm
3. By my analysis of the new 1-BP cancer bioassay, 10^{-4} excess cancer risk level = 0.06 ppm

* (“the sky's the limit”)

New NTP Cancer Bioassay of 1-BP:

- 18% of female mice exposed to 62.5 ppm developed lung tumors (versus 2% of control mice)
- rare intestinal tumors found in male and female rats
- I calculated the cancer potency factor (linearized multistage model, 95th UCL on linear term) from this bioassay as 1.67×10^{-3} per ppm (45-year, 40 hr/week adjustment)
- (Using identical method, the cancer potency factor for the NTP bioassay of methylene chloride is 1.4×10^{-4} per ppm, a factor of 12 smaller)

Derivation of an Occupational Exposure Limit (OEL) for n-Propyl Bromide Using an Improved Methodology

Karl K. Rozman^{1,2} and John Doull¹

¹Department of Pharmacology, Toxicology and Therapeutics, University of Kansas Medical Center, Kansas City, Kansas; ²Section of Environmental Toxicology, GSF-Institut für Toxikologie, Neuherberg, Germany

The lack of genetic toxicity of n-propyl bromide in all but one test performed is also in agreement with the structure activity analysis for acute and subchronic toxicities showing that $\text{CH}_3\text{Br} > \text{CH}_3\text{CH}_2\text{Br} > \text{CH}_3\text{CH}_2\text{CH}_2\text{Br}$ for genotoxicity.

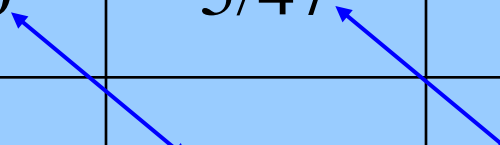
Therefore, it can be expected with confidence that if a carcinogenicity bioassay were to be conducted with n-propyl bromide at levels used in the ethyl bromide bioassay the outcome would be negative. Thus, even in the absence of a chronic bioassay it is clear that carcinogenicity is not an issue with n-propyl bromide because it could be only a very high dose effect or it would be not demonstrable. In agreement with this view is the finding that

The human NOEL for n-propyl bromide-induced headache is reported to be 170 ppm.⁽³¹⁾ Since the size of the population in that study was small, the use of a safety factor of two should be applied to protect nearly all workers, and a safety factor of three would be appropriate to provide a larger margin of safety from this adverse effect. Therefore, the recommended OEL for n-propyl bromide should be in the range of 60 to 90 ppm.

“Epic Fail,” as my Middle Schooler would say...

The Actual 1989 Data on Ethyl Bromide *vs.* the 2009 Data on 1-BP:
(# of female mice with tumors/ # of animals tested)

		Dose (ppm)			
		0	100 (62.5)	200 (125)	400 (250)
Ethyl bromide		0/50	4/50	5/47	27/48
<i>n</i> -propyl bromide		1/50	9/50	8/50	14/50



Standard application of the linearized multi-stage dose-response model indicates that nPB is TWICE as potent a carcinogen as EtBr

**ENVIRONMENTAL PROTECTION
AGENCY**

40 CFR Part 82

[FRL-7504-3]

RIN 2060-AK28

**Protection of Stratospheric Ozone:
Listing of Substitutes for Ozone-
Depleting Substances—n-Propyl
Bromide**AGENCY: Environmental Protection
Agency.

ACTION: Notice of proposed rulemaking.

SUMMARY: This action proposes to list n-propyl bromide (nPB) as an acceptable substitute for ozone-depleting substances (ODSs), subject to use conditions, in the solvent cleaning sector and aerosol solvents and adhesive end uses under the U.S. Environmental Protection Agency's (EPA or "we") Significant New Alternatives Policy (SNAP) program. The SNAP program implements section 612 of the amended Clean Air Act of 1990 (CAA), which requires EPA to evaluate substitutes for ODSs in order to reduce overall risk to human health and the environment.

Why is Dry Cleaning Hazardous?

Dry Cleaning is the practice of cleaning clothes in machines, much like your washer at home, but with industrial solvents. The vast majority of cleaners use a chemical called *perchloroethylene*, or "Perc" for short. Perc is a suspected human carcinogen, is toxic, has been found in large quantities in drinking water supplies, and is a highly persistent chemical in the environment. And yet 75% of the industry still uses Perc, even after several states have initiated a ban on the solvent. The "mainstream" alternatives are not much better. They are highly flammable, have health and environmental issues of their own, and are far less effective cleaners than Perc.

So How can a Cleaner be Green and Still Have an Effective Operation?

The options for a cleaning solvent that is truly green are limited. DrySolv is the only alternative with the cleaning attributes of Perc, but with a much greener profile.

- DrySolv is NON-FLAMMABLE, showing no flashpoint in multiple tests and test methods. (ASTM D-56 TCC, ASTM D-92 COC, ASTM D-93 TCC).
- DrySolv is NON-CHLORINATED.
- DrySolv is NON-HAZARDOUS for transport. (DOT, OSHA, NESHAP, RCRA, Clean Water Act)
- DrySolv is NOT A HAZARDOUS AIR POLLUTANT, is SNAP approved, and does not contribute to global warming. (NESHAP, Significant New Alternative Program-SNAP approved (Federal EPA)).
- The USEPA states that DrySolv's main ingredient is less persistent in the environment than many other solvents, is of low to moderate concern for movement in soil, does not warrant listing under the Toxics Release Inventory and is not prone to bioaccumulation. (USEPA - Federal Register May 30, 2007).
- DrySolv DOES NOT have a hazardous decomposition or hazardous polymerization.



Testimonial

"In January of 2007, I started using DrySolv in my dry cleaning machine due to my total frustration with all the environmental issues with perc. WOW! What a smart move that was! EPA and KDHE have no regulations on DrySolv. Environmentally, it is perfectly okay and not considered hazardous. My whites come out white, rarely do I have to spot clothes, and best of all, we have completely eliminated all filters from our dry cleaning machine. I've had great success with wonderful support on all questions and concerns from Joe and Ray about DrySolv. DrySolv has made everything so simple and easy."

Leroy Riedel

As OSHA Emphasizes Safety, Long-Term Health Risks Fester



Ledyia Davis/The New York Times

OSHA, the watchdog agency that many Americans love to hate and industry often faults as overzealous, has largely ignored long-term threats.

By IAN URBINA

Published: March 30, 2013 | 464 Comments



FACEBOOK



TWITTER



GOOGLE



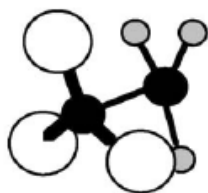
EMAIL



PRINT

TAYLORSVILLE, N.C. — Sheri Farley walks with a limp. The only job she could hold would be one where she does not have to stand or sit longer than 20 minutes, otherwise pain screams down her spine and up her legs.

"Damaged goods," Ms. Farley describes herself, recalling how she recently overheard a child whispering to her mother about whether the "crippled lady" was a meth



The Alternative

IRTA Newsletter

Volume XVIII Number 3

Summer 2009

n-Propyl Bromide Destroys Equipment in Dry Cleaning Plant

Stuart Pressman of Economy Cleaners in Sand City, California is a third generation dry cleaner who has worked in the industry for more than 40 years. Last June, he decided to use n-propyl bromide (nPB) in one of his two PERC machines. The supplier designated the cleaner as a California Beta Testing Site. The California Air Resources Board (CARB) adopted a regulation that will phase out the use of perchloroethylene (PERC) dry cleaning by 2023. To comply with this regulation, cleaners must convert to alternative processes. All of the alternatives to PERC require different equipment. To avoid making this purchase, Mr. Pressman decided to use n-propyl bromide. The supplier indicated that he could use it in his existing PERC machine.

Mr. Pressman used the nPB, which is sold under the tradename of DrySolv, for about six months and was pleased with its aggressive cleaning capability. Within about six months, in December, he began to notice a problem. On January 4, 2009, he asked for help from the suppliers of the solvent but the supplier put him off month after month and never actually visited the facility.

nPB must be used with stabilizers because the chemical is unstable when water is present. nPB reacts with the water to form hydrogen bromide, a very corrosive gas. The stabilizer takes up the water and prevents the nPB from "going acid." Several companies using the solvent have dep

(see **n-Propyl Bromide** page 10)



(from A. Finkel, *Environmental Health Perspectives*, 1995)

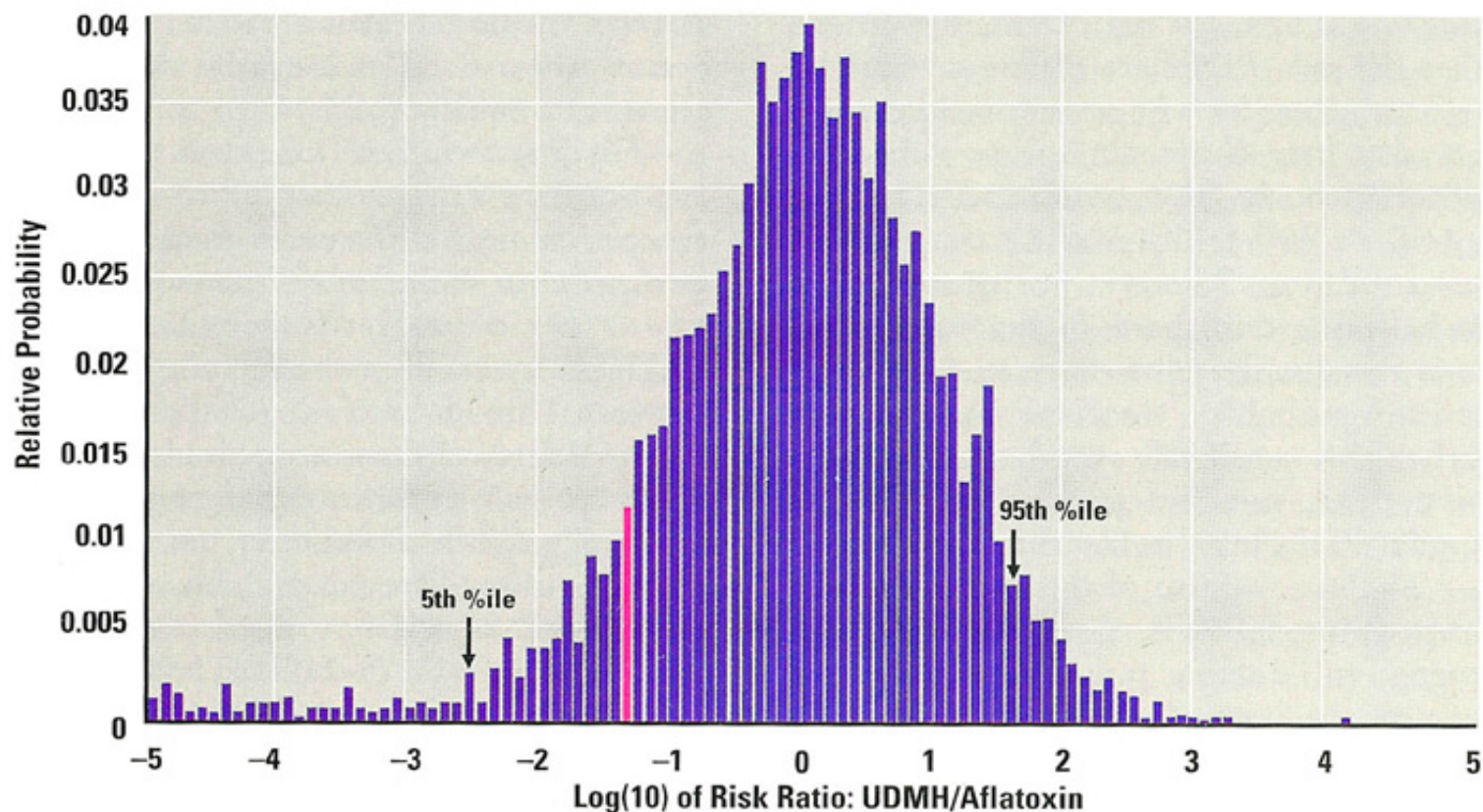


Figure 2. Probability density function (PDF) for the ratio of the risk of unsymmetrical dimethylhydrazine (UDMH) to the risk of aflatoxin, generated via 20,000 realizations from the Monte Carlo simulation described in the text. The X-axis denotes the common logarithm of the risk ratio (hence, $x = 3$ represents a risk of UDMH 1,000 times that of aflatoxin; $x = -2$ represents a risk ratio of 100:1 in the opposite direction). The height of the histogram at any point denotes the relative probability of that value compared to other possible values (the area under the smooth curve approximated by this histogram equals unity). The deterministic point estimate (1:18) of Ames et al. (19) lies at $x = -1.25$ (pink bar); the 5th and 95th percentiles (as shown by the two arrows) lie at $x = -2.57$ and $x = 1.53$, respectively.

[part 5– “Solution-Focused Risk Assessment” (SFRA) as a new Synthesis]

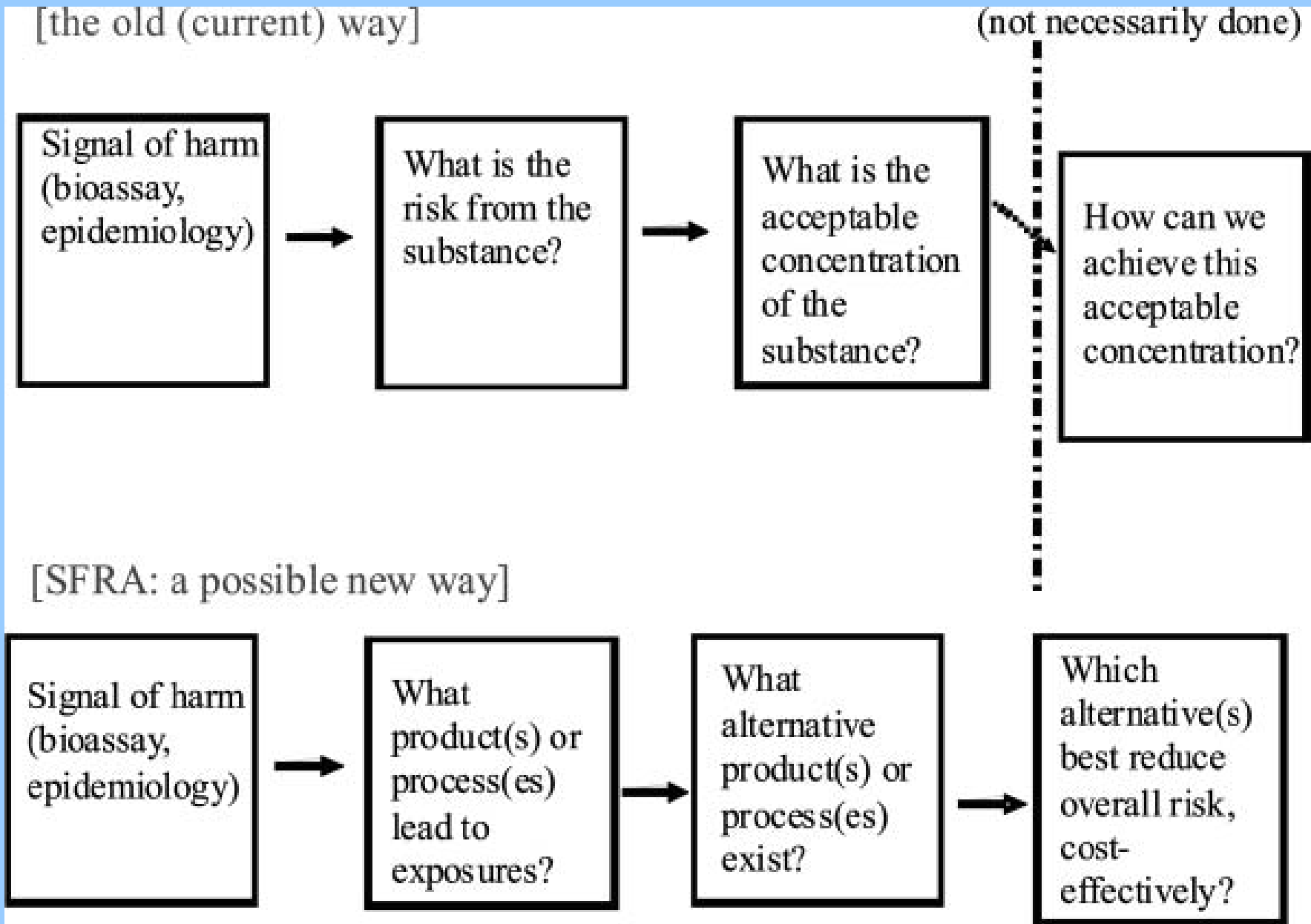


Table 3. Risk-only, technology-only, and solution-focused thinking compared.

Opening question	Analyses required	Agency pronouncement	Likely response(s) by regulated
(USEPA): What is the exposure that creates a risk of 10^{-6} ?	Toxicologic potency	Outdoor air shall contain no more than X ppb methylene chloride (MC)	<ul style="list-style-type: none"> • non-compliance • more toxic substitute • decrease ventilation (but increase worker exposures) • (waste disposal problem remains)
(OSHA): What is the exposure that creates a risk of 10^{-3} ?	Potency, technical feasibility	Workplace air shall contain no more than Y ppm MC	<ul style="list-style-type: none"> • non-compliance • more toxic substitute • increase ventilation (but increase environmental exposures) • strip paint less often (accidents?)
What is the best available technology for paint stripping?	Control efficiency	Process stream must be directed into carbon adsorbers; workers must wear respirators	<ul style="list-style-type: none"> • comply (more accidents?) • bankruptcy? • relocate overseas?
How can we repaint planes at the minimum of [risk plus control cost]?	Risk, efficiency, cost, distributional effects	Steel shot, starch pellets, walnut shells, or the like must be used in favor of solvents	<ul style="list-style-type: none"> • comply at lower cost • waste disposal problem reduced
How can we provide air travel at the minimum of [risk plus control cost]?	Risk, efficiency, cost, distributional effects	Ban (tax) painted aircraft and/or subsidize unpainted ones	<ul style="list-style-type: none"> • coated metal with artwork • less fuel used*

*An unpainted Boeing 747 weighs 500 lbs. less than a painted one; American Airlines saves 7 million gallons of jet fuel per year (about 0.5% of its total fuel consumption) by eliminating paint, with concomitant benefits for air-toxics and greenhouse-gas emissions (Segelstein 2008).

From Finkel, A.M. (2011). "Solution-Focused Risk Assessment: A Proposal for the Fusion of Environmental Analysis and Action." *Human and Ecological Risk Assessment*, **17(4)**:754-787 (and 5 concurrent responses/commentaries, pp. 788-812).



Assessing Impact Tradeoffs in Alternatives Assessments

June 11, 2013

Kathy Hart

Design for the Environment Program

Office of Pollution Prevention and Toxics



Considering Additional Impacts— Beyond Hazard Assessment

- After hazard assessment, additional life-cycle impacts of alternatives may be considered
- Purpose of life-cycle assessment (LCA) or life-cycle thinking
 - Identify improvement opportunities (materials or processes associated with greatest impacts)
 - Compare impacts of products, materials/chemicals, or processes that perform the same function
- LCA (or life-cycle thinking) results can be used to further distinguish between safer alternatives



LCA Process Overview

Four main steps (phases) in conducting an LCA:

- Goal definition and scoping: identifying specific goals and objectives, and defining study boundaries (scope)
- Compiling a life-cycle inventory: materials and energy use associated with processes
- Life-cycle impact assessment
- Analysis and summary of results, including uncertainty
 - Interpretation of results and evaluation of tradeoffs, including weighting impacts, is often left to user of results



LCA Scoping in Alternatives Assessments

Consider differences in product (and impacts) that may result from using alternatives chemicals

- Is the chemical a drop-in substitute?
- Will product manufacturing, use, or end-of-life be affected?
- Where in the life-cycle are impact changes expected?
- What type of impacts might be expected to be affected?
- What type of analysis is needed to determine if changes would be significant: full or partial LCA? life-cycle thinking?
- What type of information do I need to conduct the analysis?
- How should the information be used to choose an alternative?



Life-Cycle Impact Categories

Natural Resources

Non-renewable resource
consumption

Renewable resource
consumption

Energy consumption

Landfill space use

Ecosystem - Water

Water eutrophication

Local water quality (BOD,
TSS)

Ecosystem-Atmosphere

Global warming

Ozone depletion

Photochemical smog

Acidification

Air particulate matter

Toxicity

Chronic human health toxicity
(occupational & public, non-
cancer and cancer)

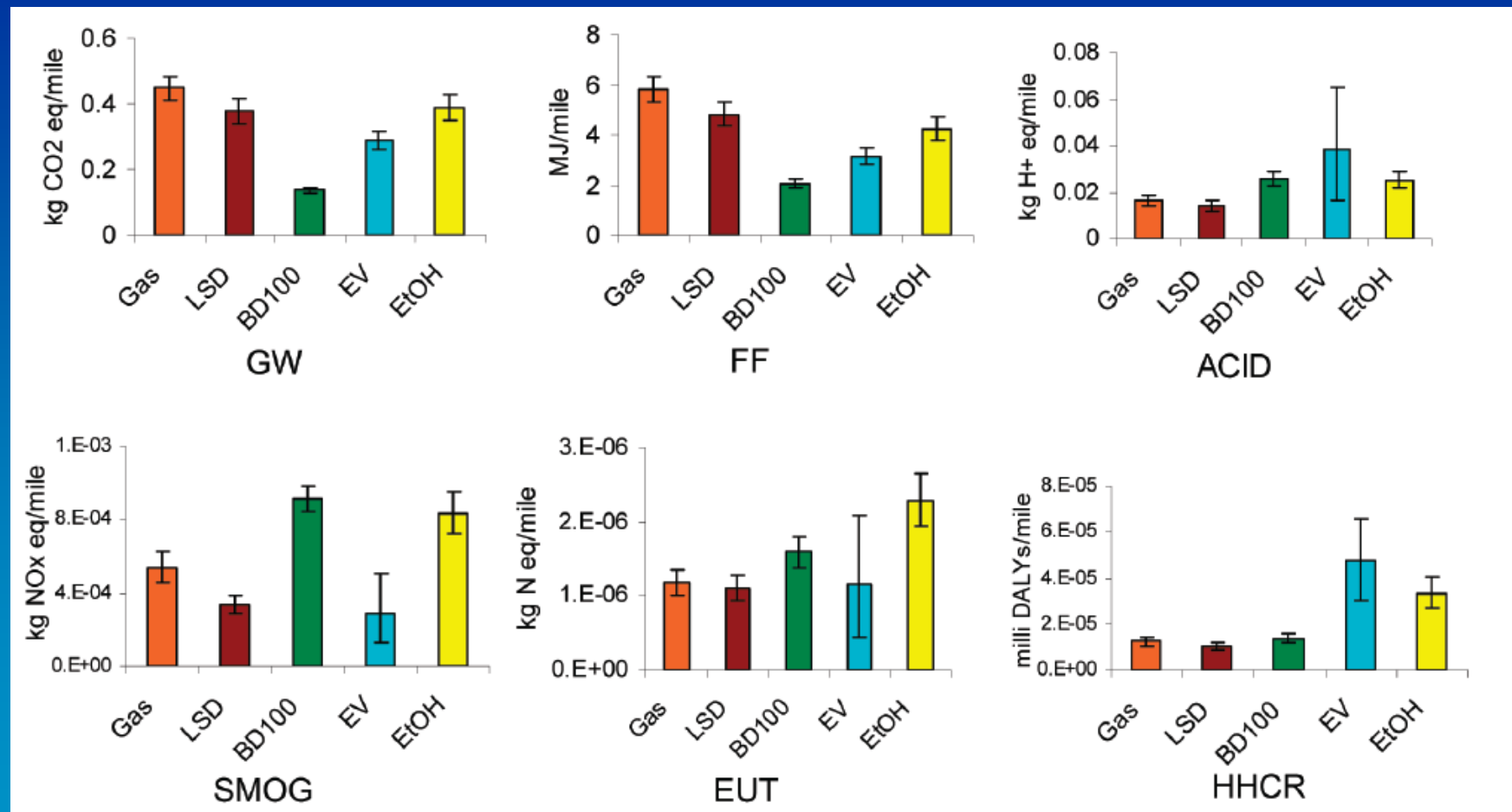
Aquatic ecotoxicity



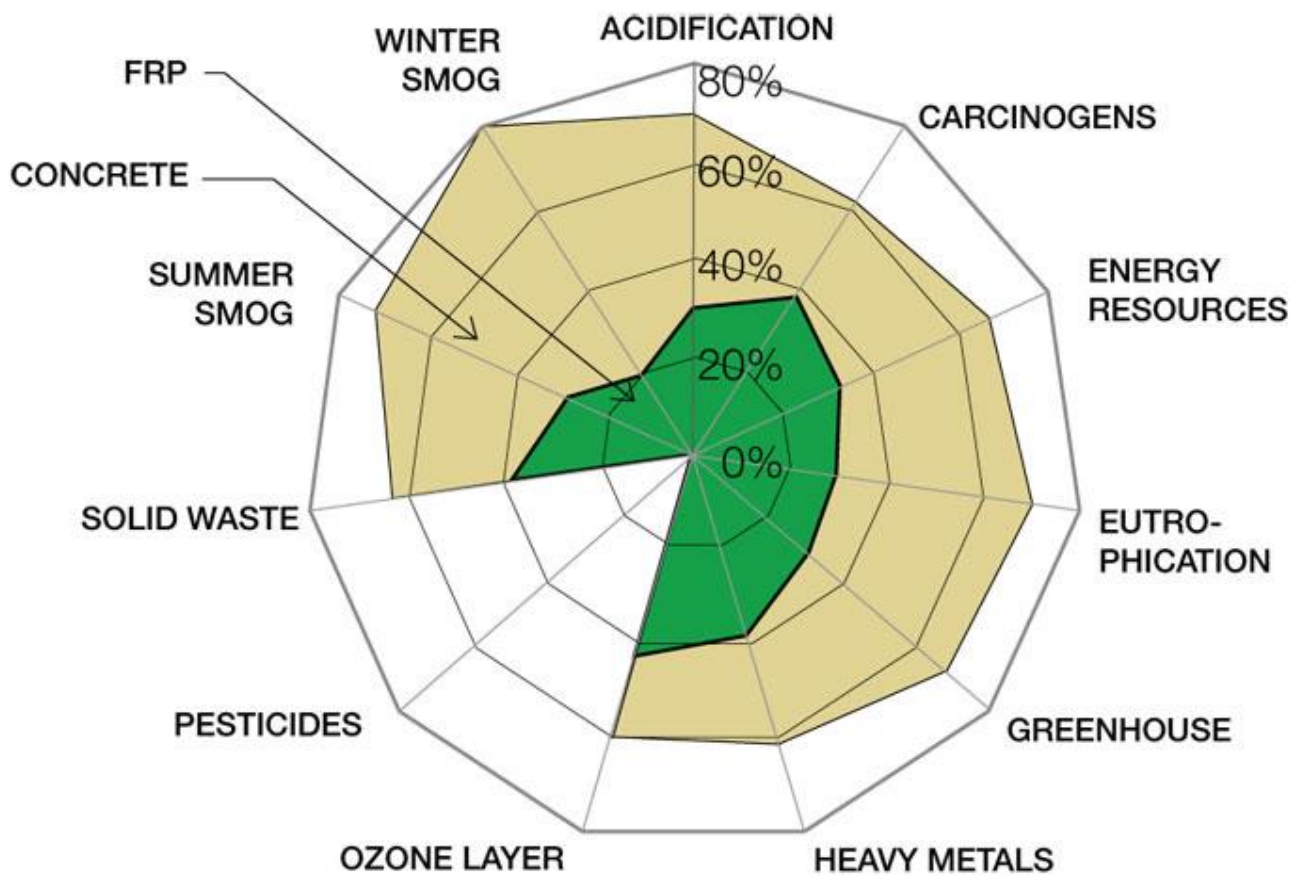
How Can LCA Results Be Used?

- LCA results can be used to compare alternatives and identify/assess tradeoffs
- Results may be aggregated across the whole life-cycle for each impact category, or aggregated by life-cycle stage
 - Does one alternative “win” or “lose” more impact categories or life-cycle stages than the others?
- Graphic displays can help to identify significant differences

Example LCA Results by Impact Category—Alternative Fuels



Example LCA Results Display





Varying Attributes Among AA Frameworks (DRAFT)

Attributes Framework	Use-Based Exposure / Risk	Cost & Availability	Other Lifecycle Impacts	Social Impacts	Stakeholders	Includes Comparison of Materials and/or Processes
REACH Tiered Approach	Yes	Yes	Not mentioned	Yes (but in the Socio-Economic Analysis)	Yes	As needed
UCLA Multi-Criteria Decision Analysis	Yes	Yes	Yes	Not mentioned	Can be added	Can be added
German Guide on Sustainable Chemicals	Yes	Yes	Yes	Yes	Not mentioned	No
BizNGO Alternatives Assessment Protocol	As needed	Yes	As needed	Not mentioned	Not mentioned	Yes
Lowell Center Alternatives Assessment Framework	Not mentioned	Yes	Not mentioned	Yes	Yes	Yes
DfE Chemical Alternatives Assessment Steps	As needed	As needed	As needed	As needed	Yes	Can be added
California Safer Consumer Products Guidance (anticipated)	Yes	Yes	Yes	Yes	Yes	Yes
Interstate Chemicals Clearinghouse (IC2) Alternatives Assessment Guidance	Yes	Yes	As needed	As needed	As needed	As needed



AA Framework References

- BizNGO Working Group for Safer Chemicals and Sustainable Materials. (2011). "BizNGO Chemical Alternatives Assessment Protocol (v1.0)." Retrieved September 30, 2012, from http://www.bizngo.org/pdf/BizNGO_CAAProtocol_ExecSum.pdf.
- Rossi, M., J. Tickner, et al. (2006). "Alternatives Assessment Framework of the Lowell Center for Sustainable Production." Retrieved September 30, 2012, from <http://www.chemicalspolicy.org/downloads/FinalAltsAssess06.pdf>.
- Interstate Chemicals Clearinghouse. (2013). "Guidance for Alternatives Assessment and Risk Reduction." Retrieved May 30, 2013, from <http://www.newmoa.org/prevention/ic2/aaguidance.cfm>.
- European Chemicals Agency (2011). "Guidance on the preparation of an application for authorisation." Retrieved May 11, 2012, from <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2011:028:0001:0121:EN:PDF>.
- EPA Design for the Environment. (2013). "Alternatives Assessments." Retrieved May 30, 2013, from http://www.epa.gov/dfe/alternative_assessments.html



AA Framework References (continued)

- Malloy, T. F., P. J. Sinsheimer, et al. (2011). Developing Regulatory Alternatives Analysis Methodologies for the California Green Chemistry Initiative. UCLA Sustainable Technology & Policy Program. Los Angeles.
- German Federal Environment Agency (2011). "Guide on Sustainable Chemicals." Retrieved April 4, 2012, from <http://www.umweltbundesamt.de/uba-info-medien-e/4169.html>.
-
- California Department of Toxic Substances Control (2012). "Draft Regulation for Safer Consumer Products." Retrieved May 30, 2013, from http://dtsc.ca.gov/LawsRegsPolicies/Regs/upload/2-SCP-REVISED-Proposed-Regulations_APA-MARKUP-April-2013.pdf



Interpretation of Results

- How results are interpreted depends on stakeholder's interests/needs—may be geographical component
- Weighting may be used to increase the importance of certain impact categories
- LCA results may help to inform safer and more sustainable substitutions, avoid unintended consequences, and identify improvement opportunities for products and processes



Contact Information


Kathy Hart

Design for the Environment Program

www.epa.gov/dfe

hart.kathy@epa.gov

202-564-8787



Visualizing Trade-offs with Multi-Criteria Decision Analysis (MCDA)

Ann Blake, Ph.D.

Environmental & Public
Health Consulting

June 11, 2013



AB 1879: Safer Consumer Products

- ...directs the Department of Toxic Substances Control (DTSC) to develop regulations that **create a process for identifying and prioritizing chemicals of concern**, and to **create methods for analyzing alternatives to existing hazardous chemicals**. It also allows DTSC to take certain actions following an assessment that range from "no action" to "restrictions or bans."

Multi-Criteria Decision Analysis

- Definition:
 - concerned with *structuring and solving decision and planning problems involving multiple criteria*.
 - The ***purpose*** is to support decision makers facing such problems. Typically, there does not exist a unique optimal solution for such problems and it is necessary to ***use decision maker's preferences to differentiate between solutions***.



ANN BLAKE, Ph.D.
Environmental & Public Health Consulting



US Army Corps
of Engineers®

UCLA STPP Decision-Making Model

- Developed as a pilot for Cal/EPA DTSC Safer Consumer Product regulations
 - Designed to be Transparent, Flexible, Pragmatic, Consistent, Rigorous
- Utilized publically available MCDA software tool
 - **Allows for transparency in weighting decisions**
 - **Allows for management of complex, heterogeneous input data**
- Used two data-rich existing case studies
 - Lead solder in printed circuit boards (DfE)
 - Garment Cleaning (Occidental College, SF Environment, TURI Five Chemicals Study data)
- Analyzed impacts of:
 - missing data, incomplete data, etc. on outcome
 - sequential application of decision rules/ criteria
 - different stakeholder weighting



ANN BLAKE, Ph.D.
Environmental & Public Health Consulting



US Army Corps
of Engineers®



Alternatives Analysis

Alternative Assessment

- Develop generic alternatives assessment matrix including higher level criteria (e.g., health, safety, environmental impact, technical performance, economic feasibility), sub-criteria, and specific measurement criteria.
- For regulated hazardous product or process, identify potential alternatives.
- Collect data on regulated product and alternatives
- Transform data to compare attributes



Alternatives Evaluation

- Identify evaluation methodology for comparing regulated products and alternatives
- Develop and apply weightings for all level of criteria
- Apply evaluation methodology to compare regulated product and alternatives

AB1879 List of Alternatives Assessment Measures

"The regulations adopted pursuant to this section shall establish a process that includes an evaluation of the availability of potential alternatives and potential hazards posed by those alternatives, as well as an evaluation of critical exposure pathways. This process shall include life cycle assessment tools that take into consideration, but shall not be limited to, all of the following:

- (A) Product function or performance.
- (B) Useful life.
- (C) Materials and resource consumption.
- (D) Water conservation.
- (E) Water quality impacts.
- (F) Air emissions.
- (G) Production, in-use, and transportation energy inputs.
- (H) Energy efficiency.
- (I) Greenhouse gas emissions.
- (J) Waste and end-of-life disposal.
- (K) Public health impacts, including potential impacts to sensitive subpopulations, including infants and children.
- (L) Environmental impacts.
- (M) Economic impacts."

Major Criteria

Public health impacts (K)

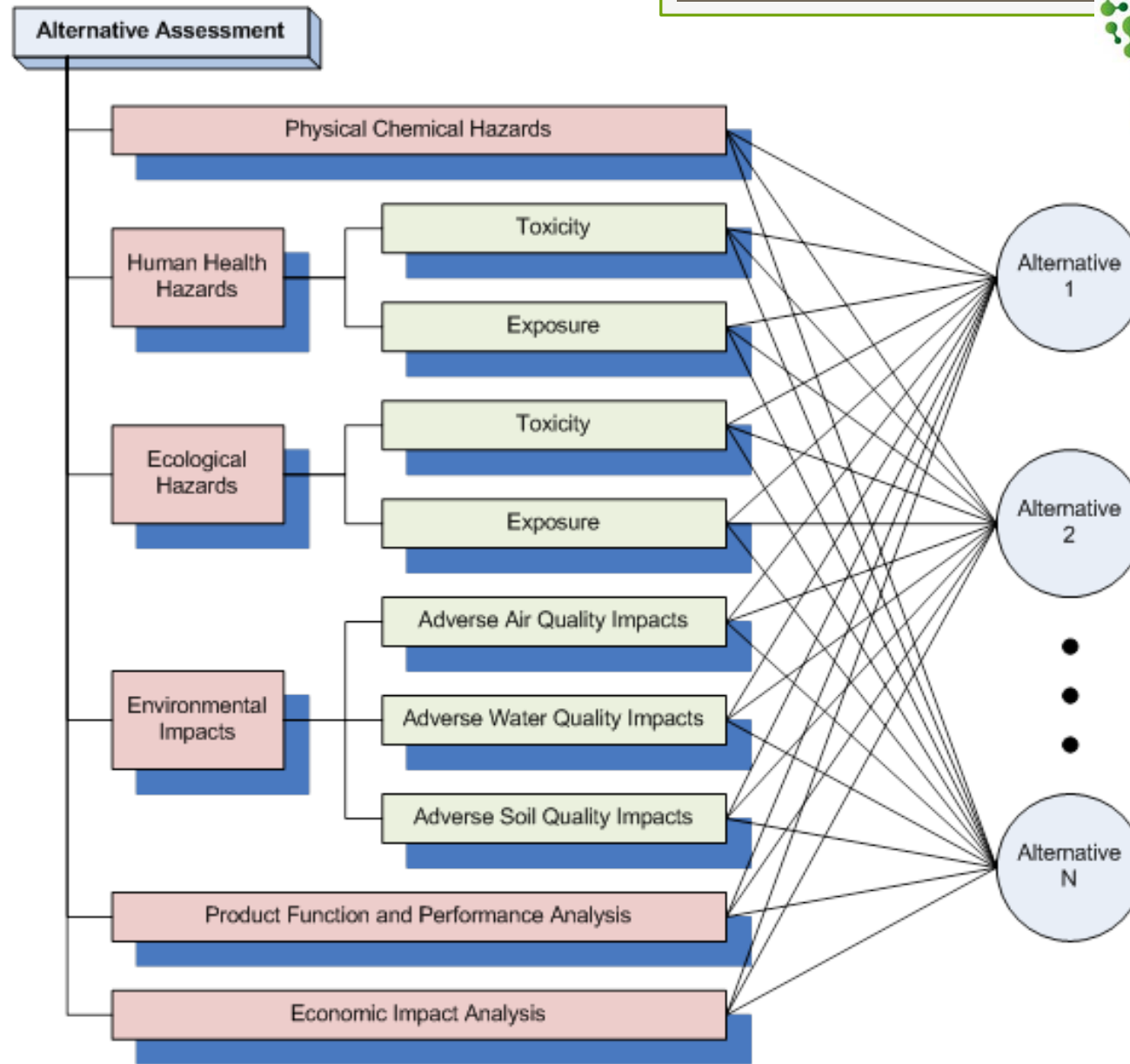
Environmental impacts (L)

Product function or
performance (A)

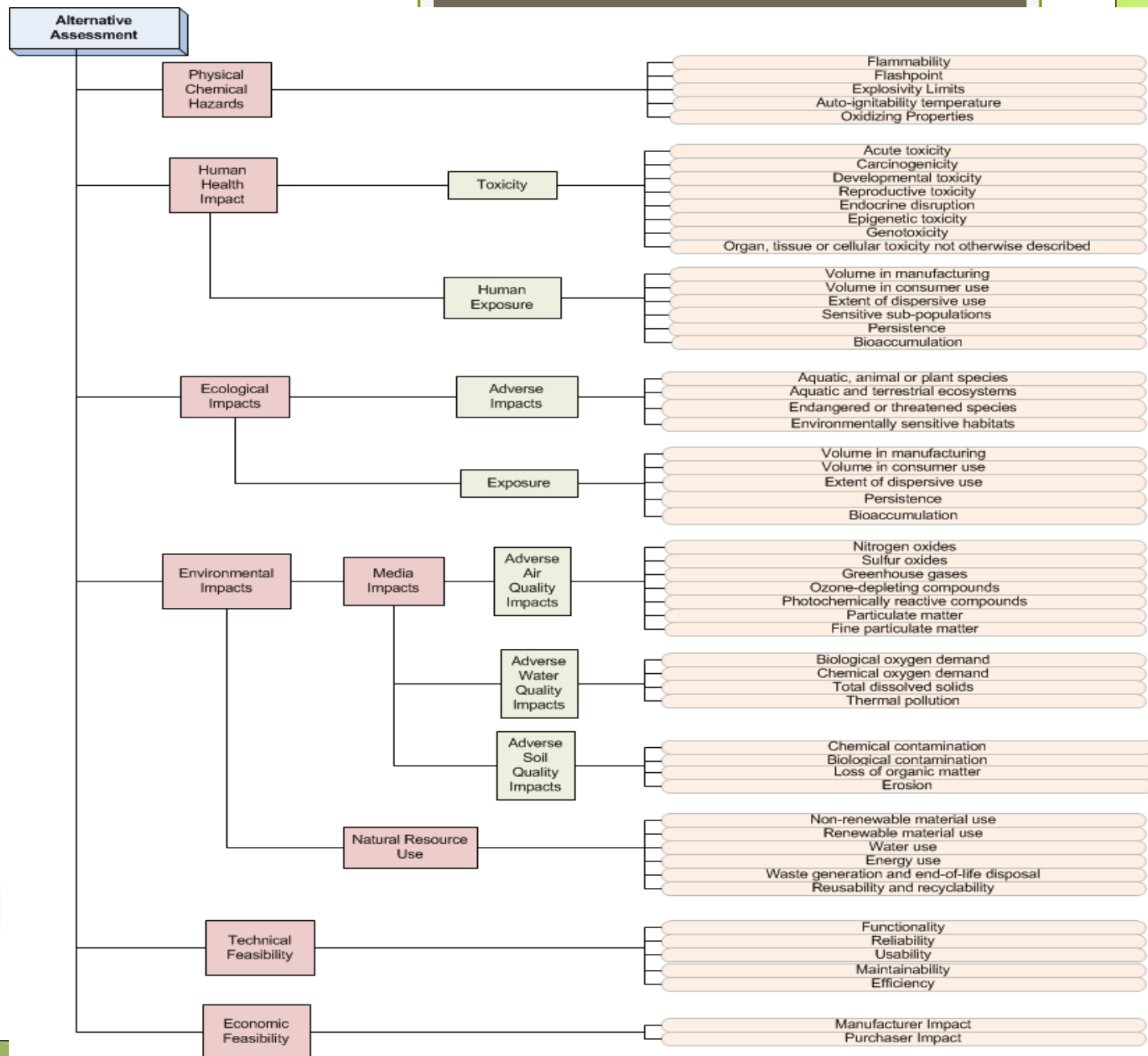
Economic impacts (M)

Sub-Criteria

- Potential hazards posed by alternatives (Section 2)
- Critical exposure pathway (Section 2)
- Potential impacts to sensitive subpopulations, including infants and children (K)
- Potential hazards posed by alternatives (Section 2)
- Critical exposure pathway (Section 2)
- Materials and resource consumption (C)
- Water conservation (D)
- Water quality impacts (E)
- Air quality (F)
- Production, in-use, and transportation energy inputs (G)
- Energy efficiency (H)
- Greenhouse gas emissions (I)
- Waste and end-of-life disposal (J)
- Useful life (B)
- Useful life (B)

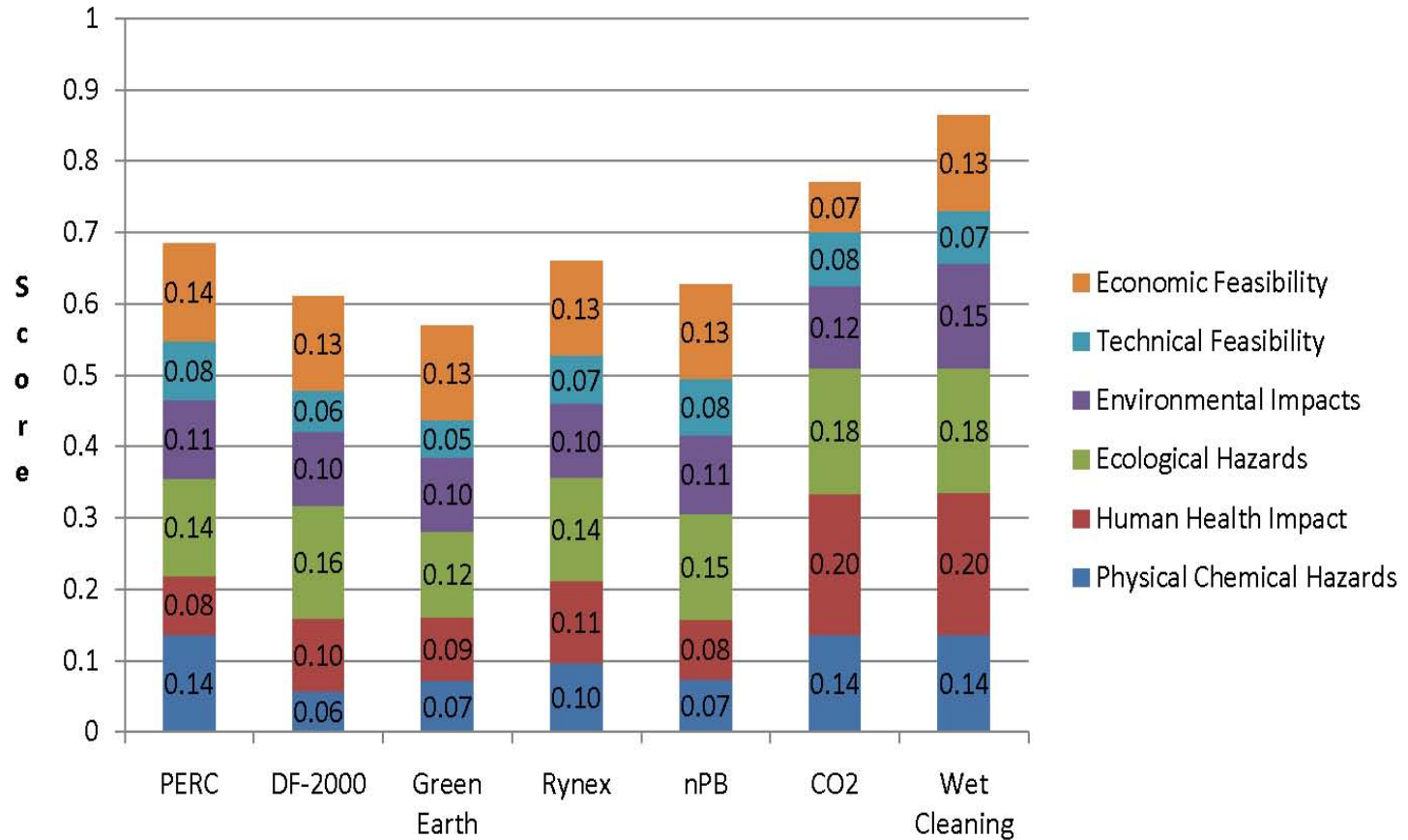


Alternatives Assessment Generic Model: Final Version





Dry Cleaning



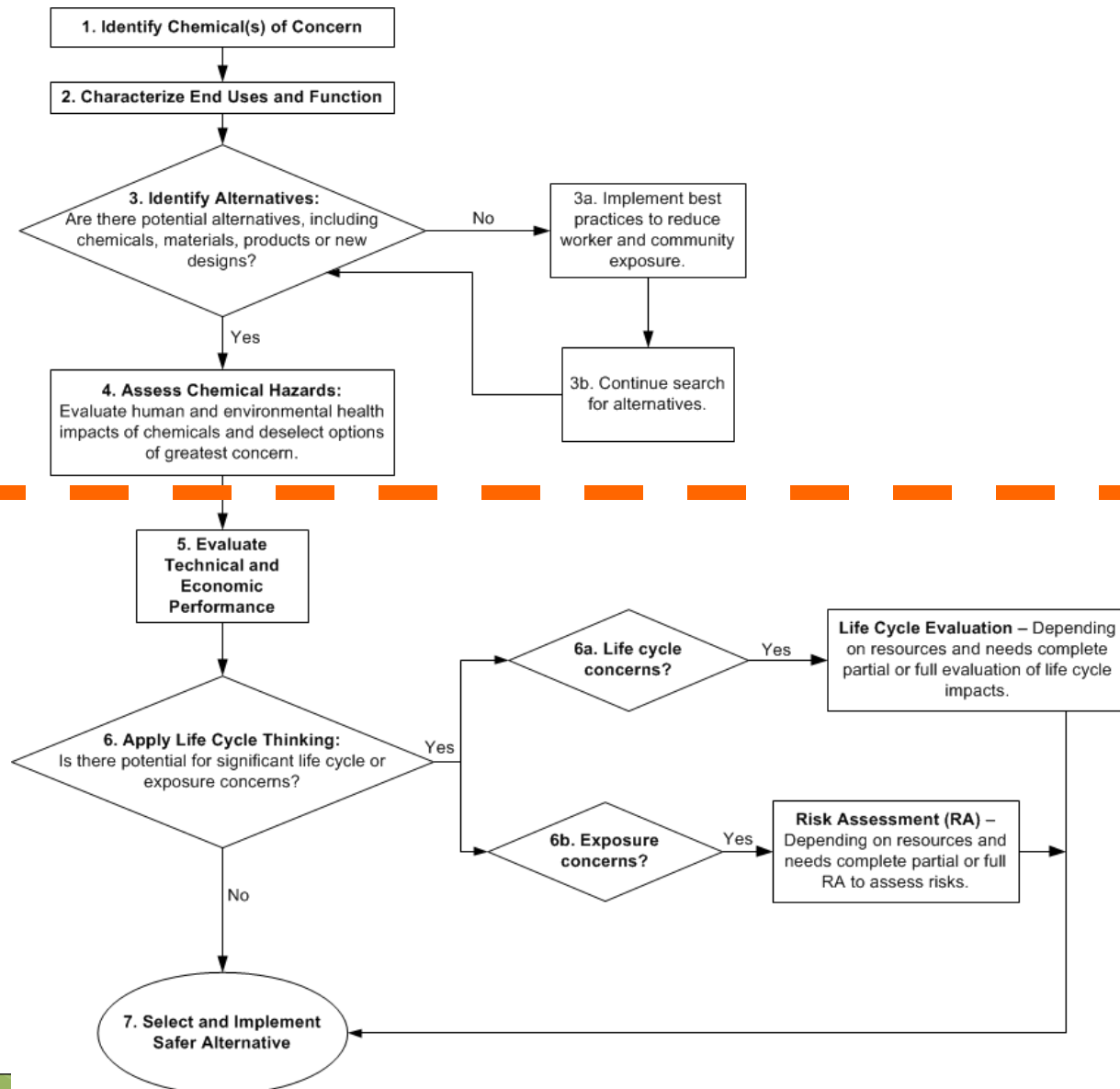


Stakeholder Weighting

Table III-1
Average Stakeholder Weighting

	Envtl. NGO	Industry	Consumer	Policymaker	Overall Average
Physical Chemical Hazards	15.22%	11.04%	15.21%	13.12%	13.75%
Human Health Impact	21.14%	18.07%	20.28%	24.75%	20.83%
Ecological Hazards	18.60%	18.67%	19.68%	18.07%	18.75%
Environmental Impacts	18.60%	20.08%	19.68%	14.11%	18.33%
Technical Feasibility	14.38%	16.47%	11.56%	16.58%	14.58%
Economic Feasibility	12.05%	15.66%	13.59%	13.37%	13.75%

BizNGO Alternatives Assessment Protocol v. 1.1



Alternative Decision Frameworks

Sequential Decision Model: Health Threshold

First Screen: Top 4 after Physical/Chemical, Human Health, and Ecological	Second Screen: Top 2 after Environmental Impact	Third Screen: Technical Performance and Economic Feasibility
Wet Cleaning	Wet Cleaning	Wet Cleaning
CO2	CO2	
Perchloroethylene		
Rynex		

Sequential Decision Model Technical/Economic Threshold

First Screen: Top 4 after Technical Performance and Economic Feasibility	Second Screen: Top 2 after Physical/Chemical, Human Health, and Ecological	Third Screen: Environmental Impact
Perc	Wet Cleaning	Wet Cleaning
nPB	Perc	
Wet Cleaning		
Rynex		

Conclusions

- It is possible to manage the vast quantities of dissimilar information required by an alternatives assessment in a transparent way
 - Decision-making framework can cope with some missing, incomplete data
- Different subsets of data may be available for different analyses, but the overall framework of criteria can provide consistency



ANN BLAKE, Ph.D.

Environmental & Public Health Consulting

(510) 768-7008

ann@annblake.com

www.annblake.com



Discussion Questions



- How can one distinguish between real and hypothetical risk trade-offs in chemical substitution decisions?
- What are some tools decision-makers can use to more thoughtfully consider potential unintended consequences in chemical substitution decisions?
- How can agencies more effectively collaborate to avoid risk shifting in chemicals decision-making?

Next Webinars



Lowell Center for Sustainable Production
UNIVERSITY OF MASSACHUSETTS LOWELL



- **Alternatives Assessment 114: Alternatives Assessment for Flame Retardants: A Cross Cutting Issue**
 - August 2013



Webinar Audio & Slides



The audio recording and slides shown during this presentation will be available at:

<http://www.chemicalspolicy.org/alternativesassessment.webinarseries.php>