Promoting Green Innovation

Applying New Methods for Identifying and Promoting Safer Consumer Products and Production Processes

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Sustainable Technology Policy Program

Overview

- Background on Alternatives Assessment
- AB998 Requirements
- Components of Alternatives Assessment
- Case Studies
  - Formaldehyde: Hardwood Plywood, Structural Use Panels
  - Lead: Wheel Weights
  - Perchloroethylene: Dry Cleaning, Vapor Degreasing, Automotive Aerosols
- Complicating Factors in Conducting AA
- Possible Decision Rules
- Linking AA to Regulatory Response
- Conclusion/Discussion

Personal Background

- Masters in Public Health
  - Epidemiology: Risk factors that cause disease
  - Thesis: Second hand smoke and cardiovascular disease
- Ph.D. Environmental Planning
  - Interest in programs to prevent illness vs. studying exposure
  - Pollution prevention in garment care industry
    - 1 chemical (perchloroethylene) and 1 process (dry cleaning)
    - Alternatives Assessment
      - Identified 2 viable safer substitutes (wet cleaning and CO2)
    - Phase out of perc dry cleaning in CA
  - Yet, 100,000 chemicals and million uses

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- Mission:
  - Assist in the development and use of safer chemicals and alternative manufacturing processes in the marketplace.

- Key Priority Areas:
  - Identification, tracking and evaluation of hazardous chemicals and technologies
  - Development and evaluation of tools for business and policymakers seeking to reduce toxics use
  - Identification and assessment of existing and emerging alternative chemicals and technologies
  - Identification and analysis of legal, economic and social barriers to and drivers of the diffusion of alternatives

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STPP Key Component

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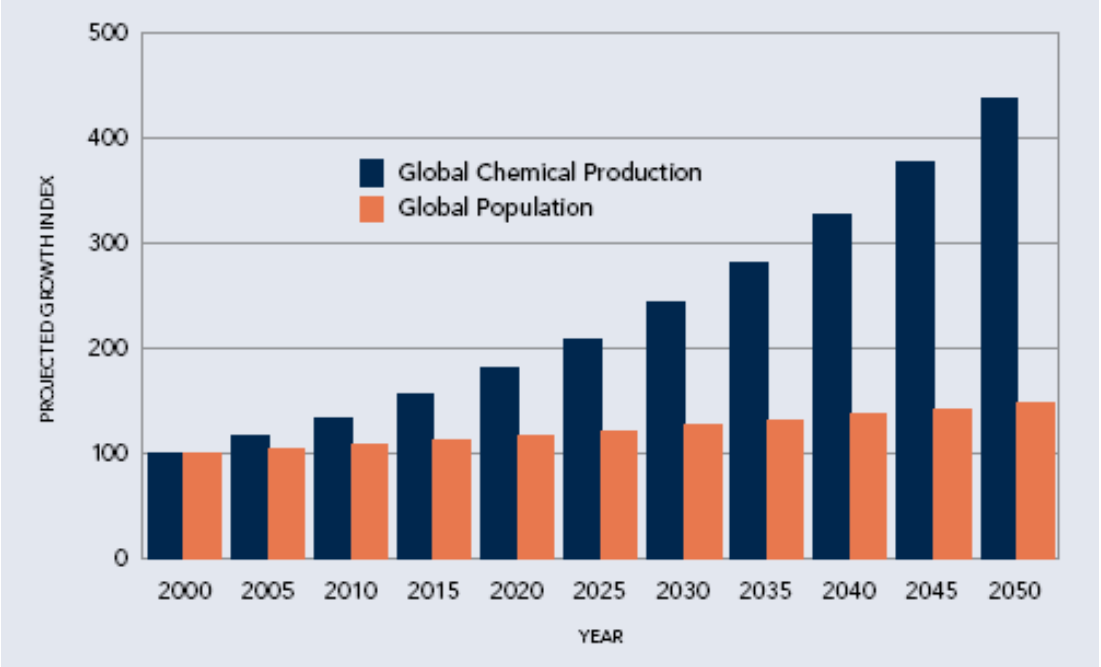
Global Chemical Production



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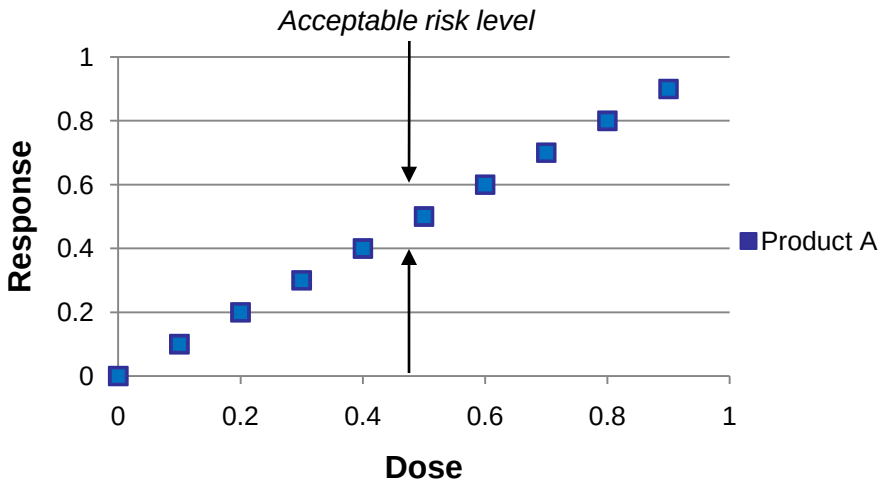
Dominant Chemical Policy Paradigm

- Risk Management
  - Science: Risk Assessment
  - Policy: Acceptable Risk



- Limitations
  - Takes risk as given
  - Risk assessment easily challenged
  - Deficiencies in engineering/management control
  - Assumes one course of action

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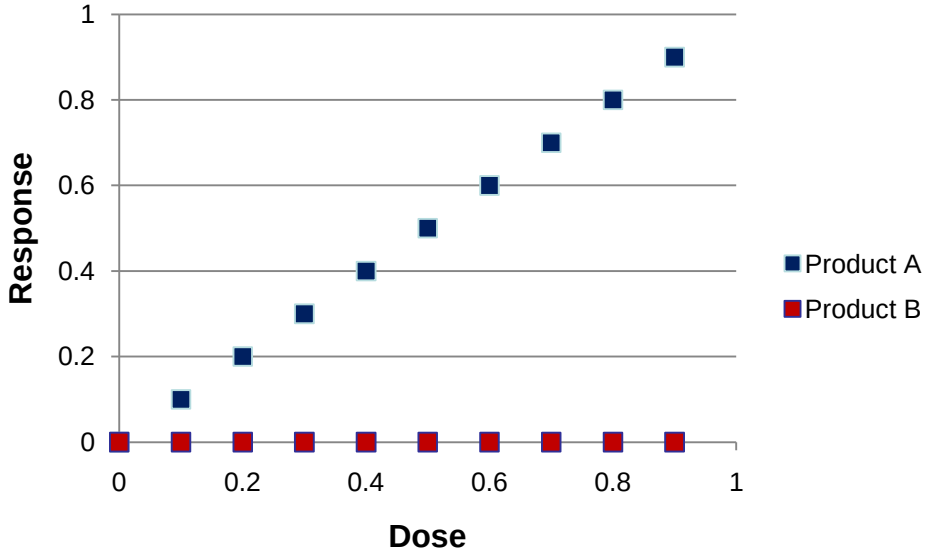
Paradigm Shift in Chemical Policy

- Risk Prevention
  - Science: Alternatives Assessment
  - Policy: Alternatives Evaluation



- Benefits
  - Effectiveness
  - Static efficiency – cost-effective
  - Dynamic efficiency – can lead to innovation
  - Equitable – occupational/fence-line and inter-generational

- Challenge
  - Science and policy methods underdeveloped

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What Alternatives?

Type of Alternative	**Example**
Drop-in chemical substitute	CFC-free refrigerants for air conditioning
Material substitute	Asbestos-free brake pads
Changes to manufacturing operations	Perchloroethylene-free dry cleaning
Changes to component/product design	Formaldehyde-free natural fiber/plastic plywood

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History of Alternative Analysis

- Federal Legislation
  - NEPA (1970)
  - Clean Water Act (1977)
  - TSCA (1976)
  - Clean Air Act (1990)
  - FIFRA (1972)
- International Treaty
  - Montreal Protocol Treaty (1989)
- European Union Regulation
  - REACH (2007)
- State Law
  - Massachusetts TURA (1989)
  - California AB1879 (2008)

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California AB 1879:
Safer Consumer Products Alternatives

Subject	Content	Date
Chemicals of Concern	Adopt regulations to establish a process to identify and prioritize those chemicals or chemical ingredients in consumer products that may be considered as being a chemical of concern.	On or before January 1, 2011
Alternatives Assessment & Regulatory Response	Adopt regulations that establish a process for evaluating chemicals of concern in consumer products, and their potential alternatives, to determine how best to limit exposure or to reduce the level of hazard posed by a chemical of concern.	On or before January 1, 2011

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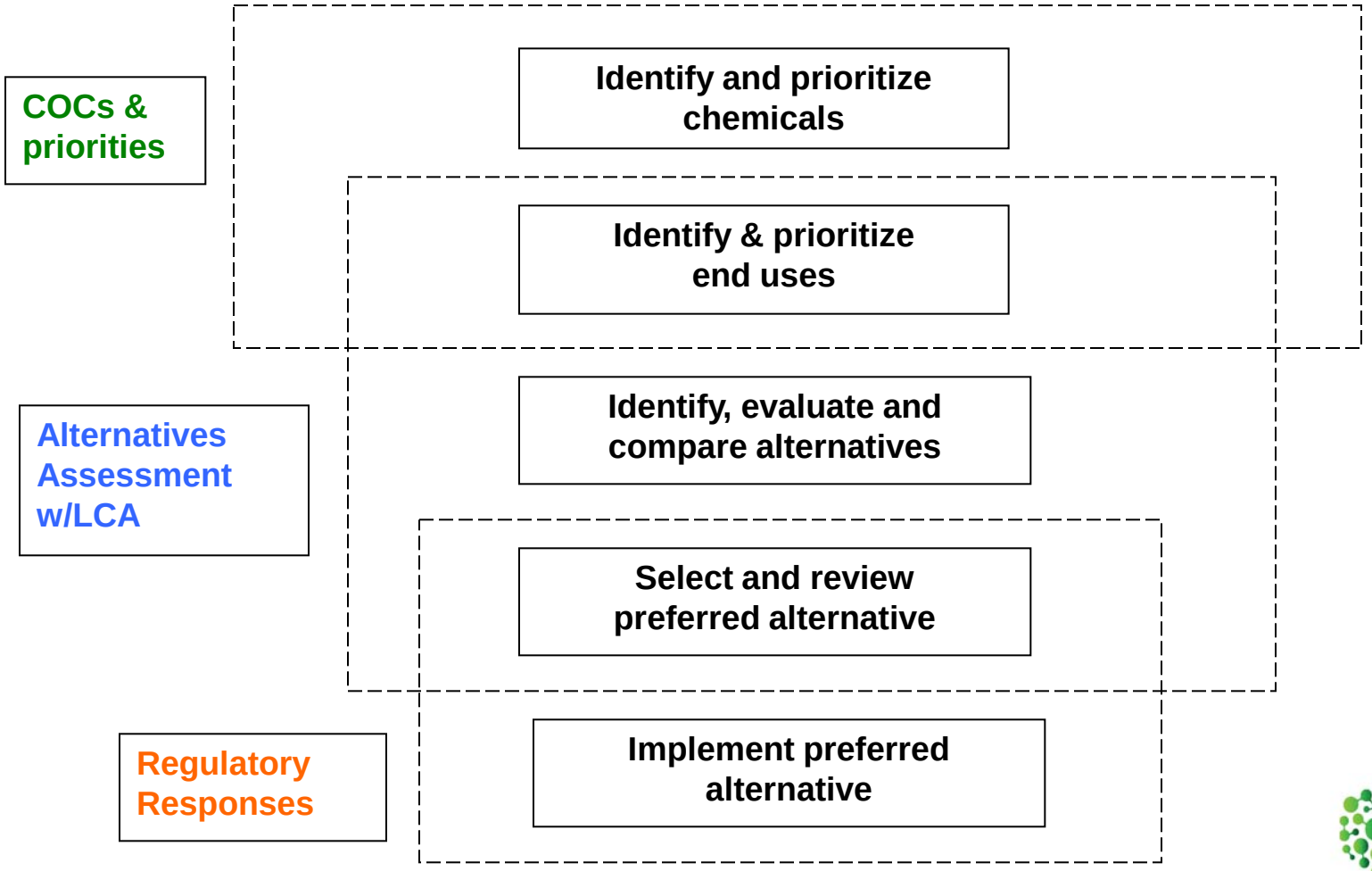
AB1879 Implementation



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AB1879
List of Alternatives Analysis 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."

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Alternatives Analysis Criteria and AB1879 Requirement

Alternatives Assessment Criteria	**AB1879: Section 25253 (a) (2)**
Human Health & Public Safety	• Potential hazards posed by those alternatives (Sec. 2). • Critical exposure pathways (Sec 2). • Public health impacts, including potential impacts to sensitive subpopulations, including infants and children (K).
Environmental Impact	• Materials and resource consumption (C). • Water conservation (D). • Water quality impacts (E). • Air emissions (F). • Production, in-use, and transportation energy inputs (G). • Energy efficiency (H). • Greenhouse gas emissions (I). • Waste and end-of-life disposal (J). • Environmental impacts (L).
Technical Performance	• Product function or performance (A).
Cost	• Economic impacts (M). • Useful life (B).

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Alternatives Analysis Method

?

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Alternatives Analysis Framework

Alternatives Assessment

- Identify potentially viable alternatives.
- For target and each alternative, collect data on five general criteria: health, safety, environment, cost, performance.
- Transform data to compare attributes within each criteria and across criteria.

Alternatives Evaluation

- Select method for comparing target to alternatives
- Identify critical trade-offs
- Weight importance of attributes (e.g., cancer vs. endocrine disruptor) or criteria (e.g. health vs. cost)
- Determine viability of alternatives

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Human Health Criteria

Attributes Comparing Target with Alternative(s)

- Chronic
  - Carcinogen
  - Mutagen
  - Reproductive toxicity
  - Immunological toxicity
  - Developmental toxicity
  - Endocrine disruption
  - Cardiovascular disease
  - Etc
- Acute
  - Allergen
  - Ocular hazard
  - Irritant
  - Etc
- Occupational exposure limit
- Sub-population: workers, children, elderly, etc.

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Human Health Data

Methods

- In vivo – animal testing
- In vitro – test tubes/Petri dish
    - High throughput bioassays
- Structure activity relationships
- Epidemiology
- Variety of test methods for each
- Meta-analysis to resolve differences

Expertise

- Toxicology
- Epidemiology
- Chemistry
- Molecular Biology

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Environmental Criteria

Attributes Comparing Target with Alternative(s)

- Aquatic toxicity
- Ecotoxicity
- Biodegradability
- Water quality
- Water use
- Ozone depletion
- Greenhouse gas
- Hazardous Air Pollutant
- Smog-forming
- Energy use
- Extraction hazards
- End-of-life disposal

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Environmental Data

Methods

- Laboratory tests
- Field tests
- Variety of test procedures for each
- Meta analysis to resolve differences

Expertise

- Biology
- Engineering
- Environmental Science

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Performance Criteria

Attributes Comparing Target with Alternative(s)

- Performance specific to product or process
- Training requirements
- Maintenance
- Durability
- R&D assessment
- Potential enhancements
- Social utility

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Performance Data Sources

Methods

- Laboratory tests
- Questionnaires
- Interviews
- Field tests
- Industry standard
- Variety of test procedures for each
- Meta analysis to resolve differences

Expertise

- Engineering
- Chemistry
- Material Science
- End user

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Economic Impact Criteria

Attributes Comparing Target with Alternative(s)

- Market price
- Raw material cost
- Life cycle cost
- Operating cost
- Capital equipment cost
- Relative nominal cost
- Economies of scale
- Price sensitivity (material/labor, etc)

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Economic Data

Methods

- Field research
- Interviews with end users and manufacturers
- Variety of procedures for each
- Meta analysis to resolve differences

Expertise

- Economist
- Engineering
- Chemistry
- Manufacture
- End user

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Alternatives Assessment Examples

Alternatives Assessment

- Identify potentially viable alternatives.
- For target and each alternative, collect data on five general criteria: health, safety, environment, cost, performance.
- Transform data to compare attributes within each criteria and across criteria.

Alternatives Evaluation

- Select method for comparing target to alternatives
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- Determine viability of alternatives

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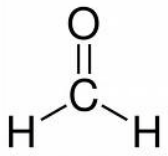
Alternatives Assessment: Formaldehyde

Hardwood Plywood Building Panels[1]

Assessment Criteria		Formaldehyde-based resin reference	PureBond soy-based adhesive
Human Health	Carcinogen in Resin	Yes	+
	Toxic Intermediate in Resin	Yes	=
	Irritant in Resin	Yes	+
Enviro	Ecotoxicity	Minor	=
Technical	Appearance/ Construction	ANSI/HVPA HP-1-2004	=
	Glue bond under moisture	Good (ANSI 3-cycle soak)	=
		Poor (ANSI 3-cycle boil)	+
	Fire Resistance	Good (ASTM E-85 Flame Spread Class C)	=
	Warp Resistance	Variable	=/?
	Product Availability	Good	=
Financial	Cost (1/2 in. 4x8)	$1.25/ft^2 (Columbian's price)	=



Comparison Key: Alt to CoC + Better = Similar – Worse ? Unknown

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[1] TURI: Five Chemicals Alternatives Assessment Study, 2006.

Alternatives Assessment: Formaldehyde

Structural Use Building Panels[1]

Assessment Criteria		Softwood Plywood with formaldehyde-based resin (Reference)	Comparison Relative to formaldehyde-based resin Softwood Plywood and OSB	
			Homasote	Viroc
Human Health	Carcinogen in Binder	Yes	+	+
	Irritant in Binder	Yes	+	=
Enviro	Ecotoxicity	Minor	+	+
	Natural Resource Conservation	Poor	+	?
	Energy Intensity	Neutral	?	-
Technical	Weight (1/2 in) lb/ft^2	Acceptable	+	-
	Fire Resistance	Good (Class C)	=	+
	Insect/Rot/Mold Resistance	Acceptable	+	+
	Load bearing/weight	Good	-	-
	Impact Resistance	Good	-	+
	Tensile Strength (lb/in^2	Excellent	-	-
	Shear	Good	+	
	Permeance	Acceptable	+	+
	Linear Expansion (50-90% RH)	Good	-	+
	“Weatherability”	Acceptable	?	?
	Nail Pull (Dry)	50 lbs	+	+
	R Value	.6	+	-
Financial	Cost (1/2 in. 4x8)	$14	-	-

[1] TURI: Five Chemicals Alternatives Assessment Study, 2006.

Alternatives Assessment: Lead

Wheel Weights[1]

Assessment Criteria		Lead Reference	Copper	Steel	Tin	Zinc
Human Health	Carcinogenicity	EPA B2	+	+	+	+
	Repro/D.Tox	IARC 2B	+	+	+	+
	Occup. Exposure	0.05 mg/m^3	+	+	+	+
Enviro	Drinking Water	15 g/L	+	+	+	?
	Aqu Tox (Freshwater)	65 g/L	-	+	?	+
	Aqu Tox (Saltwater)	210 g/L	-	?	?	-
Technical Performance	Density	11.34 g/cm^3	-	-	-	-
	Malleability	Good	=	-	=	-
	Corrosion Resistance (with coating)	Good	=	=	+	=
Cost	Price per weight (coated, ½ -2 oz)	$0.25-$0.43	-	=/+	-	=
	Available in clip-on & adhesive styles	Yes	-	=	-	=
	End-of-life Costs (Auto Shredder)	Average	+	+	+	+

[1] TURI: Five Chemicals Alternatives Assessment Study, 2006.

Alternatives Assessment: Perchloroethylene

Dry Cleaning (Revised)

Assessment Criteria		PCE Reference	Hydro Carbon	Siloxane	n Propyl Bromide	CO2	Wet Cleaning
Human Health	Carcinogenicity	2A	+	?/=	?/=	+	+
	Mutagenicity	No	=	=	=	=	=
	Repro/D.Tox	No/?	=	=	-	=	=
	Dermal/Oral/Resp.	Irritant	?	+	-	=	=
	Exposure Limits	100 ppm; 25 TLV	+	-	-	?	+
Safety	Flammability	Non-F	-	-	?	-	=
	Reactivity	Non-R	=	=	=	=	=
	Corrosivity	Non-C	=	=	=	=	=
Enviro	Water	60 days	+	?/-	+	+	+
	Soil	120 days	-	?/-	+	+	+
	Sediment	540 days	+	?/-	+	+	+
	Air	98 days	-	?/-	+	-	+
	VOC emissions	No	-	=	=	=	=
	Energy		-	-	?	+	+
	BCF	83	-	+	-	+	+
Technical	Time	45 min	-	-	=	=	=
	Load Capacity	60 lbs	-	+	=	=	=
	# of Soils		-	-	=	=	=
	Clothing Types		+	=	=	+	=
	Spotting Requirements		-	-	=	=/-	=
	Training		=	=	=	-	-
	Market Diffusion		=	=	?	-	-
Financial	Equipment		-	-	+	-	+
	Solvent		+	?	=	?	+
	Labor		-	?	=	?	=
	Operating		=	?	=	?	=
	Regulatory		+	=	?	+	+

Alternatives Assessment: Value Trade-Offs

PCE Dry Cleaning vs. Alternatives

Criteria	PCE	Petrolum	Siloxane	nPB	CO2	PWC
Human Health	CA		? CA	↑ Repro ↑ Occup. Risk		
Safety	No Fire	↑ Fire	↑ Fire	↑ Fire		
Environment		↑ VOC				
Performance					↓ Diffusion	↑ Training ↓ Diffusion
Cost		↑ Cost	↑ Cost		↑ Cost	

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Complicating Factors in Determining Viability of Alternatives

Complicating Factors	Example	Notes
Weighting intensity of a measure	• Perc=25 ppm • nPB=10 ppm	• Useful for screening criteria and determining overall viability.
Weighting relative importance of measures and criteria.	• Perc: Toxicity • Petroleum: Smog	• Useful for screening criteria and determining overall viability.
Unknown data for any measure.	• nPB: Energy	• Weighing uncertainty for screening, viability of a category and technology.
Mixed results within criteria – e.g. better, worse, unknown.	• Wet cleaning performance	• Necessary if determining overall viability of criteria and technology
Conflicting data within a measure.	• Siloxane: carciongen	• Meta-analysis.
Multiple alternatives, with some viable and superior to others on health and environmental factors.	• Wet cleaning and CO2 superior	• How to deal with sub-optimal alternatives.
Social utility	Formaldehyde structural panels • Social utility high and no apparent viable alternatives	• How to deal with CoC use when social utility low and no viable alts available.

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Alternatives Evaluation:

Alternatives Assessment

- Identify potentially viable alternatives.
- For target and each alternative, collect data on five general criteria: health, safety, environment, cost, performance.
- Transform data to compare attributes within each criteria and across criteria.

Alternatives Evaluation

- Select method for comparing target to alternatives
- Identify critical trade-offs
- Weight importance of attributes (e.g., cancer vs. endocrine disruptor) or criteria (e.g. health vs. cost)
- Determine viability of alternatives

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Methods for Determining Viability of Alternatives

- Guiding Principles
  - Qualitative approach
- Multi-Criteria Decision Analysis
  - Quantitative approach
- Hybrid

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Guiding Principles Method
-- Example --

SNAP: Significant New Alternatives Program
(Verifies safety of substitutes for ozone-depleting compounds)

<u>Guiding Principles</u>

- Evaluate substitutes within a comparative risk framework.
- Do not require that substitutes be risk-free to be found acceptable.
- Restrict only those substitutes that are *significantly* worse to human health and the environment.

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Guiding Principles Method
-- Example --

Superfund Guiding Principles for Selecting Remediation Options

Guiding Principles

- Long-term effectiveness – high weighted
- Reduction of toxicity through treatment – high weight
- Short-term effectiveness
- Implementability
- Cost-effectiveness

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Multi-Criteria Decision Analysis (MCDA)

- A discipline aimed at supporting decision makers faced with making numerous and conflicting evaluations. MCDA aims at highlighting these conflicts and deriving a way to come to a compromise in a transparent process.

- Application of environmental decision-making
  - Fisheries
  - Land use
  - Wildlife management
  - Watershed management

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Range of MCDA Methods

- Noncompensatory Methods: bad score on one attribute/criteria can't make up by good score on another

  - Examples:
    - Pros & Cons: alt. with strongest pros and weakest cons selected
    - Maximin: alt. where weakest score is highest
    - Conjuctive: alt. acceptable if it meets minimum cutoff for all attributes

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Range of MCDA Methods

- Compensatory/Partially Compensatory Methods: bad score on one attribute/criteria can make up by good score on another
  - Examples:
    - Multi-Attribute Utility Theory: Transforms diverse criteria (cost, risk, etc) into common dimensionless scale. Assigns weights to each criteria to derive an overall score.
    - Outranking: One option outranks another if it outperforms the other on enough criteria of sufficient importance and is not significantly outperformed on any one criteria.

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Policy Choices: Cal. Air Resource Board

PCE Dry Cleaning vs. Alternatives

Staff Recommendation

Policy Options	Content	Analysis
Staff Recommendation	No PCE phase out	Engineering controls sufficient to create acceptable risk.
Option 1	PCE phase out	Most of market would go to petroleum and create unacceptable increase in VOC.
Option 2	PCE and petroleum phase out	Most of market would go to siloxane and create unacceptable increase in cost.

Board Ruling

Policy Options	Content	Analysis
Staff Recommendation	No PCE phase out	Engineering controls sufficient to create acceptable risk.
Option 1	PCE phase out	Most of market would go to petroleum and create unacceptable increase in VOC.
Option 2	PCE and petroleum phase out	Most of market would go to siloxane and create unacceptable increase in cost.

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MCDA Method Used in CARB Perc Dry Clean Ruling

- Outranking
  - Staff weighting:
    - Option 1 (PCE phase out) rejected because another attribute (VOC emissions) significantly worse.
  - Board weighting:
    - Option 1 accepted because PCE phase out outperforms staff recommendation (engineering controls) another attribute (VOC emissions) not significantly worse.
    - Option 2 (PCE and VOC phase out) rejected because another attribute (cost) significantly worse.

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Conclusion

- Alternatives analysis can be applied to identify viable substitutes for hazardous products and processes.
- Alternative assessment methods for summarizing data on target and alternatives promising but underdeveloped.
- Alternatives evaluation methods for weighing attributes to determine overall viability of alternatives promising but underdeveloped.
- Development of effective and efficient alternatives analysis methods will drive innovation and diffusion of safer/greener substitutes.
- STPP committed to developing alternatives analysis methods through project

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STPP Projects

- Current/Proposed
  - Environmental Garment Care Demonstration Project
  - Safer Alternatives to Lead
  - Green Solar Power Project
  - Goods Movement and Safer Alternatives
  - Hazards of Methyl Iodide as a Fumigant
  - Inherently Safer Design in Petroleum Refineries
  - Regulatory Integration of Predictive Toxicology
  - Others?

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AB 1879: Linking Alternatives Assessment Results to Regulatory Response

- Statute links alternatives assessment evaluation to regulatory response
    - "(A)dopt regulations that establish a process for evaluating chemicals of concern in consumer products, and their potential alternatives, to determine how best to limit exposure or to reduce the level of hazard posed by a chemical of concern."
    - Since statute requires the evaluation of alternatives, more likely an alternative is viable, the stronger the regulatory response should be in promoting its use.

AB1879
List of Regulatory Response Options

(b) The regulations adopted pursuant to this section shall specify the range of regulatory responses that the department may take following the completion of the alternatives analysis, including, but not limited to, any of the following actions:

(1) Not requiring any action.

(2) Imposing requirements to provide additional information needed to assess a chemical of concern and its potential alternatives.

(3) Imposing requirements on the labeling or other type of consumer product information.

(4) Imposing a restriction on the use of the chemical of concern in the consumer product.

(5) Prohibiting the use of the chemical of concern in the consumer product.

(6) Imposing requirements that control access to or limit exposure to the chemical of concern in the consumer product.

(7) Imposing requirements for the manufacturer to manage the product at the end of its useful life, including recycling or responsible disposal of the consumer product.

(8) Imposing a requirement to fund green chemistry challenge grants where no feasible safer alternative exists.

(9) Any other outcome the department determines accomplishes the requirements of this article.

AB1879
Proposed Hierarchy of Regulatory Response Options

(5) Prohibiting the use of the chemical of concern in the consumer product.

(4) Imposing a restriction on the use of the chemical of concern in the consumer product.

(6) Imposing requirements that control access to or limit exposure to the chemical of concern in the consumer product.

(7) Imposing requirements for the manufacturer to manage the product at the end of its useful life, including recycling or responsible disposal of the consumer product.

(3) Imposing requirements on the labeling or other type of consumer product information.

(8) Imposing a requirement to fund green chemistry challenge grants where no feasible safer alternative exists.

(2) Imposing requirements to provide additional information needed to assess a chemical of concern and its potential alternatives.

(1) Not requiring any action.

(9) Any other outcome the department determines accomplishes the requirements of this article.

Linking Alternatives Assessment Outcome to Regulatory Response

Alternatives Assessment Outcomes	**Regulatory Response**
I. Alternative established as viable	• For CoC: Prohibiting the use of the chemical of concern in the consumer product. (5) • For Alternative with residual hazard: See below
II. Where: • No viable alternative for certain use, or • Alternative viable but with residual hazard, or • III., below	As appropriate for CoC or alternative: • Imposing requirements on the labeling or other type of consumer product information. (3) • Imposing a restriction on the use of the chemical of concern in the consumer product. (4) • Imposing requirements that control access to or limit exposure to the chemical of concern in the consumer product. (6) • Imposing a requirement to fund green chemistry challenge grants where no feasible safer alternative exists. (8)
III. Data missing for complete alternatives assessment	Imposing requirements to provide additional information needed to assess a chemical of concern and its potential alternatives,(2) and, as appropriate, response from II., above
IV. For all CoC and alternatives	As appropriate, imposing requirements for the manufacturer to manage the product at the end of its useful life, including recycling or responsible disposal of the consumer product. (7)

Conclusion

- Alternatives assessment: Scientific process of determining viability of an alternative to a CoC use.
- Problematic for CoC manufacturers/users to conduct alternatives assessment due to inherent conflict of interest.
- Preferable for 3rd party to conduct alternatives assessment.
- Regulations should specify how alternatives assessment should be conducted.
- Regulations should include specific decisions rules to determine viability of alternatives.
- Alternatives assessment outcomes should be explicitly linked in regulation to regulatory response.

Structure of AB1879

Goal

How best to limit exposure or to reduce the level of hazard posed by a chemical of concern in consumer products by evaluating the chemical of concern and their potential alternatives.[1]

Process

Evaluate alternatives through a life-cycle assessment tool which takes into account hazard traits, public health measure, environmental impacts, function and performance of the product, and financial impacts.

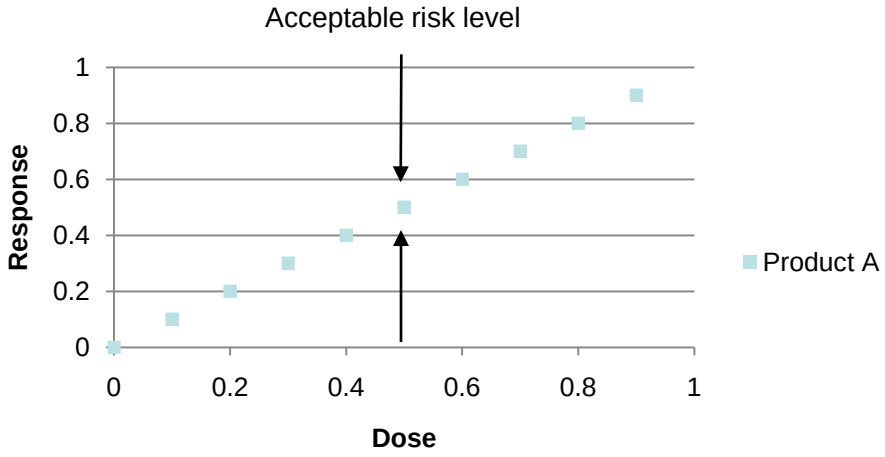
Action

After life-cycle assessment of alternatives is completed, choose the best way to limit exposure or reduce hazard of a chemical of concern in the consumer product through a range of regulatory actions: from taking no action to prohibiting use.

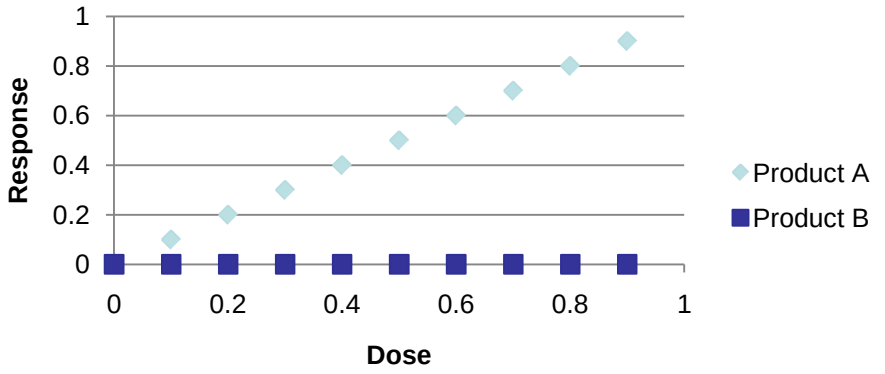
1. SB509: "Consumer product" means a product or part of the product that is used, brought, or leased for use by a person for any purposes.

Risk Reduction Paradigms

- Risk Management
  - Science: Risk Assessment
  - Policy: Acceptable Risk



- Risk Prevention
  - Science: Alternatives Analysis
  - Policy: Substitution



Defining Alternatives Assessment

- An analysis of alternatives and opportunities that prevent impacts from potentially harmful activities.

Ken Geiser, 2004

AB1879:
Opportunities and Opportunities to Fail

- Opportunities
  - Covers all chemicals in commerce.
  - Authority to phase out CoC use when safer alternatives identified.
  - Capable of spurring innovation of safer substitutes.

- Challenges
  - Statute does not provide guidance on how to conduct alternative assessment.
  - Statute does not provide guidance on appropriate regulatory response.
  - No funding in statutes for implementation.
  - If 2011 regulations not property formulated, could be counter-productive. Chemical by chemical bills may be better.

Adaptive Decision Framework

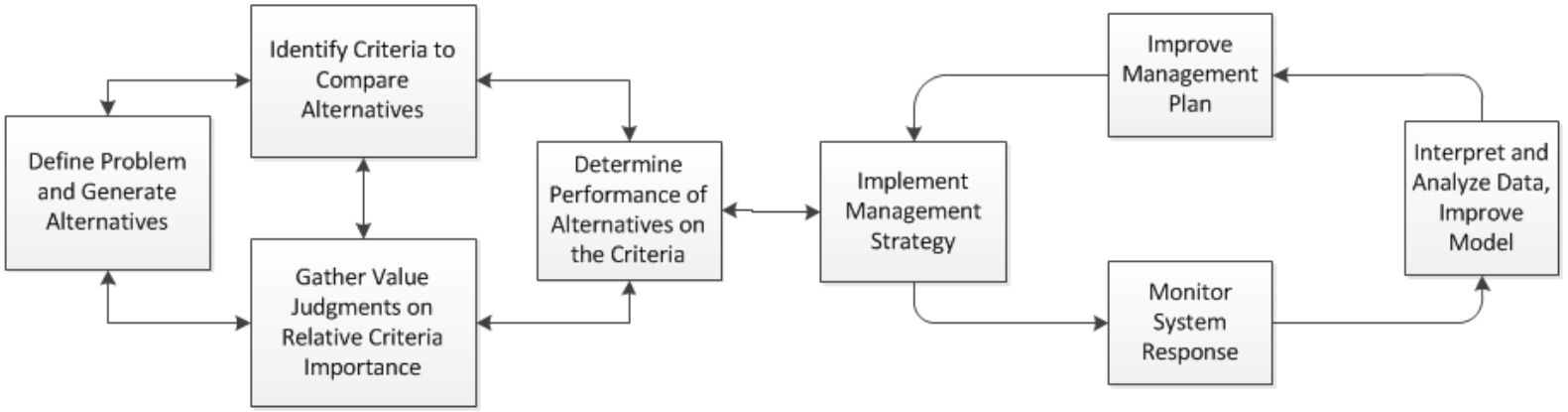
People:

Policy Decision Makers

Scientists and Engineers

Stakeholders (Public, Business, Interest Groups)

Process:



Tools:

Environmental Assessment/Modeling (Risk/Ecological/Environmental Assessment and Simulation Models)

Decision Analysis (Group Decision Making Techniques/Decision Methodologies and Software

Risk Prevention Model

Procedures for Determining Viability of Alternatives

- Screening
  - Qualitative comparison of measures or criteria.
- Weighting
  - Quantitative assessment of importance of measures or criteria.
    - Ex: Measure: Carcinogen vs. irritant
    - Ex: Criteria: Human health vs. cost
  - Social utility can be used as part of the weighting process.
- Scoring
  - Quantitative assessment of criteria, measure, or overall technology.

Possible Decision Rules Establishing Viability of Alternatives

- Option 1: If alternative has at least one measure for human health positive (+) and all other measures from other categories positive (+) or equal (=):
  - Then alternative classified as a viable safer substitute.

    Ex: Perchloroethylene dry cleaning: Professional wet cleaning alternative.

- Option 2: If alternative has at least one measure for human health positive (+), all other measures from human health and environmental categories at least equal, and at least one measure from performance or cost negative or uncertain:
  - Then evaluate further or weigh importance of this measure before determining viability of the alternative.

    Ex: Formaldehyde plywood panels: Pure-Bond soy-based alt: Performance (warp).
    Lead wheel weights: Steel alt: malleability and density.