



# Session D - Alternatives Assessment for TUR

Pam Eliason, TURI

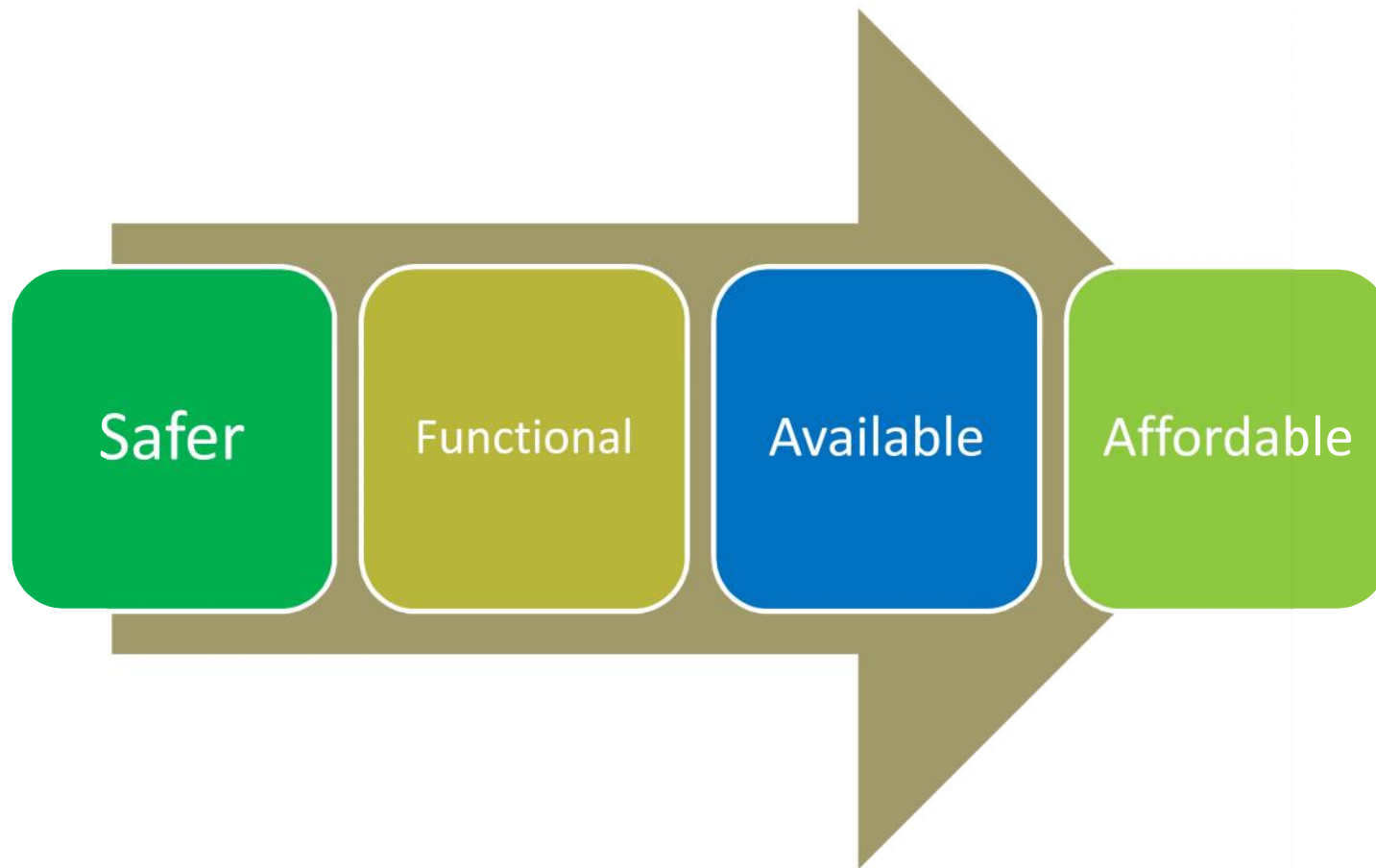
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# Overview

- Performance considerations in AA
- Small group research – interview stakeholders
- Economic considerations in AA
- Time permitting – more tools for chemical hazard assessments

# Alternatives Assessment is about MORE than Chemical Comparisons



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# Open Pool Pallet Market – Rapid Turnover Consumer Products

- Such as ...
  - Groceries
  - Consumer Electronics
- Users needs focus on minimizing risks to transported goods and on facilitating efficient movement of goods

# Key GMA Specifications

- Fire protection
- Size and Structure
- Weight
- Sanitation
- Durability
- Strength
- Recyclability
- Repair
- Moisture and Weather Resistance



The Association of Food, Beverage  
and Consumer Products Companies



“Very Important” Attribute	%
Purchase Price	61
Durability	58
Strength	57
Cost per use	55
Reusability	53
Availability	42
Easy to clean	38
Recyclability	32
Weight	31
Design versatility	26
Ease of disposal	24
Fire rating	19
Ease of Repair	15

# User Considerations in Plastic Pallet Selection

# Closed and Open-Pool

- Most pallets part of closed pool system
- Open pool increasingly important part of market
- FR in plastic pallets?
  - Small percentage of closed-pool pallets
  - Virtually all in open-pool systems

# Exercise 1 - Gathering Performance Data

- Identify stakeholders who may have information you need to assess alternatives from the perspective of functionality
- Develop list of stakeholders





# Exercise 2 – Stakeholder Criteria Scavenger Hunt

- Develop your team’s strategy with respect to gathering information from stakeholders
- “Interview” stakeholders
- Use information to further refine your recommended/preferred alternatives

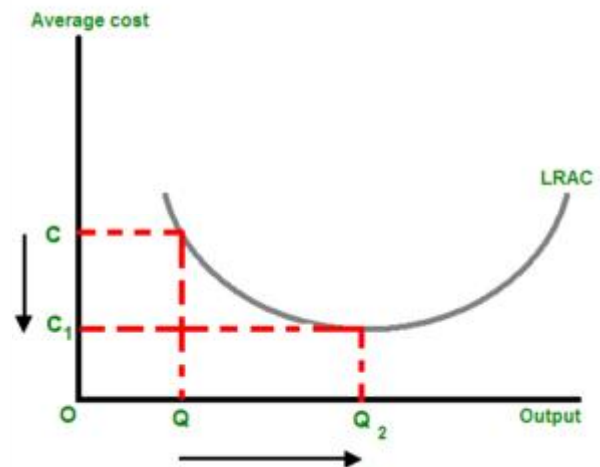


# Availability of Alternatives

- Recall Maine's definition of a "safer" alternative
- Reliable sources of quality materials are critical to companies wishing to switch to safer alternatives
- What can you say about the availability of the alternatives you've assessed so far?

# Economic Considerations – Factors that Influence Price

- Demand for alternatives can influence production
- Hidden costs – occupational health, insurance, etc
- Life cycle costs – production, use, disposal



# Reminder: Financial Analysis Requirements

## Economic Evaluation of Potential TUR Techniques (310 CMR 50.46A)

- The TUR plan must include the discount rate, cost of capital, depreciation rate, or payback period, if any, used in each analysis
- The discount method, depreciation rate, and payback period must be consistent with the toxic user's current capital budgeting procedures
- The economic feasibility decision must be made at least consistent with the toxic user's current business decision making practices

# Financial Analysis

- **PURPOSE:** To determine whether an investment adds economic value to a company
- **METHOD:** Calculate cash flows over the life of a project and apply measure(s) of profitability
- **PROCESS:**
  - Collect incremental cost information
  - Determine cash flows
  - Apply measures of profitability
  - Interpret Results

# What Costs to Include

## LABOR

Production  
Material handling  
Inspection  
Recordkeeping  
Reporting  
Monitoring  
Labeling  
Manifesting  
Stocking  
Training

## MATERIALS

Raw materials  
Solvents  
Cleaners  
Process water  
Cleaning water  
Office supplies  
Training materials  
Safety materials  
Parts

## EQUIPMENT

Production  
Cleaning  
Degreasing  
Material handling  
Storage  
Waste treatment  
Water treatment  
Air pollution control  
Painting  
Protective  
Safety

## OTHER

Depreciation  
Maintenance  
Waste disposal  
Insurance  
Taxes  
Utilities  
Regulatory fees  
Lab fees  
Health & Safety  
Liability

# “Accounting” for Costs

- **Conventional Cost Accounting** often does not account for many “indirect costs” or “hidden” costs associated with toxics use
- Raw data not often neatly packaged
- Primary sources of data:
  - **Interviews** with plant operational and environmental personnel
  - **Records** from purchasing, payroll, accounting
  - **Logs** of activities or material usage
  - **Receipts** and **Invoices** from suppliers & vendors
  - **Vendors** - new equipment & industry price trends
  - **Measurements** - times, volumes, flow rates

# Case Study Users' Considerations

- Consider Sunny Delight and Kellogg
- Large group discussion: What were some of the specific concerns about costs for users of pallets?
- How might the availability, performance or safety of alternatives modify their concerns about costs?





# Final Assessment

- What would you recommend to
  - Maine DEP
  - Users of pallets
  - Public health and safety advocates
  - Environmental health and safety advocates
  - Plastic pallet manufacturers



# Why Learn Alternatives Assessments

- Businesses, governments and NGOs are promoting it
- TUR Planners have expertise in technical and economic feasibility evaluations
  - Other groups tend to not be as sophisticated and experienced at that
- AA emphasizes the use of tools to rigorously assess whether alternatives are “safer”
  - Avoid regrettable substitutions!

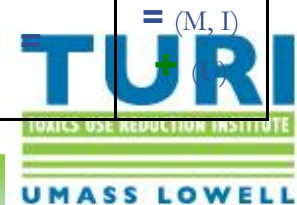
# In Case We Have Time ....

- More information on tools to help in assessing whether potential alternatives/options are in fact “safer”
  - Alternatives assessments – TURI, DfE
  - Pharos
  - P2OASys

# What about Materials?

- TURI's Five Chemical Study – life cycle thinking approach

Assessment Criteria		DEHP/PVC Reference	Comparison of Materials to DEHP/PVC Flooring		
			Linoleum	Cork	Polyolefin
Performance Criteria	Color/Pattern Choices	Large	=	-	=
	Ease of Maintenance	Easy	=	=	=
	Recyclable	Yes	-	-	=
Cost	Purchase and Installation Cost	\$2 - \$10/ft <sup>2</sup>	=	=	=
	Expected Lifespan of Material	25+ years	+	+	+
Environmental Criteria	Derived from Sustainable Material	No	+	+	=
	Use Environmentally Preferred Materials for Installation	Possible	=	+	=
	Energy Use/ GHG emissions (mfg)	Ref.	+	?	=
	Biodegradable/ Compostable	No	+	+	=
Human Health Criteria	Emissions of VOCs <ul style="list-style-type: none"> <li>• Manufacture</li> <li>• Installation</li> <li>• Use</li> </ul>	Yes (M, I, U)	=		= (M, I) + (U)



# DfE Example: Alternative flame retardants in PCBs

Chemical	CASRN	Human Health Effects									Aquatic Toxicity		Environmental		Exposure Considerations	
		Acute Toxicity	Skin Sensitizer	Cancer Hazard	Immunotoxicity	Reproductive	Developmental	Neurological	Systemic	Genotoxicity	Acute	Chronic	Persistence	Bioaccumulation		
<b>Additive Flame Retardants<sup>3</sup></b>																
<b>Aluminum hydroxide</b>																
Aluminum hydroxide	21645-51-2	L	L	L	M	L	L	M	L	L	H	M	H <sup>R</sup>	L		
<b>Exolit OP 930 (phosphoric acid, diethyl-, aluminum salt) (Clariant)</b>																
Exolit OP 930	225789-38-8	L	L	L	M	L	M	M	L	L	M	M	H <sup>R</sup>	L		
<b>Melapur 200 (Melamine polyphosphate) (Ciba)<sup>4</sup></b>																
Melapur 200	218768-84-4	L	L	L	L	L	L	L	M	M	L	L	M	L		
Polyphosphoric acid	8017-16-1	L	L	L	L	L	L	L	L	L	L	L	L	L		
Melamine	108-78-1	L	L	L	L	L	L	L	M	M	L	L	M	L		
<b>Silicon dioxide amorphous<sup>5</sup></b>																
Silicon dioxide amorphous	7631-86-9	L	L	L	L	L	L	L	H <sup>S</sup>	L	L	L	H <sup>R</sup>	L		
<b>Silicon dioxide crystalline<sup>5</sup></b>																
Silicon dioxide crystalline	1317-95-9	L	L	H <sup>4</sup>	H <sup>S</sup>	L	L	L	H <sup>S</sup>	H <sup>S</sup>	L	L	H <sup>R</sup>	L		
<b>Magnesium hydroxide</b>																
Magnesium hydroxide	1309-42-8	L	L	L	L	L	L	L	L	L	L	L	H <sup>R</sup>	L		

<sup>1</sup> The moderate designation captures a broad range of concerns for hazard, further described in Table 4-3.

<sup>3</sup> Although additive flame retardants are present throughout the lifecycle of the PCB, they are locked into the polymer matrix of the epoxy laminate material.

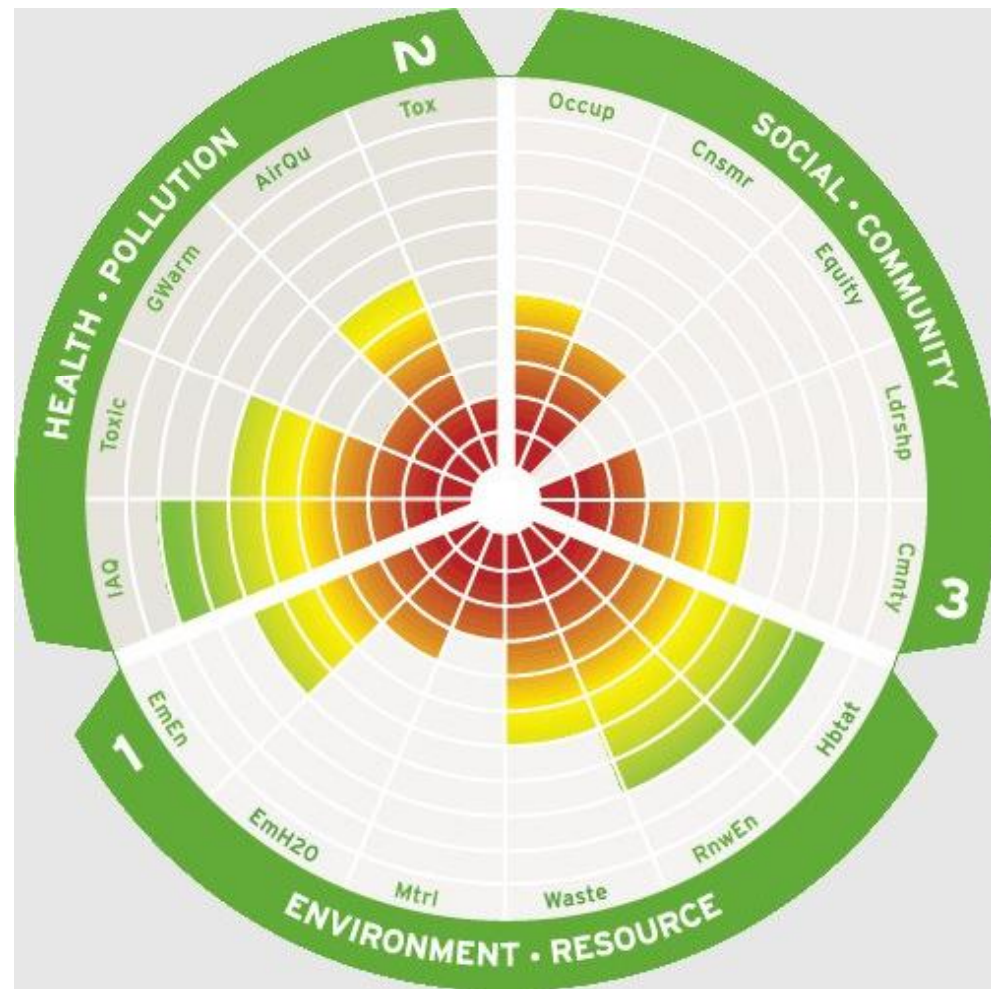
<sup>4</sup> Melapur 200 dissociates in water to form polyphosphoric acid and melamine ions. For this reason, Table 4-1 includes both dissociation ions.

<sup>5</sup> Representative CAS numbers are included in this summary table. Section 4.2.9 includes a full list of CAS numbers.

# Pharos: Building Materials Selection Tool

## Target Materials:

- PVC
- Pressure Treated Wood
- Plastic Lumber
- Formaldehyde
- Biopolymers





# Pollution Prevention Options Assessment System (P2OASys)

Designed to assist companies in two ways:

- Examine the potential environmental and worker impacts of options - the total impacts of process changes
- Compare options with the current process based on quantitative and qualitative factors.

[http://www.turi.org/Our\\_Work/Research/Alternatives\\_Assessment/Chemical\\_Hazard\\_Comparison\\_Tools/P2OASys\\_Tool\\_to\\_Compare\\_Materials](http://www.turi.org/Our_Work/Research/Alternatives_Assessment/Chemical_Hazard_Comparison_Tools/P2OASys_Tool_to_Compare_Materials)

Category	Units	Cert.	Score	Component 1		
				TRICHLOROETHYLENE		
				% 100		
				Val	Sec	Cert
<b>Acute human effects</b>		Cert	Score	Val	Sec	Cert
Inhalation LC50	ppm					
PCL/TLV	ppm	100	4	100	4	100
PFI /TI V (dusts/particles)	mg/m <sup>3</sup>					
IDLH	ppm	100	2	1000	2	100
Respiratory irritation	l /MH	100	8	m/h	8	100
Oral LD50	mg/kg	100	10	4	10	100
dermal irritation	L/MH	100	4	l/m	4	100
skin absorption	L/MH	100	2	l	2	100
dermal LD50	mg/kg					
ocular irritation	L/MH	100	10	h	10	100
<b>Chronic human effects</b>		Cert	Score	Val	Sec	Cert
Reference Dose RfD	mg/kg/day					
carcinogen	MBE/PA class	100	8	b	8	100
mutagen	l /MH	100	2	l	2	100
reproductive effects	l /MH	100	2	l	2	100
neurotoxicity	l /MH	100	6	m	6	100
developmental effects	L/MH	100	2	l	2	100
respir. sensitivty/disease	L/MH					
other chronic organ effects	L/MH	100	6	m	6	100
<b>Physical hazards</b>		Cert	Score	Val	Sec	Cert
heat	WBCT, °C					
noise generation	dBA					
vibration	m/s <sup>2</sup>					
ergonomic hazard	L/MH					
psychosocial hazard	L/MH					
<b>Aquatic hazards</b>		Cert	Score	Val	Sec	Cert
Water Quality Criteria (HWQC)	mg/l					
aquatic LC50	mg/l	100	4	660	4	100
fish NOAEC	mg/l					
plant EC 50	mg/l	100	2	535	2	100
observed ecological effects	l /MH	100	10	h	10	100
<b>Persistence/bioaccumulation</b>		Cert	Score	Val	Sec	Cert
persistence	l /MH					
BOD half-life	days	100	6	20	6	100
hydrolysis half-life	days	100	8	330	8	100
bioconcentration	log <sub>10</sub> kw	100	10	253	10	100
bioconcentration factor (BCF)	kg/l					
<b>Atmospheric hazard</b>		Cert	Score	Val	Sec	Cert
greenhouse gas	YN					
ozone depleter	ODP units					
acid rain formation	YN					
NFSLIAP	YN					
<b>Disposal hazard</b>		Cert	Score	Val	Sec	Cert
landfill	l /MH					
EPCRA reportable quantity	lbs	100	6	100	6	100
incineration	L/MH					
recycling	L/MH					
<b>Chemical hazard</b>		Cert	Score	Val	Sec	Cert
vapor pressure	mm Hg	100	8	57.8	8	100
solubility in water	mg/L					
specific gravity	N/A					
flammability	0,1,2,3,4	100	4	1	4	100
flash point	°C	100	6	37	6	100
reactivity	0,1,2,3,4	100	2	0	2	100
pH	pH units					
corrosivity	L/MH	100	2	l	2	100
High pressure system	L/MH					
High temperature system	L/MH					
mixture/reaction potential	L/MH	100	6	m	6	100
order threshold	l /MH	100	10	h	10	100
volatile organic compound	l /MH					
<b>Energy &amp; resource use</b>		Cert	Score	Val	Sec	Cert
non renewable resource	L/MH					
water use	L/MH					
energy use	L/MH					
<b>Product hazard</b>		Cert	Score	Val	Sec	Cert
upstream effects	L/MH					
consumer hazard	l /MH	100	2	l	2	100
disposal hazard	l /MH	100	8	m/h	8	100
<b>Exposure potential</b>		Cert	Score	Val	Sec	Cert
Exposure potential	L/MH	100	8	m/h	8	100

# P2OASys EHS Evaluation

- Pollution Prevention Options Analysis System
  - [http://www.turi.org/for\\_industry/sustainable\\_business\\_tools/cleaner\\_production/p2oasys\\_tool\\_to\\_compare\\_materials](http://www.turi.org/for_industry/sustainable_business_tools/cleaner_production/p2oasys_tool_to_compare_materials)
- Systematically examines potential environmental and worker impact of options
- Compares TUR options with company's current technology based on quantitative and qualitative factors
- Weighted scores to 10 – higher scores are less safe options



# P2OASys Assessment Categories

Major Category	Number of Criteria
• Acute human effects	10
• Chronic human effects	8
• Physical hazards	5
• Aquatic hazards	5
• Persistence/bioaccumulation	5
• Atmospheric hazard	4
• Disposal hazard	4
• Chemical hazard	13
• Energy & resource use	3
• Product hazard	3
• Exposure potential	1

# P2OASys Criteria

<b>Help !!!</b>		<b>To → Alternative 1</b>								
Fill out only the <b>green cells</b> ; do not forget the component %										
<b>Current Technology</b>										
Category		Units	Cert.	Score	Component 1			Component 2		
					Type name here % 100			Type name here %		
Acute human effects			Cert	Score	Val	Scor	Cert	Val	Scor	Cert
Inhalation LC50		ppm								
PEL/TLV		ppm								
PEL/TLV (dusts/particles)		mg/m3								
IDLH		ppm								
Respiratory irritation		L/M/H								
Oral LD50		mg/kg								
dermal irritation		L/M/H								
skin absorption		L/M/H								
dermal LD50		mg/kg								
ocular irritation		L/M/H								
Chronic human effects			Cert	Score	Val	Scor	Cert	Val	Scor	Cert
Reference Dose RfD		mg/kg/day								
carcinogen		IRRC/EPH Class								
mutagen		L/M/H								
reproductive effects		L/M/H								
neurotoxicity		L/M/H								
developmental effects		L/M/H								
respir. sensitivty/disease		L/M/H								
other chronic organ effects		L/M/H								

# Example of P2OASys Comparison

Category	Trichloroethylene		Acetone		Terpenes-Limonene		Caustic	Aqueous	Value Weight
	Score	Certainty	Score	Certainty	Score	Certainty	Score	Certainty	
Acute human effects	10	100	9	100	4	100	10	100	10
Chronic human effects	7	100	5	100	2	100	2	100	10
Physical hazards									10
Aquatic hazard	7	100	2	100			6	100	10
Persistence/bioaccumul	9	100	7	100	6	100			10
Atmospheric hazard							2	100	10
Disposal hazard	6	100	2	100					10
Chemical hazard	9	100	10	100	7	100	10	100	10
Energy/resource use					10	100	6	100	10
Product hazard	5	100	2	100	2	100			10
Exposure potential	8	100	4	100	2	100			10
<b>Final</b>	<b>61</b>		<b>41</b>		<b>33</b>		<b>36</b>		<b>110</b>
<b>Weighted Final</b>	<b>7.63</b>	<b>100.00</b>	<b>5.13</b>	<b>100.00</b>	<b>4.71</b>	<b>100.00</b>	<b>6.00</b>	<b>100.00</b>	