



# **Driving Safer Building Materials**

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# Environmental Impact of Buildings

## Buildings

- Use 40% of raw material globally (3 billion tons annually)
- Consume 41% of total U.S. energy
- Consume 65% of total U.S. electricity
- Emit 40% of total U.S. greenhouse gas
- Generate 136 million tons of construction and demolition waste in the U.S. annually

## Chemicals

- Construction:
  - 3.4% of all chemicals used in the U.S. go into construction
- Including 90% of all formaldehyde and 75% of all PVC



# Conventional Building Materials

- Wood
- Stone
- Cement
- Metal
- Glass
- Straw
- Ceramics





# Synthetic Building Materials

- Mastics
- Caulks
- Paints
- Foams
- Binders
- Insulation
- Counters
- Wallpapers
- Carpets
- Plastics



# Chemicals of Concern in Common Building Products

Material	Chemicals	Associated Hazards
Foam Insulation	polystyrene, isocyanates	ozone depletor, possible carcinogen, mutagen
Fiber Insulation	fiberglass, mineral wool	respiratory toxin
Paints, coatings	cadmium, cobalt, VOCs	PBT, developmental toxin
Binders	phenol-formaldehyde	carcinogen, neurotoxin
Sealants, adhesives, chinks	chloroprene, bisphenol A	carcinogen, endocrine disruptor
Carpets, windows, doors, wall coverings	phthalates, flame retardants	developmental toxin, endocrine disruptor
Roofing, flashing	lead	PBT, reproductive toxin
Switches, thermostats	mercury	PBT, neurotoxin, development disruptor
Textiles, furnishings	brominated flame retardants	endocrine disruptor

# Occupational Exposures of Chemicals of Concern in Building Materials

Material	Chemical	Exposure conditions
Cement	silica, additives (fly ash, heavy metals, radon)	mixing, cutting, deconstructing
Blown insulation	HFCs, pentane	foam blowing
Spray foam insulation	isocyanate	foam blowing
Paints and coatings	cadmium, cobalt, VOCs	painting
Treated lumber	pentachlorophenol, arsenic, creosote	cutting, handling, deconstructing
Epoxy caulks	bisphenol A	mixing, applying
Plastics	brominated flame retardants, additives	cutting, drilling, installing



## ***Example: Polyurethane Foam containing Unreacted Diisocyanates***

- California Safer Consumer Products Regulation Priority Product
- Diisocyanates used in spray polyurethane foam used in insulation, roofing and void sealing
- Diisocyanates are a leading cause of asthma in construction workers
- IARC considers toluene diisocyanates Group B Possible Human Carcinogen



# Are New Building Materials Safer?

Stabilized foamed aluminum

Fire resistant steel

Fiber-infused concrete

Monolithic glass ceramics

Fiberglass-reinforced plastic

Aluminum laminates

Zinc-titanium-copper alloys

High-density epoxy

Coating resins

Perfluorinated coatings

Carbon fiber

Polyamide

Composites

Ductal concrete

**Toxic constituents**

**Energy intensive  
production**

**Heavy life cycle impacts**

**Difficult to de-construct**

**Difficult to recycle**

**Where does this leave  
the Building Designer/Developer?**

# Building Designer Questions



## Conventional Questions:

- What is this building material?
- How will it perform?
- How much does it cost?
- Is it readily available?



# Building Designer Questions



## New Questions

- What chemicals are in this material?
- Will the chemicals be hazardous for building occupants?
- Will the chemicals be dangerous for construction workers?
- What are the life cycle environmental impacts of this material?
- Where does this material come from?

**Can Building Materials be Safer?**

# What is Driving Safer Building Materials?

- Health Concerns
- Market Drivers
- Government Policies
- NGO/Professional Advocacy
- New Building Standards

# 1. Health Concerns

- Indoor Air Quality (IAQ)
  - Chemical indoor air pollutants include lead, formaldehyde, asbestos, chlorinated solvents, petroleum distillates, toluene, and xylene--US EPA
  - 30% of new and renovated buildings receive excessive complaints related to indoor air quality---World Health Organization
- Household Dust Quality
  - Household dust in 10 houses in 7 states found 35 hazardous chemicals, including phthalates, alkylphenols, brominated flame retardants, organo-tins, various pesticides, and perfluorinated surfactants. -- US EPA

# Evidence of Exposure

- Body Burden
  - US Centers for Disease Control has identified 16 exogenous metals, 12 phthalates, and various pesticides in the body fluids of most Americans
    - 90% of samples had bisphenol A,
    - over 50% had perfluorinated compounds and
    - nearly 100% had brominated flame retardants



## 2. Market Drivers

- Energy costs and Greenhouse Gas reduction objectives
- Customer demand for “green” and healthy buildings
- Architects/developers market differentiation by “going green”
- Sustainability—“Smart Growth”, “New Urbanism”

# Eco-labels and Material Product Certifications





### 3. Government Policies

- US EPA Indoor Air Quality Standards
  - volatile organic compounds, mold, radon, etc.
- European Product Directives
  - Restriction on Hazardous Substances (RoHS)
- European Union's REACH Regulation
- Government Building Standards
  - US Federal GSA Building Standards
  - State and Local Government Building Standards
    - formaldehyde, brominated flame retardants, etc.



# US EPA Programs promoting Green Buildings

- Energy Star
- Environmentally Preferred Purchasing
- Indoor Air Plus Program
- Smoke-Free Homes
- *IAQ Design Tools for Schools*
- Federal Radon Action Plan
- EPA's Green Building Portal

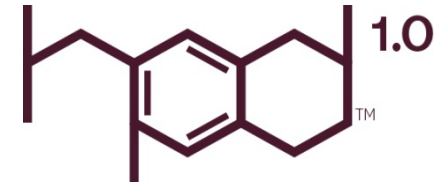


## 4. NGO/Professional Advocacy

- American Institute of Architects
  - AIA 2030 Commitment
- Health Care without Harm & Practice Greenhealth
  - GreenGuide to Health Care
- Healthy Building Network
  - Healthy Product Declaration
  - Pharos

# Health Product Declaration

## Initiated by Healthy Building Network



Standardized reporting  
format for each ingredient:

- Substance name
- Health Hazard Warnings  
(authoritative listings)
- CAS number (or species)
- % of weight of the  
product
- GreenScreen Benchmark
- Recycled content
- Uses nanotechnology
- Role or function

Tuff Stuff X42			Health Product Declaration		
<b>1 GENERAL INFORMATION</b>					
<b>Product Identification Information</b> Manufacturer: Ajax Manufacturing Product ID: SB4353 CSI MasterFormat(s): 09 96 00 Manufacturer URL: www.ajaxmfr.com Product URL: www.ajaxmfr.com/HPCs		<b>Product Description</b> High performance coating designed for painting bath stall walls and other wet surfaces.	<b>Manufacturer Contact Information</b> Contact Name: John Doe, Director of Product Quality Phone: (800) 777-1111 Email: JDoe@AjaxMfr.com Mailing Address: Product Quality Department 100 Smith Street Somewhere, TX 19999		
<b>2 CONTENTS DISCLOSURE</b>					
Certifying Party*: <input checked="" type="radio"/> First <input type="radio"/> Second <input type="radio"/> Third Disclosure level of intentionally added content (100% is ideal): <b>94 %</b> All known residuals disclosed to: <b>100 ppm</b> The manufacturer affirms that all known material content were screened for chemicals of concern and health warning listings using: Pharos Chemical and Material Library from the Healthy Building Network		All ingredients to be screened against chemicals listed on any of the Health Product Declaration Priority lists at <a href="http://www.hpdworkinggroup.org/prioritylists">www.hpdworkinggroup.org/prioritylists</a> All ingredients are assessed against the HPD Priority Lists (check at least one): <input checked="" type="checkbox"/> High Hazards List <input checked="" type="checkbox"/> Precautionary Lists <input checked="" type="checkbox"/> Building Certification Lists <input type="checkbox"/> Other:			
<b>3 CONTENTS IN ORDER OF QUANTITY (Complete list continues onto next page)</b>					
Name	Identifier	%	Health Hazard Warnings and Certification Lists	RC* %	Nano*
1 Bisphenol A diglycidyl ether (BADGE)	1675-54-3	35	(EPA Action): Developmental effects and Reproductive effects (EU ED): Some evidence of biological activity related to endocrine disruption		<input type="radio"/> <input checked="" type="radio"/>
2 Kaolin	1332-58-7	12	No warnings found		<input type="radio"/> <input checked="" type="radio"/>
3 Phenyl Glycidyl Ether	122-60-1	10-12	(Prop 65) Cancer and Male reproductive toxicity (VwVwS): Severe Hazard to Waters (EU H-Statements): H341 Suspected of causing genetic defects [more ... 1]		<input type="radio"/> <input checked="" type="radio"/>
4 Butanedioldiglycidyl Ether	2425-79-8	9	No warnings found. Green Screen Benchmark 3, [2]		<input type="radio"/> <input checked="" type="radio"/>
5 Undisclosed[3]	undisclosed	9	(EU ED) Evidence of endocrine disruption activity (EU R-Phrases) Very toxic to aquatic organisms and possible risk of impaired fertility		<input type="radio"/> <input checked="" type="radio"/>

## Over 20,000 chemicals Screened against 39 authoritative chemical hazard lists Ranked on a GreenScreen-informed hazard scale

- Priority health endpoints
- Confidence in the science
- US EPA IRIS Carcinogens, NWMP Priority PBTs, TRI PBT, Global Warming Potentials and Ozone Depleting Potentials

• NTP ROC	Very High Concern	Persistent Organic Pollutants (POPs) targeted in the Stockholm POPs treaty and other Persistent Bioaccumulative Toxicants (PBTs)*	Highest priority to eliminate
• NIOSH Ca	High Concern	Known or likely carcinogens, mutagens, reproductive toxicants, developmental toxicants or endocrine disruptors.	
• IARC Can	Moderate Concern	Significant possibility of above hazards but lower confidence or known or likely neurotoxicants, respiratory sensitizers or leading to other chronic human or ecotoxicity endpoints.	
• European	Caution	Moderate concern for any of the above health endpoints or preliminary indications of higher concern but with inadequate test data or acute human health concern	Use with caution. Avoid where possible
• State of V	Low Concern	Tested with low concern for any of the above endpoints**	Prefer
• State of C			
• OSPAR P			
• Rotterdam			
• Stockholm			
• State of C			
• Associati			

## 5. New Building Standards

- BREEAM (UK) and DGNP (Germany)
- LEED— US Green Building Council
- Green Globes— Green Building Initiative
- Living Building Challenge
- SBTool 07— International Institute for a Sustainable Built Environment
- International Green Construction Code

# LEED



- Leadership in Energy and Environmental Design (LEED) sponsored by the US Green Building Council (USGBC)
- Nearly 49,000 commercial and Institutional LEED projects in all 50 states and 130 countries
- More than 24,000 LEED certified residences
- In 2012, the USGBC released LEED Version 4 adding new transparency and performance credits for building materials

# Safer Building Materials

- There are many new (and old) safer building materials and products on the market
  - Low VOC coating
  - Locally resourced wood
  - Water-based caulks
  - Phthalate-free polymers
  - PVC-free carpeting
  - Formaldehyde-free fiber board
  - Organic, plant-based wall coverings
- Architects and developers can encourage safer materials and products through informed and targeted specifications
- Building Material suppliers in the market can and will respond if the demand is strong enough.



# LEED v4: Promoting Safer Materials through Disclosure and Optimization

**Ashley A. White, PhD**

*Senior Fellow, Materials Research  
Program Manager*

[awhite@usgbc.org](mailto:awhite@usgbc.org)



# 220,000

PROJECTS ARE CURRENTLY  
PARTICIPATING IN LEED<sup>®</sup>,  
COMPRISING MORE THAN

**10.4** BILLION SQ.  
FT.

OF CONSTRUCTION SPACE

# 1.5 MILLION

square feet certifies to LEED per

# DAY





# CREATIVE TENSION



# LEED v4: CURRENT STATUS

- » Held six public comment periods and received over 22,000 comments
- » Passed ballot in June 2013 with 86% approval
- » Engaged over 100 project teams in LEED v4 beta test
- » Program launch at Greenbuild in November 2013

# LEED v4 SYSTEM GOALS



Reduce contribution to **global climate change**



Enhance individual **human health**



Protect and restore **water resources**



Protect and enhance **biodiversity and ecosystem services**



Promote **sustainable and regenerative** material cycles



Build a **green economy**



Enhance **community quality of life**



# LEED v4 MAIN CREDIT CATEGORIES



**Sustainable Sites** – encourages locations with access to transportation and connection with amenities



**Sustainable Sites** – encourages strategies that minimize the impact on ecosystems and water resources



**Water Efficiency** – promotes smarter use of water, inside and out



**Energy & Atmosphere** – promotes better building energy performance



**Materials & Resources** – encourages using sustainable and healthy building materials and reducing waste



**Indoor Environmental Quality** – promotes better indoor air quality and access to daylight and views



**MATERIALS AND RESOURCES**





## LEED v4 TECHNICAL IMPROVEMENTS: MATERIALS & RESOURCES

### Highlights

**Life cycle thinking approach** to category.

Optional **whole building life cycle assessment** for new construction.

Focus on product **transparency** and **outcomes** through Disclosure & Optimization credits.

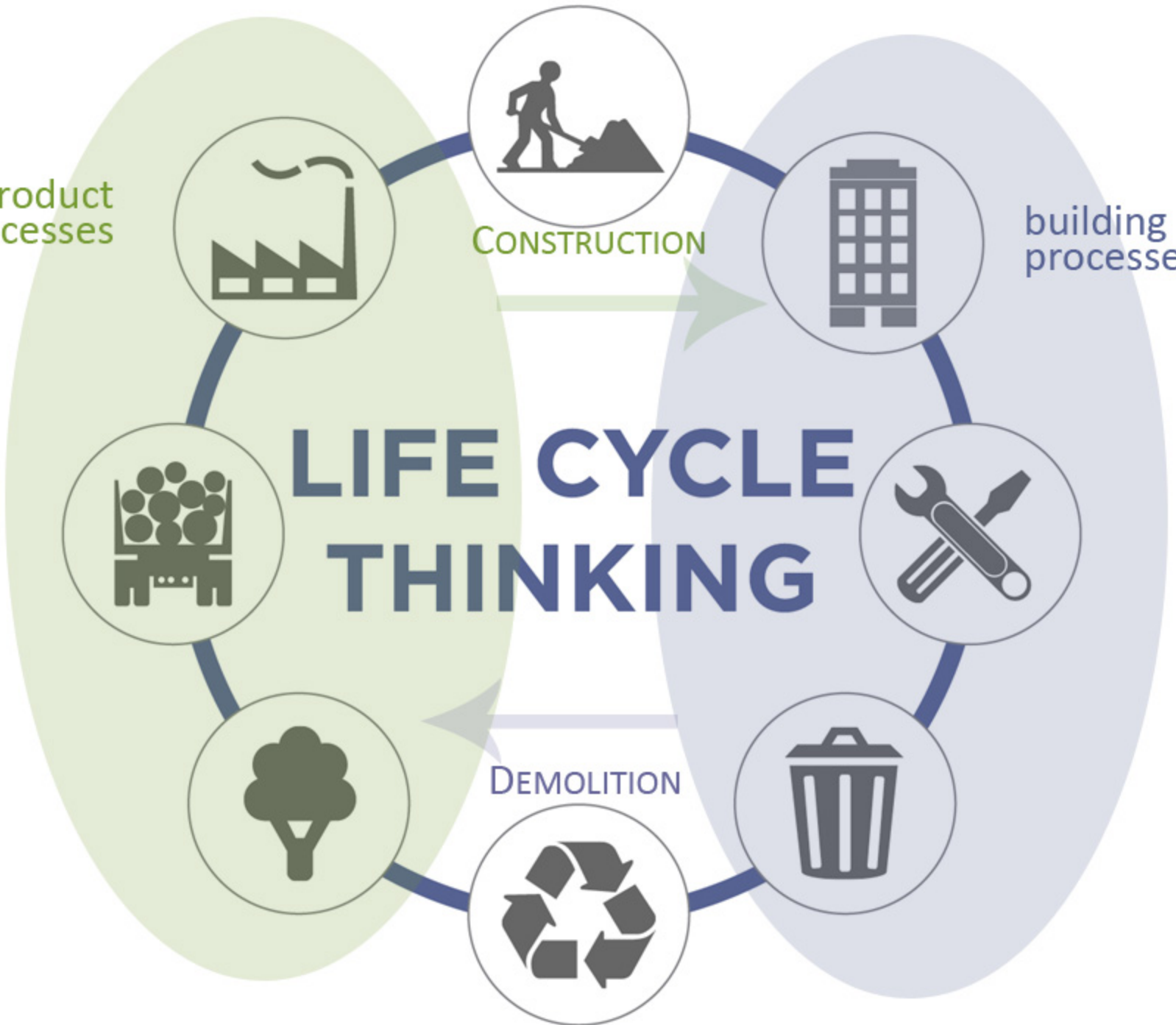
product  
processes

CONSTRUCTION

building  
processes

# LIFE CYCLE THINKING

DEMOLITION



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# disclosure

*(noun)*

transparency of product supply  
chains, ingredients, and life  
cycle impacts

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**INFORMATION = IMPACT**

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**INNOVATION**  
NECESSITATES  
DISCLOSURE

**DISCLOSURE**  
ENABLES  
EVALUATION

**EVALUATION**  
ENABLES  
PREFERENTIAL  
SELECTION

**PREFERENTIAL  
SELECTION**  
GUIDES  
INNOVATION

# OPTIMIZATION PROCESS

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# optimization

*(verb)*

reward for products meeting  
thresholds or benchmarks  
for performance





## **MR Credit**

Building Product Disclosure and Optimization  
Material ingredients

### **OPTION**

# **1**

Material  
ingredient  
reporting

**1 POINT**

**and/  
or**

### **OPTION**

# **2**

Material  
ingredient  
optimization

**1 POINT**

**and/  
or**

### **OPTION**

# **3**

Product  
manufacturer  
supply chain  
optimization

**1 POINT**

# LEED v4 MATERIAL INGREDIENTS CREDIT

## Option 1: Reporting

**Purpose:** increase the use of building products with detailed and specific physical and chemical makeup disclosures.

**Requirements:** use products with information on physical and chemical makeup disclosed by product manufacturers via easily-specified rigorous formats and standards.

The screenshot shows the LEED v4 Building product disclosure and optimization - material ingredients credit page. The page is titled "New Construction | v4 Building product disclosure and optimization - material ingredients" and "MRc4 | Possible 2 points". It features a navigation bar with "Language" and "Resources" tabs, and a "Glossary" toggle. The main content area is divided into sections: "Intent", "Requirements", and "Option 1. material ingredient reporting (1 point)". The "Intent" section states: "To encourage the use of products and materials for which life-cycle information is available and that have environmentally, economically, and socially preferable life-cycle impacts. To reward project teams for selecting products for which the chemical ingredients in the product are inventoried using an accepted methodology and for selecting products verified to minimize the use and generation of harmful substances. To reward raw material manufacturers who produce products verified to have improved life-cycle impacts." The "Requirements" section states: "Use at least 20 different permanently installed products from at least five different manufacturers that use any of the following programs to demonstrate the chemical inventory of the product to at least 0.1% (1000 ppm)." The "Option 1. material ingredient reporting (1 point)" section lists three requirements: 1) "Manufacturer Inventory. The manufacturer has published complete content inventory for the product following these guidelines: a) A publicly available inventory of all ingredients identified by name and Chemical Abstract Service Registration Number (CASRN); b) Materials defined as trade secret or intellectual property may withhold the name and/or CASRN but must disclose role, amount and GreenScreen benchmark, as defined in GreenScreen v1.2; c) Health Product Declaration. The end use product has a published, complete Health Product Declaration with full disclosure of known hazards in compliance with the Health Product Declaration open Standard." 2) "Cradle to Cradle. The end use product has been certified at the Cradle to Cradle v2 Basic level or Cradle to Cradle v3 BioCycle level." The right sidebar contains a "Join LEEDuser" section with a "CREATE FREE ACCOUNT" button and social media sharing options for Twitter, Facebook, and LinkedIn.

**1**

Manufacturer inventory

**2**

Health Product Declarations (HPD)

**3**

Cradle to Cradle

**4**

Other USGBC approved programs

# INVENTORY DATA REQUIREMENTS

What?

- Chemical name
- CASRN
- % by weight

How much?

- 1000 vs 100 ppm
- residuals

To whom?

- Self-declared
- Third party assessed

**Table 1: Inventory data requirements by program – Ingredient & material level**

	HPD	Pharos BPL	Green Screen	C2C	Declare
<b>Core ingredient level elements shared by all programs</b>					
Chemical name	X	X	X	X	X
CASRN	X	X	X	X	X
% by weight	X	X	X	X	X
Supplier contact information	Components only	Components only	X	X	X
<b>Program specific common elements shared by two or more programs and collected at the ingredient or homogenous material level</b>					
Function/Role	X	X	X	X	
Nanomaterial form	X	X	X	X	
Residual info	X	X	X	X	
Recycled content	X	X		X	
Location in product		X	X	X	
Material form related to hazard (e.g., fiber, particle size, etc.)		X	X	X	
Renewable sourcing		X		X	

1 GENERAL INFORMATION

<b>Product Identification Information</b>  Manufacturer: Ajax Manufacturing Product ID: SB4353 CSI MasterFormat(s): 09 96 00 Manufacturer URL: www.ajaxmfr.com Product URL: www.ajaxmfr.com/HPCs	<b>Product Description</b>  High performance coating designed for painting bath stall walls and other wet surfaces.	<b>Manufacturer Contact Information</b>  Contact Name: John Doe, Director of Product Quality Phone: (800) 777-1111 Email: JDoe@AjaxMfr.com Mailing Address: Product Quality Department 100 Smith Street Somewhere, TX 19999
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2 CONTENTS DISCLOSURE

<b>Certifying Party*</b> : <div>1st 2nd 3rd</div> <div><input checked="" type="radio"/> <input type="radio"/> <input type="radio"/></div> <div><small>* First: Manufacturer's self-declaration; Second: Verification by trade association or other interested party; Third: Verification by independent certifier (ideal).</small></div>	<div>All ingredients to be screened against chemicals listed on any of the Health Product Declaration Priority lists at <a href="http://www.hpdworkinggroup.org/prioritylists">www.hpdworkinggroup.org/prioritylists</a></div> <div>All ingredients are assessed against the HPD Priority Lists (check at least one): <input checked="" type="checkbox"/> High Hazards List <input checked="" type="checkbox"/> Precautionary Lists <input checked="" type="checkbox"/> Building Certification Lists <input type="checkbox"/> Other:</div>	<b>Total Volatile Organic Compound Content</b>  Material: 30.0 g/l Regulatory: 50.0 g/l Total incl. EPA exempt: 60.0 g/l Zero VOC tints: <input checked="" type="radio"/> Yes <input type="radio"/> No <input type="radio"/> N/A
<div>Disclosure level of intentionally added content (100% is ideal): 86 %</div> <div>All known residuals disclosed to: 100 ppm</div> <div>The manufacturer affirms that all known material content were screened for chemicals of concern and health warning listings using: Pharos Chemical and Material Library from the Healthy Building Network</div>		

3 CONTENTS IN ORDER OF QUANTITY (Complete list continues onto next page)

				PC*	PI*	yes	no	
Name	Identifier	%	Health Hazard Warnings and Certification Lists	RC* %		Nano*		Role
1 Bisphenol A diglycidyl ether (BADGE)	1675-54-3	35	(EPA Action): Developmental effects and Reproductive effects (EU ED): Some evidence of biological activity related to endocrine disruption			<input type="radio"/> <input checked="" type="radio"/>		Resin
2 Kaolin	1332-58-7	16	No warnings found			<input type="radio"/> <input checked="" type="radio"/>		Diluent
3 Phenyl Glycidyl Ether	122-60-1	13	(Prop 65+) Cancer and Male reproductive toxicity (VwVwS): Severe Hazard to Waters (EU H-Statements): H341 Suspected of causing genetic defects [more ... 1]			<input type="radio"/> <input checked="" type="radio"/>		Pigment suspension
4 Butanedioldiglycidyl Ether	2425-79-8	13	No warnings found. Green Screen Benchmark 3. [2]			<input type="radio"/> <input checked="" type="radio"/>		Viscosity reducer
5 Undisclosed[3]	undisclosed	11	(EU ED) Evidence of endocrine disruption activity (EU R-Phrases) Very toxic to aquatic organisms and possible risk of impaired fertility			<input type="radio"/> <input checked="" type="radio"/>		Flame retardant
COMPLETE LISTING OF ALL 10 INGREDIENTS CONTINUES ON PAGE 2								

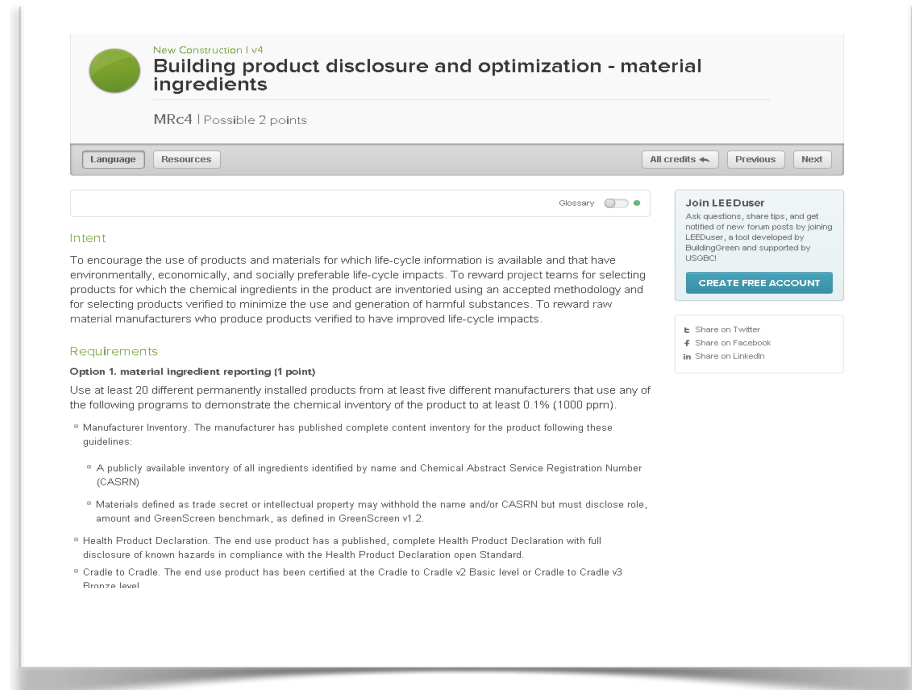
\* RC = Recycled Content: PC = Post Consumer, PI = Post Industrial (Pre-consumer) / Nano = comprised of nanoscale particles or nanotechnology

# LEED v4 MATERIAL INGREDIENTS CREDIT

## Options 2 & 3: Optimization

**Purpose:** increase the use of building products optimized to enhance human health.

**Requirements:** use products with physical and chemical profiles known to have desirable human health profiles via easily-specified rigorous standards and certifications.





## OPTION 2. MATERIAL INGREDIENT OPTIMIZATION PATHS

GreenScreen v1.2 Benchmark

Cradle to Cradle Gold or Platinum (v2)  
or Silver and above (v3)

REACH Optimization

Other USGBC approved programs

# LEED, MATERIALS, AND HEALTH INITIATIVE

## Goals

- Improve the indoor environment from a human health perspective
- Reduce barriers to materials transparency
- Improve the understanding of the health impacts of building materials
- Increase industry and public understanding of the importance of materials transparency and product optimization
- Increase availability of products with publicly disclosed ingredient profiles and demonstrated track records of product improvement

# LEED, MATERIALS, AND HEALTH INITIATIVE

## *Senior Research Fellows*

### Thought leadership

- A cohort of Senior Research Fellows at the U.S. Green Building Council, University of California Berkeley, University of Massachusetts Lowell, Georgia Tech Research Institute

### Critical analysis

- Fellows will advance dialog around critical issues through blogs, papers, and a materials guide

### Convening

- Senior Fellows will be convening lectures, discussions, and workshops over the coming year

# LEED, MATERIALS, AND HEALTH INITIATIVE

## Senior Research Fellows

[insight.gbig.org](http://insight.gbig.org)

- “Is it possible to provide an inventory of ‘all’ chemicals in a product?”

Charlene Bayer, Georgia Tech Research Institute

- “Envisioning a perfect building material”

Marty Mulvihill, Berkeley Center for Green Chemistry

- “Bunnies and butterflies: envisioning the ideal future of building materials”

Ashley White, USGBC

### Bunnies and Butterflies: Envisioning the Ideal Future of Building Materials



By *Ashley White*

Posted November 7, 2013

If we could know everything about b  
the entire supply chain – from the e  
chemical supplier, through the prod  
the consumer – how would this tran


# LEED, MATERIALS, AND HEALTH INITIATIVE

## *Event Series*

### Formats

- Lunch lectures
- Day and half-day meetings
- Conference sessions

### Topics

- Transparency/disclosure
  - Chemical hazard assessment
  - Optimization/innovation
  - Data and tools – Data jam/Data palooza
- 

# LEED, MATERIALS, AND HEALTH INITIATIVE

## *Event Series*

<https://www.youtube.com/user/USGBCGreenbuild/>  
**Materials and Health Event Series**



**[usgbc.org/leedv4](https://usgbc.org/leedv4)**



# QUESTIONS



# Sustainability at 3M



Inventing  
Tomorrow  
Sustaining Our Future



# Environmental Solutions for Our Customers

[www.3M.com/EnvSolutions](http://www.3M.com/EnvSolutions)

- 3M has hundreds of solutions to help customers
  - Reduce energy, air pollution, and waste;
  - Use more renewable resources;
  - Achieve green building certification;
  - Protect employee health & safety;
  - And more!



3M™ High Efficiency  
Filtrete™ Filter



3M™ Window Film



3M™ Mirror Film



Post-it® 100% Recycled  
Notes in Cabinet Pack



33M™ PPS™ Paint  
Preparation System™



Nomad™ Matting



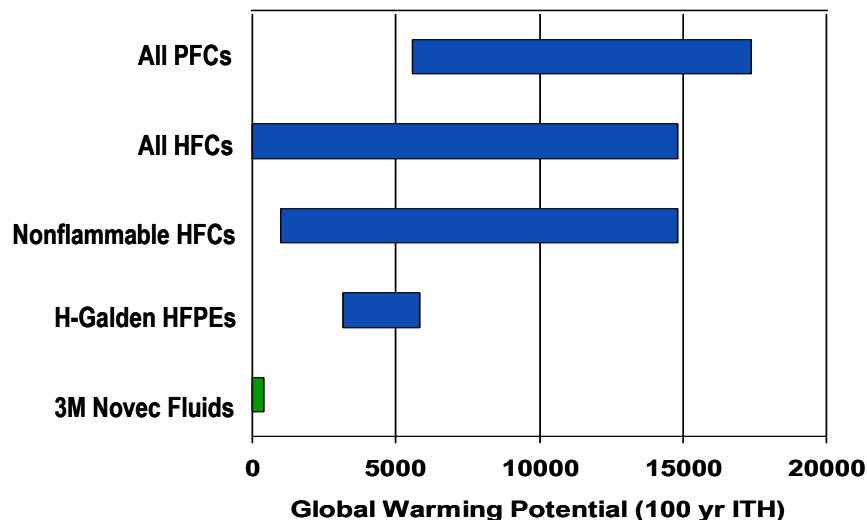
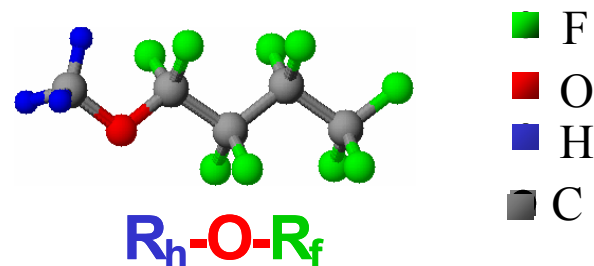
3M™ Adhesives

Over 150 products  
enabling greener  
building



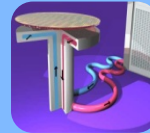
# 3M™ Novec™ Fluids

- Started in 1996 with hydrofluoroether (HFE) chemistry
  - *Non-ozone depleting*
  - *Low global warming potential (GWP)*
  - *Non-flammable and inert*
  - *Non-irritating*
  - *Best EHS position*
- Developed into a portfolio of materials that deliver on the Novec brand promise of **safe, effective, environmentally sustainable chemistry**

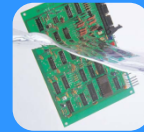


# Sustainability – "Working our Magic" with Novec™ Fluids

- Growing need for sustainable replacements to ozone-depleting substances, potent green house gases
- 3M™ Novec™ Fluids are safe, non flammable, non ozone depleting, and very low Global Warming Potential (GWP)
- Proven performance in several applications



Fluorinated heat transfer fluids for semiconductor processing and electronics cooling



Fluorinated cleaning and coating fluids for electronics, medical, industrial and semiconductor applications



Clean extinguishing agents for fire suppression in datacenter, telecom, marine, defense and other high value applications

*Enabling technology for markets demanding sustainable solutions*





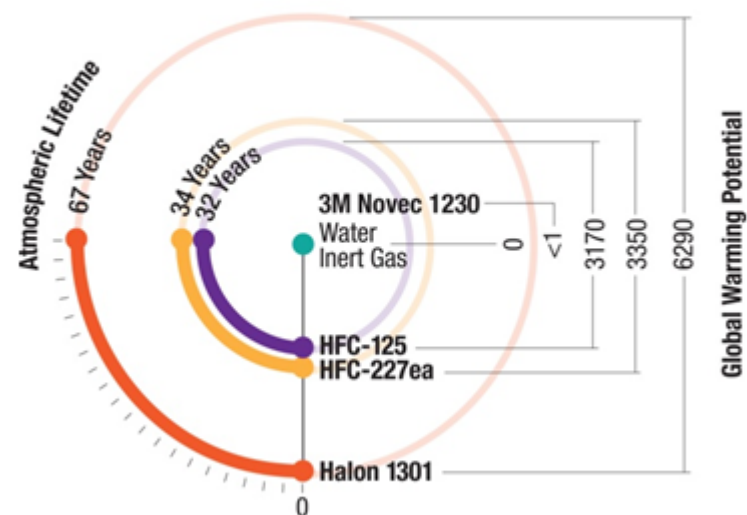
# Life Cycle Management at Work

## Novec™ 1230 Fire Protection Fluid

- Next-generation halon alternative
- Superior performance in extinguishing efficiency, safety, and global warming impact
  - *Zero ozone depletion potential*
  - *5-day atmospheric lifetime*
  - *A global warming potential of 1 (compared to alternative with GWPs of 1300-12,000)*



**Environmental Footprint\***  
Typical Fire Suppression Materials



\* Intergovernmental Panel on Climate Change (IPCC), Fifth Assessment Report (AR5), 100 Year fTH, CO<sub>2</sub> = 1.



# Two-Phase Immersion Cooling using 3M™ Novec™ Engineered Fluids

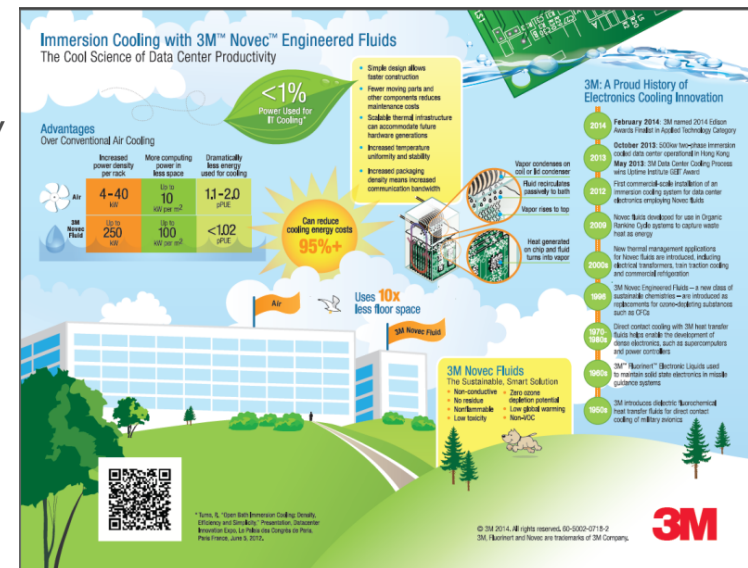
## ■ Energy Efficient

- Heat transfer process within the tank requires no power
- Data suggests a pPUE less than 1.01 on a 25°C and less than 1.03 in the summer in Death Valley (ambient 50°C)
- Uses <1% of IT power for cooling
- Increasing condenser size optimizes efficiency

## ■ Water Efficient

- No municipal water consumption for evaporative cooling

## ■ Safe, Environmentally Sustainable Working Fluid





3M Sustainability

[www.3M.com/Sustainability](http://www.3M.com/Sustainability)



# Inventing Tomorrow

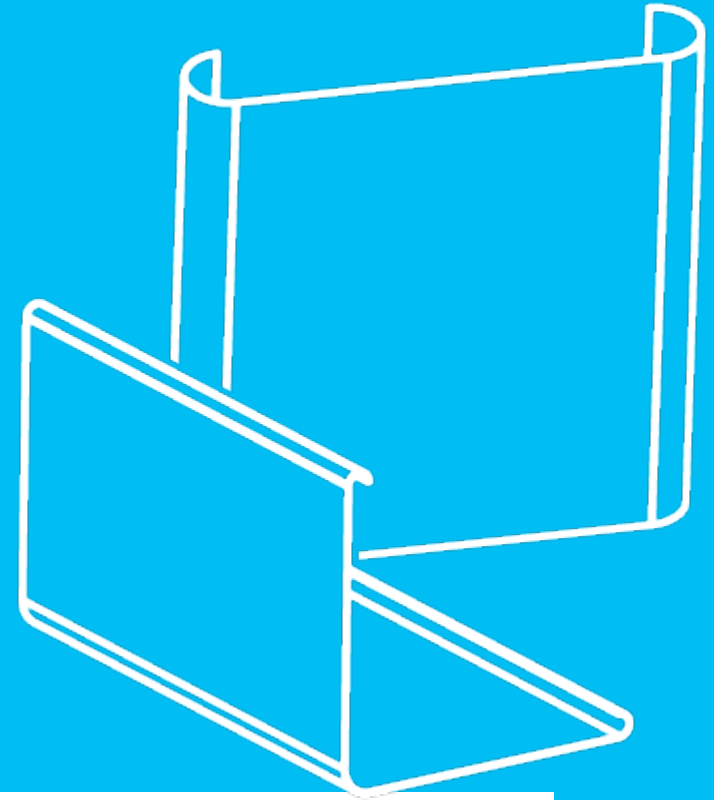
## Sustaining Our Future



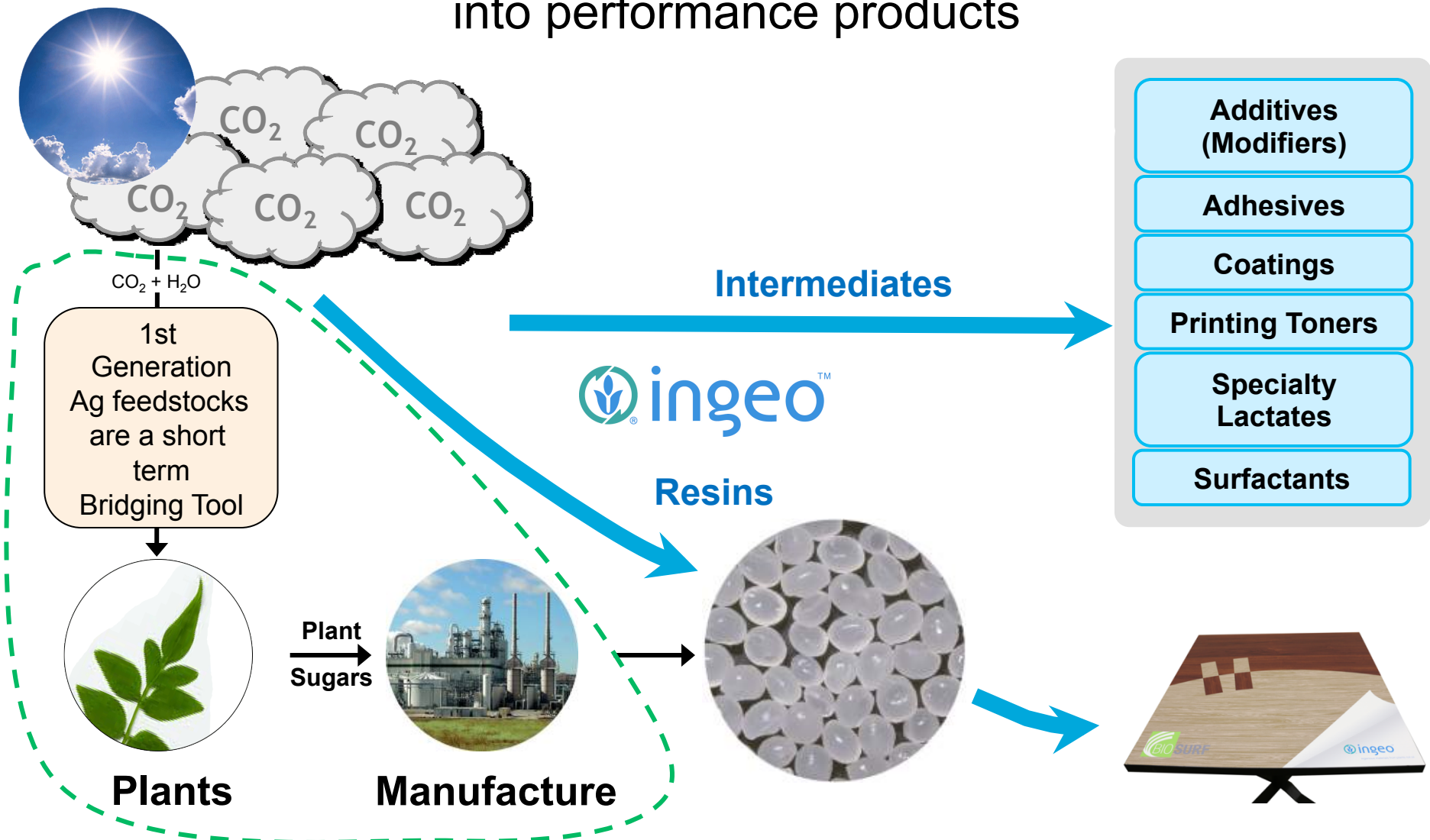


# Advancing Safer Building Materials

Dan Sawyer  
Global Leader – New Business Segment

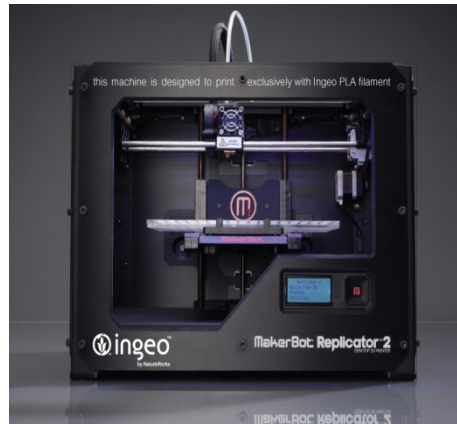


# NatureWorks is in the business of turning greenhouse gases into performance products





# New Business Segment at NatureWorks



**Kodak**

LG Hausys, zeo® Flooring,  
“Prestige” line

**BioPlastic**  
SOLUTIONS

Printed with toner containing  
>80% bio-polymer



**Ingeo**

**NatureWorks**

# Nature-derived chemistry can help avoid chemicals of concern

- Redlist Chemicals – Declare Program:
  - PVC – Commonly used in profile extruded parts, resilient flooring and laminates – Concerns about phthalate plasticizers or heavy metal stabilizers.
  - Formaldehyde (added) – Used as a binder in boards
- Precautionary Principle
  - Styrene identified as “Reasonably anticipated to be a human carcinogen,” by NIH, *Report on Carcinogens, Twelfth Edition*, 2011
  - Consumer expectations become market demands
- Polylactide derived from polymerized lactic acid
  - Lactic acid generated naturally, anaerobically in the body
  - Responsible for tanginess in yogurt
  - Produced commercially through aerobic yeast-based fermentation

# Influential companies and retailers are listening to their stakeholders/consumers and taking action . . .

## Kaiser Permanente:

“There is growing evidence that environmental exposures to some chemicals contribute to asthma, reproductive

Staples, Staples seeks to offer customers products that are inherently safer for human and environmental health.

At Kaiser Permanente, we are committed to researching and sourcing safer alternatives to products such as cleaners, solvents, disinfectants, plastics used in medical devices and building materials, flame retardants and formaldehyde.”

## Google:

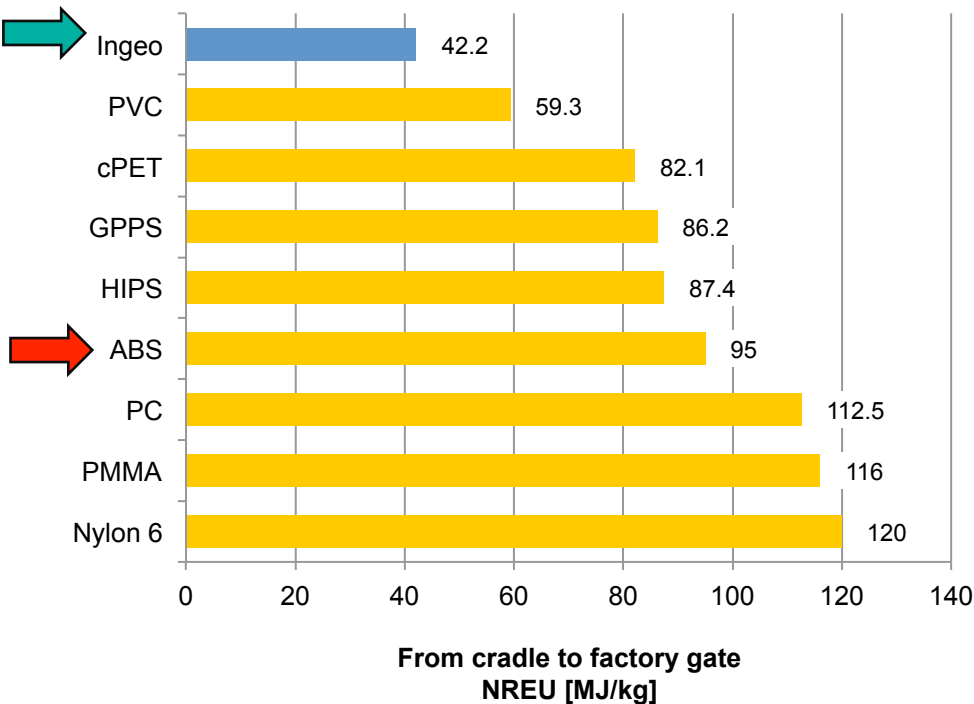
We believe that a healthy work environment and a sustainable world begin with transparency and cooperation. A surprising

number of chemicals have been incorporated into commonly used building materials without being assessed for their

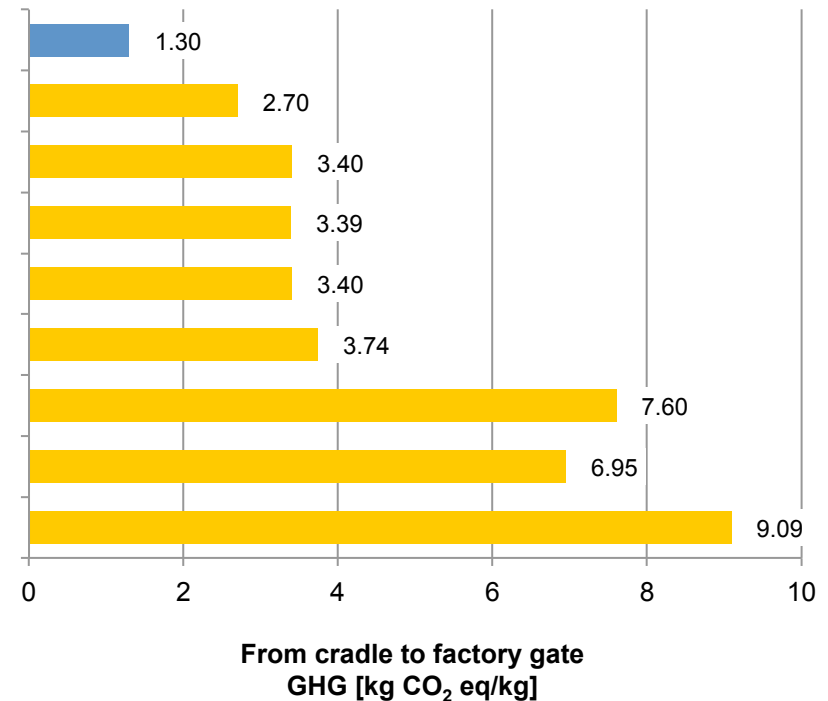
impact on human health. We’ve eliminated many of these chemicals in our buildings, and only use paints, sealants, adhesives, carpets, and furniture with the lowest levels of VOC’s and formaldehyde possible. We also exclude toxic elements like lead and mercury. We actively seek sustainable materials that are locally manufactured, high in recycled content, and biodegradable.

# Comparing eco-profiles – Benefits of recycling greenhouse gasses. . .

## non-renewable energy use

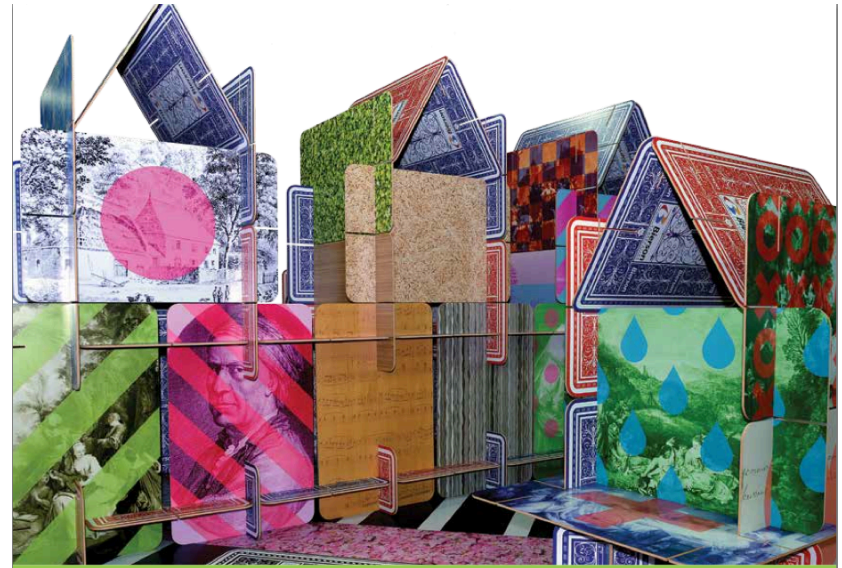


## greenhouse gas equivalents





# Developing PVC – free laminates from BioVation Holdings . . .

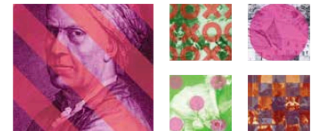


## GlobalShop 2014 Show Booth Winner.

The editors of design:retail magazine selected Bierson Corporation as the winner of the Best in Show Booth Award for GlobalShop 2014.

The booth featured a house-of-cards theme, with the 'house' constructed with pieces of BIOSURF, a new material made from soy and corn that allows retailers to create design concepts using custom digital imagery integrated into laminated surfaces.

The colorful and creative booth design was fun and whimsical, with bonus points for being made with sustainable materials.



“To receive this kind of recognition is an honor, and partnering with BIOSURF was integral to our winning design. David Casebier - Bierson Corp.”



# ingeo

 NatureWorks



# Baltix Sustainable Furniture entering the market. . .



ingeo

 NatureWorks

# BioEdge® edgebanding complements laminates. . .

**BioPlastic**  
SOLUTIONS



ingeo

 NatureWorks

© 2014 NatureWorks

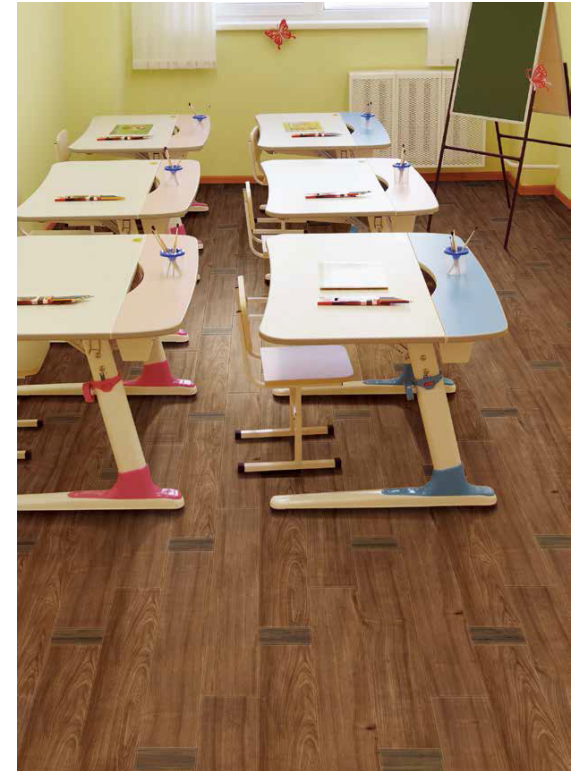


# Printability allows infinite customization in commercial flooring tiles. . .



All Layers Contain Bio polymer:

1. Bio surface treatment
2. Bio clear wear layer
3. Bio high resolution image layer
4. Bio base layer
5. Bio backing layer



# Challenges in advancing safer materials

- Establishing legitimate safety information based on sound science
  - EPD's, HPD's
  - Background information to support PD's – Sustainability credentials
  - Scientifically demonstrating healthier materials are resulting in better health
  - Avoiding greenwashing – e.g. fragmentation promoting additives
- Overcoming performance misconceptions
  - Establishing longer-term performance/durability takes time
- Connecting the dots
  - Educating architects, designers, corporate sustainability and building experts about available alternatives
  - Documenting and communicating successful case studies



Performance based plastics and fibers made from abundant and sustainable natural resources.

Ingeo: naturally advanced materials.

Dan Sawyer

Global Leader – New Business Segment

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USGBC + GC3: Advancing Safer Chemicals in the Building Products Sector

**The Durst Organization:** *A Building Developer, Owner, Manager Role*

3M Innovation Center, Minnesota | May 28, 2014



“Leave this place better  
than you found it.”

- Rose and Joseph Durst, 1915







Generations of Builders, Building for Generations.





# One Bryant Park











Product Content Transparency	<p><b>Definition:</b> The following reporting shall be provided for all targeted products submitted for use in the project:</p> <p>Health Product Declaration (HPD) EC REACH Material Safety Data Sheet (MSDS)</p> <p>Additional product certifications or manufacturer's information may be provided to supplement, but not replace, the above reporting.</p>
	<p><b>Standard:</b> <u>HPD</u>: Health Product Declaration Open Standard, as developed by the Health Product Declaration Collaborative. The HPD is an open standard format for reporting transparent building product content and associated health data.</p> <p><u>EC REACH</u>: European Commission EC No. 1907/2006, Registration, Evaluation, Authorization, and Restriction of Chemicals (REACH) including Annexes I, II, IV, V, XI, XIII, XIV, and XVII. Manufacturers that export to, or are located in the European Union (EU) economic area are required to report on the presence, or lack thereof, of chemicals of concern as defined under the EC REACH program.</p> <p><u>MSDS</u>: US Department of Labor, OSHA Standard 29 CFR 1910.1200 Appendix D, Safety Data Sheets (Mandatory). Manufacturers selling products in the USA for use in construction are required to publish an MSDS.</p> <p><b>Documentation:</b> Provide all of the following:</p> <p><u>HPD</u>: Completed HPD form, as developed by the Health Product Declaration Collaborative, <a href="http://www.hpdcollaborative.org">www.hpdcollaborative.org</a>.</p> <p><u>EC REACH</u>: Manufacturer's Certification bearing the product name and denoting the REACH-defined chemicals included in the product, or lack thereof. In accordance with EC No. 1907/2006, demonstrate Registration of the substance to the European Chemical Agency (ECHA) and provide required documents including Article Communication and Notification, Chemical Safety Report (Annex I), and Safety Data Sheet (Annex II), as applicable.</p> <p><u>MSDS</u>: Manufacturer's current published MSDS.</p>













# Building Product Ecosystems

## ***Partners:***

- The Durst Organization
- Parsons The New School for Design
- City University of New York
- Mount Sinai Hospital

***Mission:*** To build product ecosystem health for those affected by New York City construction, through material research and innovation, process improvements, policy/code evolution, and accessible education for all.



# Building Product Ecosystems

## ***Working Groups:***

- Evolving Wallboard Systems
- Flame Retardants and Code
- Glass in Concrete

## ***Academic Focus Areas:***

- Integrated Green Chemistry Education
- Communications and Social Change

the

# Health Product DECLARATION is...

a consistent language  
for product content reporting

an inventory tool

a format for screening content  
health hazards

**Health Product DECLARATION 1.0**

Name  
Product ID  
Website  
Manufacturer  
Address  
Address Line 2  
City, State, Code  
Description

Classification  
Contact Name  
Title  
Phone  
Email

Release Date  
Expiry Date  
HPD URL

☐ Self-published  
☐ Second Party  
☐ Third Party

Certifier  
Certificate #

**SUMMARY**  
The content of this product was assessed for health hazard warnings as required using

Residuals Disclosure  
☐ Measured 100 ppm  
☐ Measured 1000 ppm  
☐ Predicted by process chemistry  
☐ As per MSDS (1,000 & 10,000 ppm)  
☐ Not disclosed  
☐ Other

Full Disclosure of Intentional Ingredients  
Full Disclosure of Known Hazards  
Disclosure Notes

☐ Yes ☐ No  
☐ Yes ☐ No

Contents in Descending Order of Quantity (if the area below is full, refer to the following pages for additional listings)

Hazards  
☐ PBT (Persistent and Bioaccumulative Toxic)  
☐ Cancer  
☐ Gene mutation

☐ Development  
☐ Reproductive  
☐ Endocrine  
☐ Respiratory

Highest concern GreenScreen score - no ingredients benchmarked  
☐ Neurotoxicity  
☐ Mammal  
☐ Skin or Eye  
☐ Aquatic toxicity

☐ Land toxicity  
☐ Physical hazard  
☐ Global warming  
☐ Ozone depletion

☐ Multiple  
☐ Unknown

Total VOC Content  
Material (g/l)  
Regulatory (g/l)  
Content Notes

Does the product contain exempt VOCs?  
Are VOC-free tints available?

☐ N/A ☐ Yes ☐ No  
☐ N/A ☐ Yes ☐ No

Certifications and Compliance (if the area below is following pages for additional listings)  
VOC Emissions  
VOC Content





## CONTEXT

### A RANGE OF PRODUCT SELECTION CRITERIA



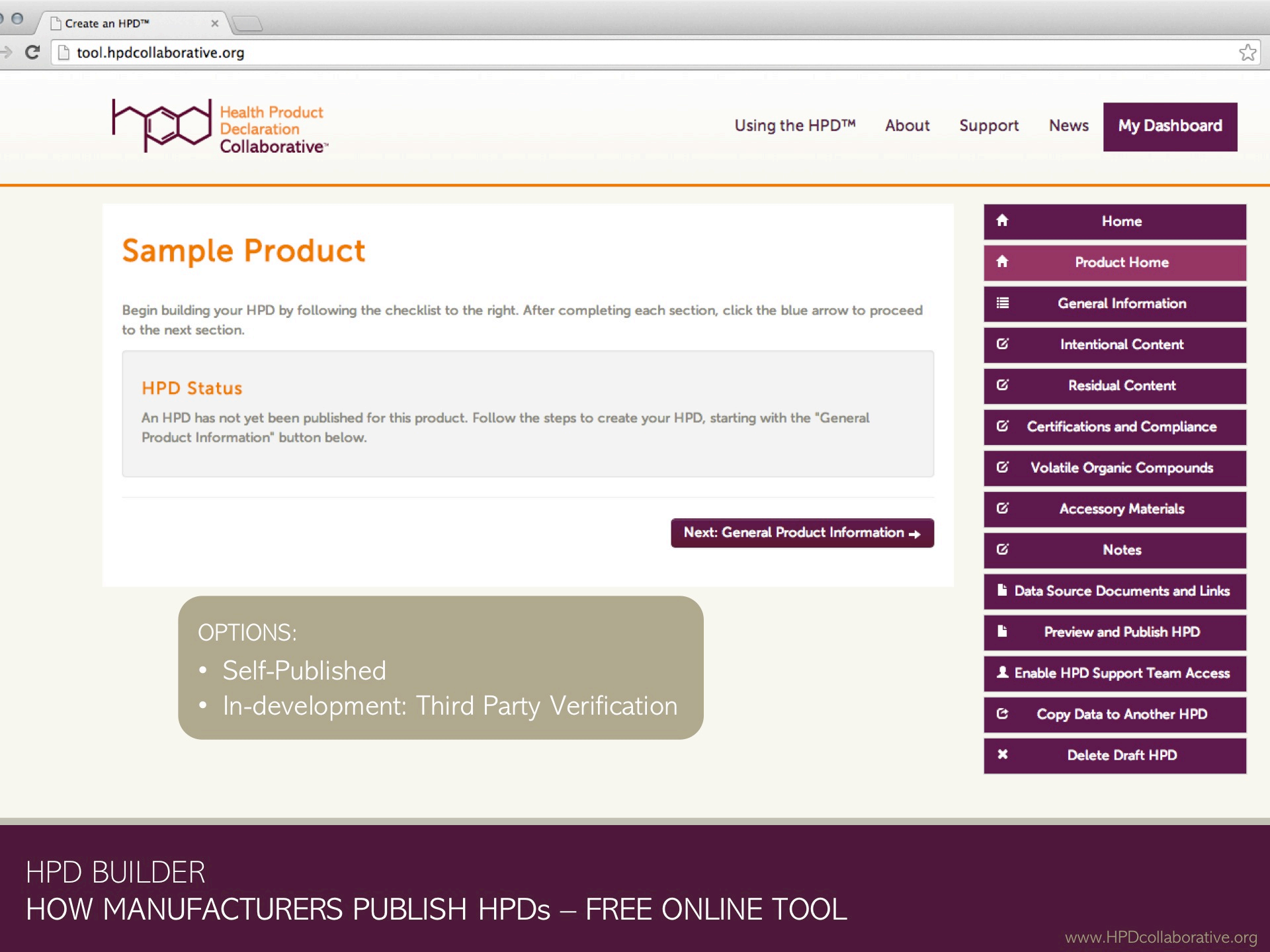
## CONTEXT

### ENVIRONMENTAL PRODUCT DECLARATION (EPD) - CRADLE TO GRAVE









## Sample Product

Begin building your HPD by following the checklist to the right. After completing each section, click the blue arrow to proceed to the next section.

### HPD Status

An HPD has not yet been published for this product. Follow the steps to create your HPD, starting with the "General Product Information" button below.

Next: General Product Information →

#### OPTIONS:

- Self-Published
- In-development: Third Party Verification

- Home
- Product Home
- General Information
- Intentional Content
- Residual Content
- Certifications and Compliance
- Volatile Organic Compounds
- Accessory Materials
- Notes
- Data Source Documents and Links
- Preview and Publish HPD
- Enable HPD Support Team Access
- Copy Data to Another HPD
- Delete Draft HPD

The HPD Standard is solely a declaration of product content and direct health hazards associated with exposure to its individual contents. It is not a full assessment of environmental impacts from the life cycle of this product. It is not an assessment of risks associated with actual use of the product. It does not address the potential health impacts of substances used or created during manufacture that do not appear in the final product as residuals, nor substances created during combustion or other degradation processes.

This Health Product Declaration was generated following the requirements of the noted Standard version and is valid for a total of 3 years after date of issue or three months after a substantive change of product contents occurs. Users should verify that this Health Product Declaration is compliant with the most current version of the HPD Standard. Accuracy of claims made in this Health Product Declaration is the sole responsibility of the listed manufacturer and certifier (if applicable). The HPD Collaborative does not warrant any claim made herein, explicit or implicit. The HPD Standard is an "open standard" developed and managed by the HPD Collaborative, a nonprofit organization. For more information, visit [hpdcollaborative.org](http://hpdcollaborative.org).

#### CONTENT IN DESCENDING ORDER OF QUANTITY

All ingredients must be assessed for health warnings against Priority Hazard Lists, regardless of disclosure level. Priority Hazard Lists and information on the GreenScreen Benchmarks can be found at [www.hpdcollaborative.org/hazardlists](http://www.hpdcollaborative.org/hazardlists).

GS: GreenScreen Benchmark; RC: Recycled Content; PC: Pre-Consumer; PI: Post Industrial (Pre-consumer); BO: Both post industrial and post consumer; Nano: comprised of nanoscale particles or nanotechnology.

Ingredient Name	CAS number	% Weight	GS	RC	PC	PI	BO	Nano	Role
Hazard A									Warning A
Hazard B									Warning B
Hazard C									Warning C
Hazard D									Warning D
Hazard E									Warning E
Notes									

Flame Retardant

context for content  
hazard screening data

HEXABROMOCYCLODODECANE (HBCD)		25637-99-4	
PBT	Stockholm: Persistent Organic Pollutant (POP) - under review		
Development	EU H-Statements: H361 Suspected of damaging fertility or the		
Endocrine	TEDX: Potential Endocrine Disruptor (also in OSPAR)		
Multiple	EPA Action: TSCA Work Plan chemical - Action Plan in devel		
Allows foam insulation to meet the stringent fire safety requirements governed by			
The chemical Industry has announced the development of an innovative new			
flame retardant is currently underway but will take time to be fully im			



MANUFACTURERS ADVISORY PANEL (MAP)

53 COMPANIES, AND COUNTING...





## Technical Committee

- 13 subject matter experts, supported by informal group of additional advisors
- Preserves the integrity of HPD content
- Responsible for interpretation, revision and expansion of the standard

## Manufacturers Advisory Panel

- Provides direct feedback + recommendations of individual companies or via work groups
- Open to any manufacturer with an HPD in-progress or published

## Other programs

- Collaboration with complimentary product standards, labels, evaluation tools

LEARNING AS WE GO  
HOW THE HPD EVOLVES OVER TIME

## USGBC Funded Research

### 5 PROGRAMS:

- GreenScreen™ for Safer Chemicals
- Cradle to Cradle Certified<sup>CM</sup> Products Program
- Pharos™
  - Chemical & Material Library
  - Building Product Library
- Health Product Declaration™
- Declare™

## Material Health Evaluation Programs Harmonization Opportunities Report

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August 20, 2013

Report of the Material Health Harmonization Task Group

Lauren Heine  
*Clean Production Action*

Matteo Kausch, Susan Klosterhaus & Stacy Glass  
*Cradle to Cradle Products Innovation Institute*

Tom Lent  
*Healthy Building Network*

HARMONIZATION

[usgbc.org/resources/material-health-evaluation-programs-harmonization-opportunities](http://usgbc.org/resources/material-health-evaluation-programs-harmonization-opportunities)

[www.HPDcollaborative.org](http://www.HPDcollaborative.org)





Thank you!

[www.hpdcollaborative.org](http://www.hpdcollaborative.org)

[www.durst.org](http://www.durst.org)