Mainstreaming Green Chemistry Webinar Series

The GC3's Agenda to Mainstream Green Chemistry: What it Says and What it Means in Practice

January 25, 2016

GREEN CHEMISTRY & COMMERCE COUNCIL

Business Mainstreaming Green Chemistry

What is the GC3?

A business membership organization working collaboratively to accelerate the application of green chemistry across industry sectors and supply chains

Mission is to make green chemistry standard practice in industry, for innovation, public health, and environmental protection

75 Members, Including:

GC3

Growth in demands for safer chemicals and products

- During the past 10 years, significant increase in demands for safer chemicals and products
- Growth of green chemistry research, education, awards
- Unprecedented growth in collaborations between sectors and within supply chains to advance safer, more sustainable chemicals and products, and green chemistry research and education
- An increasing number of green chemistry success stories but:

We have made progress but have a long way to go…

- Despite significant successes in programs, collaborations and recognition of need, it's still a marginal consideration.
- The green chemistry community lacks a coherent long term strategy, strong coordination, and significant, stable funding.
- Yet to be integrated into fabric of education, R&D or the chemical enterprise
- Much of the progress has been on the demand side and not on the supply side. Supply of green chemistry solutions has not kept pace

GC3 Agenda to Mainstream Green Chemistry

- Based on research, collaborative initiatives and dialogue outline a strategic path forward to accelerate research and adoption of green chemistry
- Short term goals
  - Scale green chemistry innovation
  - Elevate the importance of green chemistry in education and research
  - Develop and pass smart policies that support markets, research, and innovation

Moving forward

- This is a unique time to accelerate the growth of green chemistry
- But this requires vision, leadership, resources, and collaboration across sectors and stakeholder groups (government, industrial, academic)
- The Agenda creates an imperative for action by putting in one place an explanation of green chemistry, it's benefits, barriers and drivers, strategies to overcome barriers and strategic GC3 actions

Using the Agenda

- Government: As a roadmap for developing national strategy/framework
- Companies: To help guide R&D strategy, stakeholder engagement
- Researchers and educators: To advocate for increased funding, establishment of academic programs, and to link more closely with business/societal need
- Advocates: To prioritize the importance of leadership and funding for solutions

Today's Speakers

Amy Perlmutter

Principal
Perlmutter Associates

Bob Israel

President, Stewardship
& Sustainability
The Valspar Corporation

Babette Petterson

Chief Commercial
Officer
BioAmber, Inc.

Ground Rules

- Due to the number of participants in the webinar, all lines will be muted
- If you have a question or comment, please type in the Q&A box located in the drop-down control panel at the top of the screen
- Questions will be answered at the end of the presentations

The GC3's Agenda to Mainstream Green Chemistry: What it Says and What it Means in Practice

Amy Perlmutter

January 25, 2016

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Business Mainstreaming Green Chemistry

An Agenda to Mainstream Green Chemistry

Green Chemistry & Commerce Council

Agenda Goals:

- Scale green chemistry innovation
- Elevate the importance of green chemistry in education and research
- Develop and pass smart policies that support markets, research, and innovation

Process

- Literature review
- GC3 member survey
- Original research (metrics, barriers, business case)
- Input at Roundtables
- Input from advisory committee

Advisory Committee

- Eric Beckman, University of Pittsburgh
- Mark Brady, Business Oregon
- David Constable, American Chemistry Society
- Tracey Easthope, Michigan Ecology Center
- Mary Grim, Timberland LLC
- Al Innes, Minnesota Pollution Control Agency
- Bob Israel, Valspar Corporation
- Julie Jones, Advancing Green Chemistry
- Kendra Martz, Construction Specialties, Inc
- Marty Mulvihill, UC Berkeley
- Beverly Thorpe, Clean Production Action
- Martin Wolf, Seventh Generation
- Ken Zarker, Washington State Department of Ecology

Contents:

- Why An Agenda to Mainstream GC?
  - Overview
  - Defining Green Chemistry
  - How Green Chemistry is Practiced
  - The Growth of Green Chemistry
  - The Case for Green Chemistry
  - Drivers and Barriers
- Five Key Strategies
- Taking Action

Defining Green Chemistry

- The design of chemical products/processes that reduce or eliminate the use and generation of hazardous substances throughout their lifecycle.
- Builds on conventional chemistry and engineering by applying 12 fundamental principles that guide molecular design of sustainable chemical products/processes.
- Product developers, manufacturers, retailers, brands: all play important role in implementation.
- Can be an iterative process or it can yield a disruptive innovation.

Drivers of Green Chemistry

TABLE 1: Top Ranked Drivers of Green Chemistry by Business Type for GC3 Members

	Chemical Mfr	Product Mfr	Product Brand	Retailer
Concern for Worker Health/Safety	✔	✔	✔	✔
Concern for Environment	✔	✔	✔	✔
Competitive Advantage	✔	✔	✔	✔
Fits Our Brand	✔	✔	✔	✔
Customer Demand	✔	✔	✔	✔
Risk Avoidance/Reduction		✔	✔	✔
Profits Generated	✔			
Cost Savings		✔		
Opens New Markets	✔			

Barriers to Green Chemistry

Development, Identification, and Evaluation of Green Chemistry Innovations
High cost and long time frame to research, develop, test, and scale up safer alternatives
Perception of lack of value in pursuing green chemistry
Lack of sufficient information available to assess chemical hazards
Lack of financial and policy support for green chemistry research and companies
Regulatory uncertainty
Externalization of costs (public health, environmental degradation) of conventional chemistry
Supply-Chain Alignment
Lack of technically and/or economically feasible safer alternatives
High cost, time, and risk of incorporating alternatives (performance, testing, regulatory, product redesign, etc.)
Perceived high cost of green chemistry alternatives
Lack of transparency in supply chain
Requirements for supply-chain transparency
Incumbency of existing chemicals and markets
Multiple complex supply chains for any given chemical
Risks of switching not shared across supply chain
Supply and demand not in sync
Lack of communication within supply chains
Education
Lack of green chemistry-trained chemists and chemical engineers
Lack of alignment of industry need and academic workforce
Inertia and incumbency of traditional chemistry education
Metrics
Lack of agreement on what should be “counted” as green chemistry
Lack of data to measure progress and make the case for green chemistry benefits

Five Key Strategies:

The GC3 calls for continuing research and dialogue among stakeholders to keep an up-to-date understanding of the changing market factors driving and holding back green chemistry and adoption, and to use this understanding to grow green chemistry practice.

Five Key Strategies:

The GC3 calls for and will support smart state and federal policies that accelerate and enhance green chemistry innovation and adoption.

Five Key Strategies:

The GC3 supports efforts that help create collaborations within and among supply chains and industry sectors, and which involve other key stakeholders, for the purposes of growing demand, building capacity, stimulating innovation, and improving information flow.

Five Key Strategies:

The GC3 supports the dissemination of information to the marketplace that supports green chemistry education, research, and practice.

Five Key Strategies:

The GC3 supports the development and use of metrics to track and understand green chemistry benefits and progress.

Taking Action:

- Support the proposed federal "Sustainable Chemistry R&D Act of 2015" or similar legislation that meets the GC3's criteria of smart policies

  (Status: held Congressional briefing Jan 13, 2016)

- Expand the development and use of innovative tools and resources to accelerate green chemistry

  (Status: launching/revamping Portals: Innovation, Retail, Education)

Taking Action:

- Convene a National Summit on Green Chemistry Education

  (Status: to be developed)

- Build agreement on priority metrics needed to measure progress in GC and ways to gather such metrics

  (Status: will hold meeting at GC3 Roundtable this year)

Taking Action:

- Engage with public and private sector funding entities to target critical green chemistry needs

  (Status: to be developed)
- Advance collaborative supply chain partnerships

  (Status: Preservatives Project underway, additional project TBD)

GC3 Actions, Barriers Addressed, and Strategies Used

Action	Barriers Addressed	Key Strategies Addressed
Support the proposed federal "Sustainable Chemistry Research and Development Act of 2015," or similar legislation that meets the GC3's criteria for "smart policies"	• Perception of lack of value in pursuing green chemistry • High cost and long time frame to research, develop, test, and scale up safer alternatives • Lack of technically and/or economically feasible alternatives • Lack of green chemistry-trained chemists and chemical engineers	• Enhance Market Dynamics • Support Smart Policies
Expand the development and use of innovative tools and resources to accelerate green chemistry	• High cost and long time frame to research, develop, test, and scale up safer alternatives • Incumbency of existing chemicals and markets • Supply and demand not in sync • Lack of green chemistry-trained chemists and chmiecal engineers	• Foster Collaborations • Inform the Marketplace
Convene a National Summit on Green Chemistry Research and Education	• Lack of green chemistry-trained chemists and chemical engineers • Lack of alignment of industry need and academic workforce • Inertia and incumbency of traditional chemistry education	• Enhance Market Dynamics • Inform the Marketplace
Build agreement on the priority metrics needed in the short term to measure progress in green chemistry and ways to gather such information	• Lack of agreement on what should be "counted" as green chemistry • Lack of data to measure progress and make the case for green chemistry benefits	• Enhance Market Dynamics • Track Progress
Engage with federal agencies to open funding channels targeted at critical green chemistry needs	• High cost and long time frame to research, develop, test, and scale up safer alternatives • Lack of financial and policy support for green chemistry research and companies • Lack of technically and/or economically feasible safer alternatives • Incumbency of existing chemicals and markets	• Enhance Market Dynamics • Support Smart Policies
Advance Collaborative Supply-Chain Partnerships	• Lack of technically and/or economically feasible safer alternatives • Lack of communication within supply chains	• Enhance Market Dynamics • Foster Collaborations

An Agenda to Mainstream Green Chemistry

For more information

http://greenchemistryandcommerce.org/projects/mainstreaming

mainstream@greenchemistryandcommerce.org

GREEN CHEMISTRY & COMMERCE COUNCIL

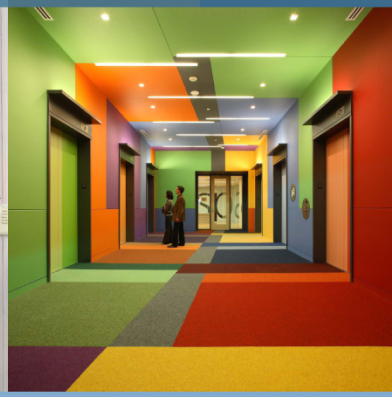
Business Mainstreaming Green Chemistry

people community innovation operations governance

How Do We Mainstream Green Chemistry?







How do you eat an elephant?

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Realities that exist today

- The combative approach – consensus of what success looks like
- Resistance to change
- The supply & demand cost paradigm
- Fear of the low cost, non-green competitor
- Conflicting beliefs and application of Hazard vs Risk
- Conflicting stakeholder communication
- Consumers don't know what to believe
- Multiple green standards/specifications
- The all or nothing approach to green
- The pull for green chemistry only happens quickly in the face of calamity

The question becomes one of ‘how’ to mainstream Green Chemistry

- Who are the stakeholders?
  - Chemical manufacturers
  - Brand owners/formulators
  - Retailers
  - Consumers
  - Government
  - NGOs
  - Investors
  - Academia/Scientific Community
  - Others?

- What role do these stakeholders have to contribute to green chemistry?

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What Needs to Change?

- Stakeholders need to realize their role in mainstreaming green chemistry
- Antagonistic/combative approaches causes consumer confusion, lack of stakeholder consensus, trust and conflicting communication
- We need to move from ‘taking out the bad’ to ‘building in the good’
- A positive proactive approach to problem solving that aligns stakeholders
- Removing barriers to innovation and green chemistry requires that stakeholders are aligned and embrace their roles in the process
- Green Chemistry is a journey. Therefore stakeholders must accept a continuous improvement approach
- Stakeholder collaborations need to broaden

A Holistic Approach to Green Chemistry

- Needs to happen on a Macro and Micro scale
- Broader collaboration among stakeholders
- ‘Building in the good’ as part of new innovation
- Agreement on priorities in need of green chemistry solutions
- Expediting and incentivizing green chemistry
- Market entry vs current technology – understanding the value of green chemistry solutions
- Embracing continuous improvement
- Creating trust among stakeholders
- Consensus on science
- Consensus on communication

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So what's needed?

- Macro approach
  - Government Framework to green chemistry incentives, subsidies, grants
  - An education system that teaches the necessity for green chemistry and engineering
  - Stakeholder consensus on priorities, targets and investments
  - Stakeholder consensus on science, specifically toxicology
  - Acceptance of the cost, performance, green chemistry confluence (continuous improvement)
- Micro approach
  - Broad stakeholder collaborations to solve specific problems
  - Broad stakeholder consensus and communication
  - Innovation that demands price, performance and 'green' on equal footing, always
  - Incentives which reward these innovations
    - B2B, B2C, G2B, G2C

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- You can’t expect things to change if you don’t change what you’re doing!

- Thank You!

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NYSE : BIOA

GC3 Webinar: Mainstreaming Green Chemistry

Commercialization of bio-based chemicals

January 25th, 2016

GREEN CHEMISTRY & COMMERCE COUNCIL

Business Mainstreaming Green Chemistry

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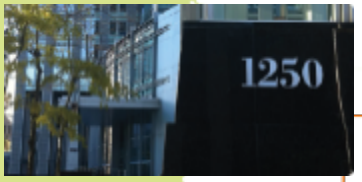
WHO WE ARE
BIOAMBER IS A SUSTAINABLE CHEMICALS COMPANY

Our offices

Key facts

- NYSE listed: **Since May 2013**
- Established: **2008**
- Employees: **100**

Montreal, QC
Headquarters



Minneapolis, MN
R&D Facility

Our manufacturing site

Pomacle, France
Demonstration Plant
2010

Sarnia, Canada
Commercial Plant
2015

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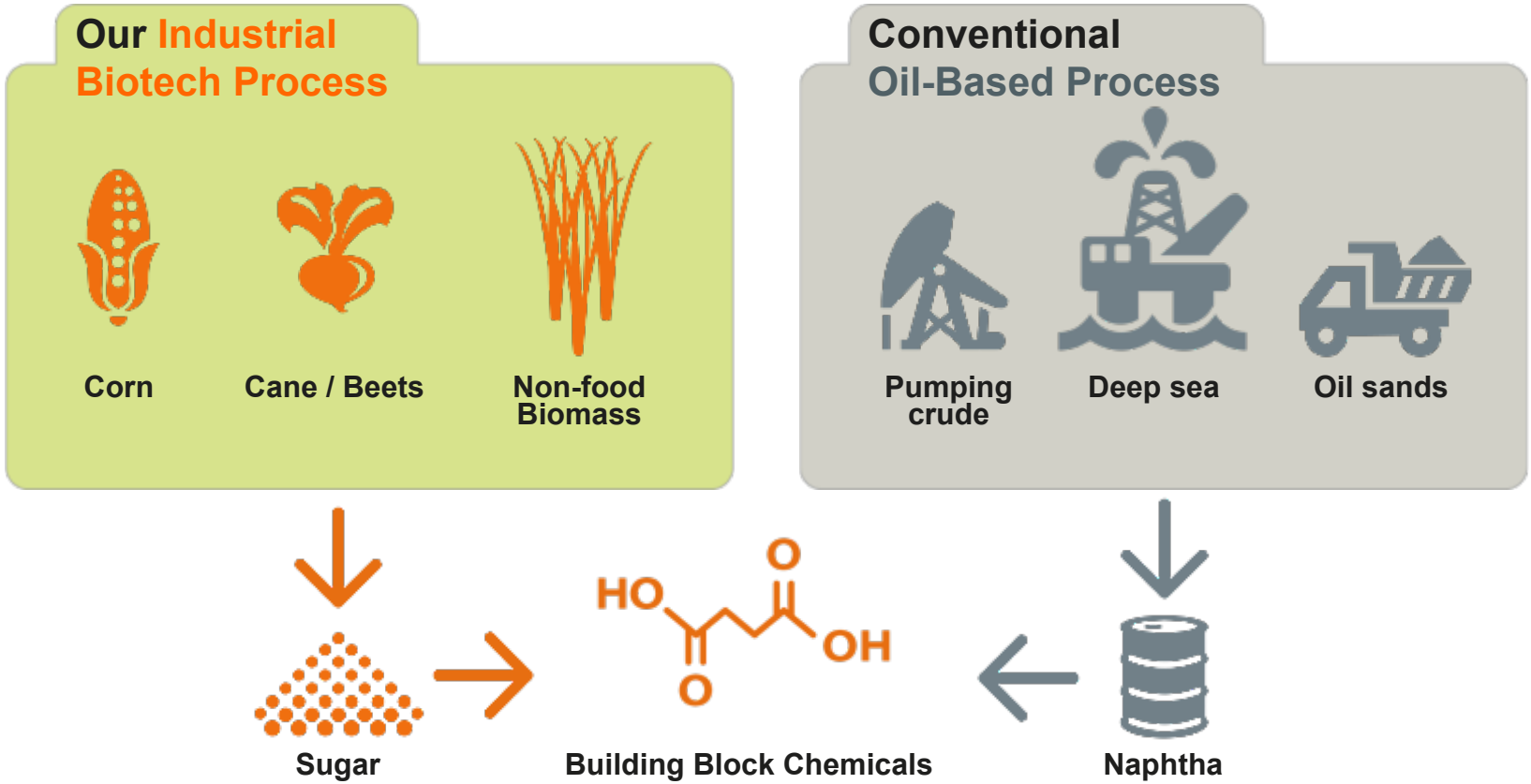
WHAT WE DO
WE MAKE CHEMICALS **SUSTAINABLY**



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WE HAVE CAPACITY
COMMERCIAL PLANT OPENED AUGUST 2015

	SARNIA 2015	PLANT #2 Est. 2017
CAPACITY (Annual MT)	30,000 SA	70,000 SA 100,000 BDO

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A MEANINGFUL IMPACT

A 30,000 MT capacity plant saves...

5.5M tree seedlings growing for 10 years

508,000 barrels of oil consumed

GHG Emissions of 45,000 US cars

Electricity use of 46,000 US homes

210,000 tons of CO_2 equivalent gas/year

2 trillion BTUs of energy/year

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WHY IS THIS IMPORTANT
GLOBAL MARKET TRENDS

1 Evolving **consumer preferences**

- Sustainability
- Natural
- CO_2 footprint reduction

2 Climate **change**

3 **Performance and Innovation**

Food & flavours

Personal Care

Paints & Coatings

Polyurethanes

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WE CREATE VALUE:
PERFORMANCE AND SUSTAINABILITY

Resins & Coatings

Alkyd Resins, Saturated Polyesters, UPR's, Polyurethane Dispersions

Polyurethanes

PU Leather, TPU's CPUs, PUD's, Adhesives and Foams

Personal Care

Natural Emollient Esters for Skincare and Haircare; bio-based solutions for exfoliation

Flavors & Food

Natural Ingredients for multi-functional benefits; Flavor Enhancer; Salt Reducer

Bio Plastics

Polybutylene Succinate for range of applications ;Paper Coatings, Packaging, Mulch Film & Durables

Bath Tablets

Natural effervescence for Bath Tablets and Bath Salts

Lubricants

Succinic esters for Lubricant Base Oils, or Additives

Flooring

Bio-Based, Phthalate-Free Plasticizers

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NYSE : BIOA

BRIDGING ACCROSS THE VALUE CHAIN

MARKET PUSH AND MARKET PULL TO ACCELERATE ADOPTION

Push: Suppliers

Pull: Consumers

Reinventing the green process

Raw material → **Chemical Producers** → **Formulators Manufacturer** → **Retailer** → **Consumer**

bioamber™

- Bio-based Building Blocks

DuPont Tate & Lyle BioProducts™

- Differentiation with new more sustainable products
- Better H&E Profile
- Reduces dependency on fossil feedstocks

- Corporate sustainability
- Changing goals
- Brand Equity

- Consumer needs

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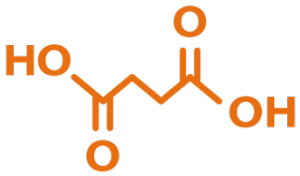
VALUE CHAIN PARTNERSHIPS
KEY TO SUCCESS

BIO-SA™ → Coatings chemical → Textiles applications

bioamber™

- **Bio-Succinic Acid**



covestro INSQIN®

- **Impranil ® eco DL 519**
- **Impranil ® eco DLS**
- **Impranil ® eco DLP-R**

Waterborne, solvent-free polyurethane dispersions for textile coatings with up to 65% bio-based content

PU-coated synthetic materials for footwear, garment and accessory. Enabling industry to meet sustainability aspirations

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PERFORMANCE FROM NATURE
INSQIN® TEXTILE COATINGS-SOLVENT FREE, WATERBOURNE

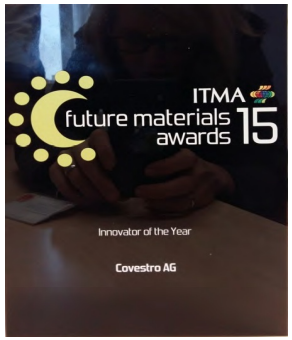
Covestro Developments with covestro INSQIN®

WB PU for sports footwear material with high peeling strength >3.5 kg/cm

WB PU for garment material that retains soft handle at all temperatures

WB PU for bag material that is embossable

bioamber™



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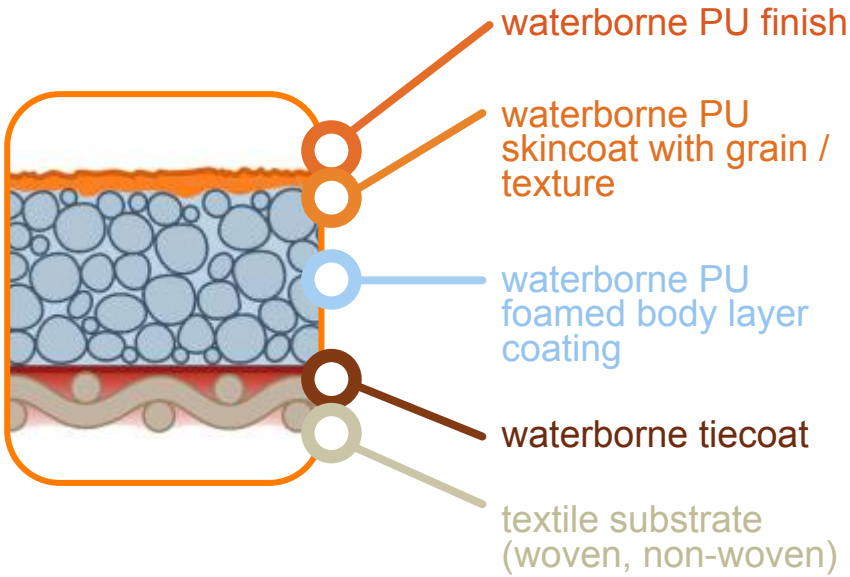
Impranil® eco
RENEWABLE MATERIALS FOR PU SYNTHETICS & TEXTILES

HIGH PERFORMANCE ENABLED BY NATURE



bioamber inspired

Impranil® eco DL 519
approx. 45% bio-based

Impranil® eco DLS
approx. 56% bio-based

Impranil® eco DLP-R
approx. 65% bio-based

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1. ENHANCE MARKET DYNAMICS
2. SUPPORT SMART POLICIES
3. FOSTER COLLABORATION
4. INFORM THE MARKETPLACE

ACCELERATE MARKET ADOPTION HELP OVERCOME BARRIERS

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Upcoming Events

The Green Chemistry Portal's *Ask the Innovators* Series: How Green Is Your Raincoat?

On-line discussion, Wednesday, January 27th
11:30-1:00, EST

GC3 INNOVATORS ROUNDTABLE
MAY 24-26, 2016 | BURLINGTON, VT

Thanks for joining us!

For more information about the GC3:
www.greenchemistryandcommerce.org

GC3 GREEN CHEMISTRY & COMMERCE COUNCIL
Business Mainstreaming Green Chemistry