Green Chemistry Education Webinar Series

The Role of Policy in Green Chemistry Research & Adoption

June 16, 2015
What is the GC3?

- Cross-sectoral, B2B network of over 70 companies and other organizations
- Formed in 2005
- Collaboratively advances green chemistry across sectors and supply chains
Today’s Speakers

Joel Tickner
Director of GC3
Associate Professor, Environmental Health UMASS Lowell

Robert Giraud
Principal Consultant, Environmental Engineering, DuPont Company
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 presentation.
Policy and its Role in Green Chemistry

Joel A. Tickner, ScD
Director, Green Chemistry & Commerce Council
June 16, 2015
Key Take Aways

• Policy - public and private - plays an important role in:
  – Shaping chemicals and materials choices
  – Supporting research, development and adoption of green chemistry
  – Providing incentives/disincentives to move away from/towards certain types of chemistries

• The sheer number of policies - sometimes with conflicting requirements - can be a challenge for chemists and designers

• Poorly designed policies can potentially serve as barriers to green chemistry while well-designed policies can support innovation
What do we mean by policy

• “a law, regulation, procedure, administrative action, incentive, or voluntary practice of governments and other institutions...Policy decisions are also frequently reflected in resource allocations.”

• US CDC http://www.cdc.gov/stltpublichealth/policy/
Forms of policy

• Broad statements/goals/principles
• Strategic plans (energy policy, agency sustainability policy, non-toxic environment policies, etc.)
• Guidance
• Laws/mandates/requirements
• Incentives/awards
• Information
• Education
• Resource allocation, budgets
Broad types of policy

- Private versus public policy
- Carrots versus sticks
- Regulatory (mandatory) versus discretionary
Traditional types of policies chemists/designers are familiar with

- **Design standards**
  - ASTM/NFPA, etc
    - Flammability
    - Safety (e.g., Toys)
  - Performance standards
    - Failure rates
    - Mil SPECS
    - Material properties
  - Single chemical restrictions (RoHS, CPSIA)

- **Health Safety and Environment policies** can be thought of as a type of design standard
Forms of Private Policy

• Corporate goals/metrics
• Requirements for use of particular standards, tools, or certifications
• Disclosure requirements
• Restricted Substances Lists/chemical restrictions
• Chemical Testing Programs
• Incentives - preferable purchasing, etc.
• Curriculum/Educational Standards (ACS/ABET)
Government Policy at Multiple Levels

• International (ratified into national policy)
  – Conventions - POPs, Montreal Protocol
  – Regional - Conventions, agreements between nations
• National (including economic regions - EU)
• State
• Local
• The complexity can be challenging in a global supply chain
Types of regulatory government policy options for chemicals

• Standards - pre-market/manufacture requirements, acceptable exposure levels, permits, performance standards
• Restrictions
• Assessment requirements
• Testing requirements
• Information disclosure - on toxicity, ingredients, emissions, planning
## Federal laws regulating toxic chemicals

<table>
<thead>
<tr>
<th>Chemical Type/Use</th>
<th>Law</th>
<th>Implementing Agency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pharmaceuticals/Medical devices</td>
<td>Federal Food Drug and Cosmetics Act</td>
<td>Food and Drug Administration</td>
</tr>
<tr>
<td>Cosmetics</td>
<td>Federal Food Drug and Cosmetics Act</td>
<td>Food and Drug Administration</td>
</tr>
<tr>
<td>Food additive/food contact articles</td>
<td>Federal Food Drug and Cosmetics Act</td>
<td>Food and Drug Administration</td>
</tr>
<tr>
<td>Toys</td>
<td>Consumer Product Safety Improvement Act and Federal Hazardous Substances Act</td>
<td>Consumer Product Safety Commission</td>
</tr>
<tr>
<td>Other types of products and manufacturing processes</td>
<td>Toxic Substances Control Act</td>
<td>Environmental Protection Agency</td>
</tr>
<tr>
<td>Pesticides</td>
<td>Federal Fungicide Rodenticide and Insecticide Act and Food Quality Protection Act</td>
<td>Environmental Protection Agency</td>
</tr>
<tr>
<td>Nanomaterials</td>
<td>Depends</td>
<td>Depends</td>
</tr>
<tr>
<td>Workplace exposures</td>
<td>Occupational Safety and Health Act</td>
<td>Occupational Safety and Health Administration</td>
</tr>
</tbody>
</table>
Discretionary types of federal policies affecting chemical regulation & development

- Purchasing/procurement policy
- Support/recognition programs
- Economic policies - technical support, liability, financing, tax incentives, subsidies
- Guidance documents
- Loan/grant programs
- R&D/Research Support Programs
- Innovation Programs
- Education policy
- Affected by: Budget/Resource allocation
States and localities advancing broad chemicals policies

- States are often innovators in environmental policy
- Started with single chemical restrictions now moving towards broader, information and substitution based policies
- Leaders - ME, MI, CA, WA, MA, NY, MN, OR as well as local - San Francisco, Seattle, etc
- Over 1000 policies proposed or implemented in last 10 years- more likely.
- New green chemistry support programs - MI, OR, WA, MN
- Greater interstate collaboration
Passed and Pending State Chemicals Legislation

To select more than one item in each list, hold down the command key (Mac) or control key (Windows) while making your selections.

<table>
<thead>
<tr>
<th>State</th>
<th>Region</th>
<th>Status</th>
<th>Chemical</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>All</td>
<td>All</td>
<td>2-ethyl-1-hexanol</td>
</tr>
<tr>
<td>Alabama</td>
<td>Arctic</td>
<td>Proposed</td>
<td>4-phenylecyclohexene</td>
</tr>
<tr>
<td>Alaska</td>
<td>Midwest</td>
<td>Enacted</td>
<td>Alkylphenol</td>
</tr>
<tr>
<td>Arizona</td>
<td>Northeast</td>
<td>Failed</td>
<td>Arsenic</td>
</tr>
<tr>
<td>Arkansas</td>
<td>Pacific</td>
<td></td>
<td>benzyl butyl phthalate (BBP)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Policy Category</th>
<th>Product Types</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>All</td>
<td>2014</td>
</tr>
<tr>
<td>Alternatives Assessment</td>
<td>Brake Friction Materials</td>
<td>2013</td>
</tr>
<tr>
<td>Biomonitoring</td>
<td>Children's Products</td>
<td>2013</td>
</tr>
<tr>
<td>Data Collection</td>
<td>Cleaning Products</td>
<td>2012</td>
</tr>
<tr>
<td>Design for the Environment</td>
<td>Clothing and Footwear</td>
<td>2011</td>
</tr>
<tr>
<td>Environmental Health Tracking and Surveillance Systems</td>
<td>Cosmetics</td>
<td>2010</td>
</tr>
</tbody>
</table>

Search Entire Database

Enter words or phrases, separated by commas.

Search

http://www.theic2.org/chemical-policy
So...Do these policies actually work?

- Evidence that well designed policies can stimulate innovation in safer chemistry and toxics reduction
- Greater attention to chemical toxicity in the design phase and safer substitutes but green chemistry is far from being “mainstreamed”
- Policy implementation and analysis are key to understanding why certain policies or types might succeed or fail
Figure 1-1
Participants in the Policy Process

The Congress
- Acts
- Bills
- Debates
- Oversight
- Hearings

The President
- Laws
- Vetos
- Orders
- Rhetoric
- Proposals

Agency Executives
- Regulations
- Programs
- Implementation
- Enforcement

Executive Office of the President
- Presidentially Appointed Review Groups
- Contract Analysts
- Academic Policy Researchers
- Academic Policy Consultants

Committee Staff Analysts
- Congressional Research Service
- General Accounting Office
- Congressional Budget Office

Office of Technology Assessment
- Invited Witnesses and Consultants
- Proponent Special Interest Groups
- Opponent Special Interest Groups

Media Analysts and Journalists
- Private Policy Research Institutes

The General Public
Designing Policies to Support Green Chemistry Innovation

• Core Elements
  – Willingness
    • Restrictions, information requirements, planning requirements, purchasing policies, recognition
  – Capacity
    • Technical assistance, information requirements, R&D support, Education
  – Opportunity
    • Education, tax incentives, grants

Example - Toxics Use Reduction in MA

• Goals and definitions
• Requirement to characterize and report on chemical use (metrics)
• Requirement to conduct planning and evaluate alternatives
• Fees that fund technical, research, and education support, demonstration and partnerships
States can support green chemistry and design for environment through:

- Information development and dissemination
- Economic Incentives
- Recognition Programs
- Regulation and Policy Tools
Federal Green Chemistry R&D Policies


https://www.govtrack.us/congress/bills/114/s1447/text
Sustainable Chemistry R&D Act - Core Elements - Interagency Sustainable Chemistry Program

- Provides support for sustainable chemistry research, development, demonstration, technology transfer, commercialization, education, and training through grants, partnerships, loans, prizes and interagency collaboration
- Examines methods for federal government to create incentives for sustainable chemistry, including funding.
- Expands the education and training of students and professionals
- Collects and disseminates information on sustainable chemistry research, development, and technology transfer
- Supports (including through technical assistance, participation, financial support, or other forms of support) venues for outreach and dissemination of sustainable chemistry advances
- Develops metrics to track the outputs and outcomes of the Program
An Agenda for Mainstreaming Green Chemistry

Foster Collaboration
Inform the Marketplace
Support Smart Policies
Track Progress
Understand the Marketplace

GC3
GREEN CHEMISTRY & COMMERCE COUNCIL
Thank You

For more information about the GC3:
www.greenchemistryandcommerce.org
Role of Policy in Advancing Green Chemistry Innovation

Robert J. Giraud
E. I. du Pont de Nemours and Company

GC3 Green Chemistry Education Webinar
June 16, 2015
Values
The Foundation of DuPont

DUPONT CORE VALUES

SAFETY & HEALTH
ENVIRONMENTAL STEWARDSHIP
RESPECT FOR PEOPLE
HIGHEST ETHICAL BEHAVIOR
DuPont is a Science Company

We work collaboratively to find sustainable, innovative, market-driven solutions to solve some of the world’s biggest challenges, making lives better, safer, and healthier for people everywhere.
Sustainability

Our mission is sustainable growth.

Sustainability is at the core of what we do – from reducing our operational footprint and creating market-facing sustainable solutions to addressing the global challenges of the future.

Our sustainability efforts create shareholder and societal value while reducing our environmental footprint along the value chains in which we operate.

We are committed to inclusive innovation with suppliers, customers, governments, academic institutions and others.

Policy

Policy — set of principles that directs current and future business decisions and activities to carry out core values and behaviors held critical to the company.
The DuPont Commitment

The DuPont Commitment: Safety, Health and the Environment

The core director of DuPont is Sustainable Growth—the creation of shareholder and societal value while we reduce our environmental footprint along the value chains in which we operate. This commitment to safety, health and environmental excellence, we affirm to all our stakeholders, including our employees, customers, shareholders and the public. That is why we will continue to improve our business and care for the environment. We will implement strategies that build sustainable businesses and achieve the greatest benefit for all our stakeholders without compromising the ability of future generations to meet their needs.

We will continuously improve our practices in light of advances in technology and new understandings in safety, health and environmental science. We will make consistent, measurable progress in implementing this commitment throughout our worldwide operations and support Responsible Care® as a key program to achieve this commitment.

Highest Standards of Performance, Business Excellence

We will achieve the highest standards for the safe operation of facilities and the protection of our environment. We will improve and deploy our practices, processes and products to reduce their risk and impact throughout the product life cycle. We will develop new products and processes that have increasing margins of safety for both human health and the environment.

Compliance with this Commitment and applicable laws is the responsibility of every employee and contractor acting on our behalf and a condition of their employment or contract.

We will deploy our resources, including research, development and capital, to meet this Commitment and will do so in a manner that strengthens our businesses.

We will continuously analyze and improve our practices, processes and products to reduce their risk and impact throughout the product life cycle. We will develop new products and processes that have increasing margins of safety for both human health and the environment.

• We will continuously analyze and improve our practices, processes and products to reduce their risk and impact throughout the product life cycle. We will develop new products and processes that have increasing margins of safety for both human health and the environment.

• Compliance with this Commitment and applicable laws is the responsibility of every employee and contractor acting on our behalf and a condition of their employment or contract.

• We will deploy our resources, including research, development and capital, to meet this Commitment and will do so in a manner that strengthens our businesses.

* SHE Commitment originally issued in 1994.
Supplier Code of Conduct

• Suppliers will provide DuPont with high-quality products and services that meet all applicable quality and safety standards. Suppliers will need to demonstrate that they have quality management systems.

• Suppliers will comply with all laws and regulations

• Suppliers will implement measures to protect any Trade Secrets provided during the course of our business transactions.

• Suppliers are expected to embrace Responsible Care® or develop similar programs to support their own operations.
Responsible Care® Guiding Principles

• To lead our companies in ethical ways that increasingly benefit society, the economy and the environment.

• To design and develop products that can be manufactured, transported, used and disposed of or recycled safely.

• To work with customers, carriers, suppliers, distributors and contractors to foster the safe and secure use, transport and disposal of chemicals and provide hazard and risk information that can be accessed and applied in their operations and products.

• To design and operate our facilities in a safe, secure and environmentally sound manner.

• To instill a culture throughout all levels of our organizations to continually identify, reduce and manage process safety risks.

• To promote pollution prevention, minimization of waste and conservation of energy and other critical resources at every stage of the life cycle of our products.

• To cooperate with governments at all levels and organizations in the development of effective and efficient safety, health, environmental and security laws, regulations and standards.

• To support education and research on the health, safety, environmental effects and security of our products and processes.

• To communicate product, service and process risks to our stakeholders and listen to and consider their perspectives.

• To make continual progress towards our goal of no accidents, injuries or harm to human health and the environment from our products and operations and openly report our health, safety, environmental and security performance.

• To seek continual improvement in our integrated Responsible Care Management System® to address environmental, health, safety and security performance.

• To promote Responsible Care® by encouraging and assisting others to adhere to these Guiding Principles.
Responsible Care® Product Safety Code

Core Elements

- Undertake scientific analyses of their products, and take steps so that they can be used safely.
- Enhance cooperation and communications along the chemical value chain, so chemical producers and those who use, handle or sell chemicals work together to improve awareness of risk and manage chemical safety along the value chain.
- Consider impacts on public health and the environment as products are developed and improved.
- Conduct risk characterization of their products based on their hazards, uses and exposures, considering new research and contact with children.
- Provide public access to product safety and stewardship information.
- Establish senior company leadership’s commitment to a visible culture of product safety and accountability.

Across the Value Chain

Chemical Development  \( \rightarrow \)  End-of-Life

Transportation  \( \rightarrow \)  Downstream Product Manufacturers

Consumer
Sound Science Informs Public Policy

Long-Range Research Initiative. *Global Research Strategy – 21st Century Approaches to Risk Sciences*
Public Policy: Montreal Protocol

Most successful multilateral environmental agreement in history because

• Grounded in sound science
• Aligned the goals of governments, industry, NGOs
• Developed innovative regulatory structure:
  — Combined flexibility with regulatory certainty, enabling governments to adapt to their own circumstances
  — Recognized HCFCs as interim solutions, providing confidence in the market for environmentally superior products
• Made special provisions for developing countries

Public Policy: EU MAC Directive

European Commission (EC) HFC Regulations

• Predictable regulatory scheme with realistic timeline

• The 2006 European Directive on mobile air-conditioning systems (MACs) aims at reducing emissions of greenhouse gases which contribute to global warming.

• EC MAC Directive allows only refrigerants with a GWP less than 150 in “new type” vehicle models sold in EU countries beginning January 1, 2011 and in all new vehicles in 2017.
Systems
Sustainable Growth is built on strong stewardship

Key Stakeholders
- People & Planet
  - Product Sustainability
  - Process Sustainability

Key Stakeholders
- Product Stewardship
  - Customers
  - Supply Chain Partners

Key Stakeholders
- Environmental Stewardship
  - Employees
  - Local Communities

Key Stakeholders
- Products
  - Product Regulatory

Key Stakeholders
- Facilities
  - Environmental Regulatory

Products
Product Stewardship Along the Value Chain

Defined as the shared responsibility for the identification, management, and communication of product health, safety, and environmental information and issues along the entire value chain in a way that adds value and meets customer, market, societal, and stakeholder expectations throughout the product life cycle, in support of our companies’ right to operate, innovate and compete.

Product Stewardship and Regulatory Affairs Council
See https://www.conference-board.org/councils/councildetail.cfm?councilid=302
Product Stewardship Management System

Life cycle stages in which health & safety impact of products are assessed for improvement

Collaboration with customers & supply chain partners

DuPont Research

DuPont Innovation Centers

- Japan
- Thailand
- Taiwan
- India
- Mexico
- Brazil
- Russia
- USA
- Turkey
- Korea
- Switzerland

Markets, Customers and Partners

New Products
- New Businesses
- Product Improvements
- Application Developments
- Process Improvements
Chemicals Management Module

The outdoor industry (suppliers, global brands and retailers) are developing supply chain facing tools to understand and assess the life-cycle environmental impacts for apparel, footwear and equipment.

- **Chemical management is a key focus area**
- **Framework**
  - Comprehensive, *tiered* strategy
  - Roadmap for integrated chemicals management into your business

**Success requires collaboration along the entire supply chain – a systematic approach**

The goal of the Chemicals Management Module is to identify and drive improvements within your organization and supply chain toward sustainable chemistry.
DuPont Innovation Platform

Global Market Insights + Science + Technical Capabilities

Solutions
- Agriculture
- Electronics & Communications
- Industrial Biosciences
- Nutrition & Health
- Performance Materials
- Safety & Protection
- Performance Chemicals
DuPont 2015 Sustainability Goals*

Reducing Environmental Footprint
- Greenhouse Gas Emissions
- Water Conservation
- Fleet Fuel Efficiency
- Air Carcinogens
- Independent Verification of Site Programs

Serving the Marketplace
- Environmentally Smart Market Opportunities from R&D Efforts
- Products that Reduce Greenhouse Gas Emissions
- Revenues from Non-Depletable Resources
- Products that Protect People

* 2015 Sustainability Goals were announced in October 2006.
Sustainability Trends

Current Trends: These are already impacting and shaping our businesses’ markets today.

- Product Sustainability & Transparency
- Resource Efficiency (Land, Water, Energy, etc.) & Environmental Stewardship
- Climate Change & Low Carbon / Renewable Energy
- Supply Chain Sustainability & Resilience

Accelerating Trends: These are already in play for some businesses, expect increased focus in coming years.

- Water – Availability & Quality
- Climate Change Adaptation
- Zero Waste
- Product End of Life Circular Economy

Expectation that companies integrate sustainability into corporate strategy and growth plan.
Green Chemistry utilizes a set of 12 design principles\(^1\) that seeks to maximize efficiency and minimize health and environmental impacts throughout all stages of a chemical’s life cycle.

DuPont takes a holistic approach to putting the 12 principles of Green Chemistry into practice.

DuPont is a leader in the industrial application of the 12 principles of Green Chemistry.

• Front End Loading: Generate as much knowledge as early as possible while options are still open

• ‘Fail Fast / Succeed Early’

• Two-phases of R&D¹
  1. Early → quickly eliminate poor candidates and absorb risk
  2. Late → increase probability of launch

• Disciplined, but flexible “Stage Gate” process with well defined advancement criteria

Proactive product stewardship

**Concept Phase:** develop ideas and evaluate business merit and technical feasibility
- Determine whether this product is new or if it is significantly changing an existing product which would require you to initiate this product stewardship process.
- Get basic property, regulatory and public perception data about the chemicals.

**Evaluation and Planning Phase:** refine the product and its definition
- Determine global inventory listing status for product, raw materials, & support chemicals.
- Explore potential export control restrictions.
- Identify applications and end uses.
- Build a product stewardship review team.
- Explore gaps in toxicological or environmental fate data.

**Candidates and Prototype Phase:** develop process concept for larger scale production
- Screening co-products, intermediates, emissions and waste.
- Identify impacts on the environment.
- Consider sustainability of the product/process.

**Demonstration Phase:** define and demonstrate final process/products
- Develop permit strategy.
- Develop process safety guidelines.
- Finalize occupational health procedures.

**Commercialization Phase:** full scale operation and maintenance
- Conduct pre-launch formal product stewardship review.
- Establish frequency of future product stewardship reviews.
Products
Our Science Accelerates Discovery, Inventions & Growth

When DuPont science meets the demands of the global market, the result is innovation.

>10,000 SCIENTISTS AND ENGINEERS

$2.2 BILLION SPENT ON RESEARCH & DEVELOPMENT IN 2013

OVER 150 RESEARCH & DEVELOPMENT LOCATIONS WORLDWIDE
R&D Results

Revenue from New Products

- Introduced in prior 5 years
- Introduced in prior 4 years

US Patents Granted Annually

- 400 in 2000
- 910 in 2011
- ‘08-’11 Avg. 671

US Patent Filings

New Products Commercialized

- 800 in 2004
- 1742 in 2011
- ‘08-’11 Avg. 1470

DuPont Record of Sustained Innovation
Over The Last Decades,
We Introduced Game-Changing Innovations

Biobased Industrials – Bio-PDO®
- Sorona® is used in carpets, textiles, auto parts and packaging
- Zemea® has applications in cosmetics & personal care, as well as in other markets

Solamet® Photovoltaic metallization paste and Tedlar® films
- New technology drives solar energy toward grid parity

Rynaxypyr® and Cyazypyr™ for Insect Control
- New class of blockbuster chemistry with minimal impact to non-target species, low environmental impact and lower use rates

Hytrel® RS and Zytel® RS
- BioBased polymers engineered to reduce use of fossil fuels without reducing performance

Optimum®
AQUAmx® Hybrids
/ Optimum®
AcreMax® insect protection technology
- Yield advantage in water-limited environments and improved productivity

The DuPont Oval Logo, DuPont™ and all products denoted with ® or ™ are registered trademarks or trademarks of E. I. du Pont de Nemours and Company or its affiliates.
DELIVERING INNOVATIVE SOLUTIONS FOR A CLEANER, SAFER PLANET

Exceeding Regulatory Requirements
Meeting Environmental Challenges

HFCs
Zero ODP
Very Low GWP

HCFCs
Zero ODP
High GWP

CFCs
Low ODP
High GWP

High ODP
High GWP

ODP = Ozone Depletion Potential
GWP = Global Warming Potential

COLLABORATE
• Work with regulatory agencies
• Engage stakeholders across the value chain

INNOVATE
• Apply science to meet market challenges
• Develop proprietary new products

COMMERCIALIZATE
• Create manufacturing and supply chain processes
• Deliver cost-effective solutions that meet customer and societal needs

OPTEON™ YF FOR MOBILE AC—COOLING CARS WITHOUT HEATING THE PLANET

REGULATORY COMPLIANCE
Meets EU Mobile Air Conditioning (MAC) Directive with GWP of 4

OPTIMAL BALANCE
Optimal balance of safety, environmental sustainability, performance and cost vs. other options

INTERCHANGEABLE
“Drop-in” replacement for current refrigerants

SAVES 600 MILLION GALLONS OF FUEL PER YEAR
Could save more than 600 million gallons of fuel annually
CBI protection is required to sustain innovation

- The ability to preserve legitimate CBI and prevent piracy of intellectual property is critical to competitiveness and innovation.

- There is active industrial espionage seeking to steal trade secrets that needs to be recognized – if we simply give innovation away, there is little reason to innovate.

Development of Safer, More Sustainable Products Is Promoted by:

- Focus on meeting customer needs (inclusive innovation)
- Multidisciplinary, well integrated teams
- Holistic approach to reducing environmental footprint along the value chain
- Disciplined R&D project management that integrates Green Chemistry and Product Stewardship from the start
- Exposure-based tiered approach to hazard data collection
- Implementation of ‘21st Century’ approaches to hazard identification and risk assessment
Ongoing Needs

Stable, predictable regulatory environment for products and processes
  • Science-based approach to risk management: \( \text{risk} = f(\text{hazard}, \text{exposure}) \)
  • Engagement of industrial innovators in the development of regulations
  • Strong protection of confidential business information

Government support for development of transformational technologies
  • Partnerships with academia and government labs on technology development
  • Facilitation of pilot scale and demonstration facilities to overcome the issues of scale and incumbency for new technologies

Collaboration to assure improvement in research tools with better predictive capabilities, e.g.:
  • Global regulatory acceptance of validated new \textit{in vitro} assays
  • Development of AOP library toward more mechanistically-based QSARs
Together, we can accomplish what no one can do alone.
Acknowledgements

Bob Buck
Dawn Rittenhouse
Melissa Joerger
Cathie Barton
Henry Bryndza
Jim Romine
Bob Reich
Phil Palmer
Tom Connelly
Stanley Merritt
Rose Passarella
Maureen McGeehan
Tim Bingman
John Gannon
Mark Thompson
Mark Harmer
John Carberry
Paul Tebo
**METIS Chemical Screening Visualization Tool (CSVT)**

**Potential for Concern**
- **Indicated by Color:** Green: Low; Orange: Moderate; Red: High/Very High
- **Indicated by Wedge Length:** 1 = Low; 2 = Moderate; 3 = High; 4 = Very High

**Environmental Impacts**
- Transport in Air
  - Long Range Transport
- Ozone Depletion
- Global Warming Potential

**Public Perception**
- NGO List
  - Watch List
- Industry Desalination List
- Biomonitaging List
- Biopersistence

**Transport in Air**
- Long Range Transport

**Persistence**
- Air (Half-life)
- Water (Half-life)
- Soil (Half-life)

**Soil Mobility**
- Mobility to Groundwater

**Aquatic Toxicity**
- The measured or estimated toxicity to aquatic organisms.

**Bioaccumulation**
- Uses measured or estimated values to indicate the potential for a chemical to sorb to lipids.

**Mutagenic Activity**
- Reproductive Toxicity
- Carcinogenicity

**CMR**

**Bioaccumulation**
- BCF-LogP
- BCF
- BAF

**Aquatic Toxicity**
- Daphnia
- Fish
- Algae

**Soil Mobility**
- The potential for a chemical to migrate from soil into groundwater.

**Aquatic Toxicity**
- Indicates the predicted half-life in each environmental compartment.

**Bioaccumulation**
- Indicates the predicted half-life in each environmental compartment.
Upcoming Events

The Clariant Portfolio Value Program System: How a Leading Specialty Chemical Company has Developed a Systematic Approach for Improving the Sustainability Performance of its Products
Wednesday, June 17, 2015  |  11:00 AM EDT

GC3 Green Chemistry Education Webinar Series: Introduction to Life Cycle & Alternatives Assessment
Thursday, June 18, 2015  |  2:00 PM EDT

Advancing Green Chemistry: Barriers to Adoption & Ways to Accelerate Green Chemistry in Supply Chains
Thursday, July 23, 2015  |  12:00 PM EDT

11th Annual GC3 Innovators Roundtable
May 24-26, 2016  |  Burlington, VT
Thanks for joining us!

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