The Green Chemistry Business Summit

A First-of-its-kind Summit of Scientific, Industrial, and Investment Leaders Assembled to Harness the Economic and Workforce Opportunities of Green Chemistry

Northern Essex Community College, Haverhill, MA
October 31, 2007

Summary Notes

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On October 31st, 2007, Northern Essex Community College hosted the Green Chemistry Business Summit - a first-of-its-kind event intended to harness the economic and workforce opportunities for clean manufacturing through Green Chemistry. To meet this objective, the Summit assembled professionals from scientific, industrial, academic, and investment sectors.

Keynote speakers included the two founders of Green Chemistry science: Dr. John Warner and Dr. Paul Anastas. Their joint appearance, a rare occurrence, indicated the importance of the Green Chemistry Business Summit as a benchmark in the evolution of Green Chemistry as a vehicle to stimulate economic growth. Additional keynotes included Dr. Berkeley Cue, retired Vice President of Pfizer, Bruce Rayner, Vice President for Technology Forecasters, and Daniel Hullah, Associate with Rockport Capital Partners. Greg Watson, Assistant Secretary for Clean Energy and Technology in the Executive Office of Energy and Environmental Affairs, delivered greetings from the Governor. Mr. Watson suggested there the efforts to support Green Chemistry in Massachusetts are complimentary the goals of the New England Clean Energy Council, which seeks to accelerate New England's clean energy economy. Summit organizers Seth Itzkan, of President of Planet-TECH Associates, and John Michitson of Haverhill, made opening remarks.

Themes

The Summit explored five facets germane to Green Chemistry business development. Each of these, listed below, is key to growing and maintaining a regional economic leadership in the field. They are:

1. Green Chemistry Science
2. Economic Opportunity for Industry
3. Investment Opportunities
4. Workforce Development Opportunities
5. Technology Transfer & Open Innovation

Findings

- **Business Opportunity:** Green Chemistry presents an enormous opportunity to harness clean economic growth. The applicable industries run the gamut from pharmaceuticals to electronics. Berkeley Cue of Pfizer showed that Green Chemistry can save the pharmaceutical industry $10B annually, $700M over the lifetime a typical product. There are also important regional opportunities. It was shown there are over 200 bio-pharmaceutical companies in Eastern Massachusetts, all of which can benefit from the cost saving potentials of Green Chemistry. Amy Cannon, Co-Founder of the Beyond Benign Foundation, discussed the potential role of Green Chemistry in supporting regional economic development. The benefits include attracting and maintaining companies, creating a steady supply of jobs, and using local resources.

- **European Mandates:** European and Asian mandates for toxic products reduction (such as REACH, WEEE, RoHS) are driving manufacturing changes here in the United States.

- **International Competition**: China and India are far ahead of the United States in Green Chemistry education and research. Not one U.S. chemistry department requires its students to take classes in toxicology.

- **Workforce Development:** Workforce development and training opportunities are starting to be developed here in Massachusetts to meet the emerging need for industry. David Hartleb of Northern Essex Community College and Mahesh Sharma of Cambridge College each spoke of initiatives their respective institutes are taking to address the need for training in Green Chemistry and related industries. Amy Cannon of the Beyond Benign Foundation discussed efforts underway to promote Green Chemistry curriculum in schools, including projects in collaboration with the Boston Museum of Science.

- **Finance**: The investment community is paying a growing interest to green technologies. Current areas of focus for Rockport Capital Partners include power electronics, battery technology, biofuels and building materials.

- **Intellectual Property Management and Rapid R&D:** Innovative models for rapid idea generation and research and development must be employed. The Open Innovation model was presented as ideal for fostering Green Chemistry research. Jon Cronin of InnoCentive discussed the "online marketplace for ideas" and the Innocentive approach of building a global community of solution providers. Innocentive has over 130,000 "solvers" in 175 countries and 60 industry disciplines that share in the global marketplace of industrial and scientific innovation.

- **Culture Change:** Culture change was often referred to as the key factor in affecting industrial adoption of Green Chemistry. Executives must begin to develop a "systems thinking" approach to product creation and degradation. They must consider a "cradle-to-cradle" perspective in the lifecycle management of their products.

- **Cross Industry Collaboration:** Cross industry collaboration was considered essential to regional economic development in Green Chemistry. Energy saving and environmentally beneficial innovations developed for one sector may have promise in others. Avenues for cross-sector collaboration and information sharing should be in place to support the growth of a regional economic development in Green Chemistry and other emerging clean technologies.

Speakers

Greg Watson, Assistant Secretary for Clean Energy and Technology, Executive Office of Energy and Environmental Affairs
John C. Warner, Ph.D., President and CTO, The Warner Babcock Institute for Green Chemistry
Paul Anastas, Ph.D., Professor in the Practice of Green Chemistry, Yale University Center for Green Chemistry and Engineering
Berkeley Cue, Ph.D., Retired Pfizer VP; Creator, Pfizer's Green Chemistry initiative
Amy Cannon, Ph.D., Co-Founder, Beyond Benign Foundation
David Hartleb, Ph.D., President, Northern Essex Community College (NECC)
Mahesh Sharma, Ph.D., President, Cambridge College
Bruce Rayner , Vice President and Director of Research and Consulting, Technology Forecasters, Inc.
Daniel Hullah, Associate, Rockport Capital Partners
Joel A. Tickner, ScD, Assistant Professor, Lowell Center for Sustainable Production UMASS/Lowell;
Eugene Buff, M.D., Ph.D., Consulting Director, Yet2.com, Inc.
Jon Cronin, Ph.D., Director, Sales, InnoCentive
Abigail A. Barrow, Ph.D., Director, Massachusetts Technology Transfer Center University of Massachusetts

Organizers / Chairs

John C. Warner, Ph.D., - President and CTO, The Warner Babcock Institute for Green Chemistry
John Michitson, Merrimack Valley Economic Development Council
Seth Itzkan, M.S., President, Planet-TECH Associates

Sponsors

Massachusetts Technology Collaborative
Merrimack Valley Venture Forum
Merrimack Valley Economic Development Council
Warner-Babcock Institute for Green Chemistry
Beyond Benign Foundation
Planet-TECH Associates

Attendees included

Cory Atkins, Massachusetts State Representative
Harriett Stanley, Massachusetts State Representative
Brian Dempsey, Massachusetts State Representative
Jim Fiorentini, Mayor, Haverhill, Massachusetts
Jim JaJuga, Greater Haverhill Chamber of Commerce
Pat Cloney, Director, Massachusetts Office of Business Development
Art Roberts, Massachusetts Office of Business Development, Industry Specialist for Defense and Alternative Energy

International Attendees

Sergey Tsyganov, Russian Federation of Basic Research
Erik Noaksson, Jegrelius Research Centre, JILU, Sweden
Tomas Ostberg, Jegrelius Research Centre, JILU, Sweden
Magnus Hedenmark, Jegrelius Research Centre, JILU, Sweden

Additional Information

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http://www.ivalley.org/greenchemistry

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Speaker Highlights, Key Points

Session	Presenter	Highlights
AM Sessions		
Greetings from the Governor & State Programs Supporting Green Technology Businesses in The Commonwealth	Greg Watson - Assistant Secretary for Clean Energy and Technology, Executive Office of Energy and Environmental Affairs	• Brings greetings from the Governor and the Secretary of Energy and Environmental Affairs • Says that Green Chemistry can be part of the State's effort to promote clean energy • Discussed formation of New England Clean Energy Council
Green Chemistry in Practice	John Warner - President and CTO, The Warner Babcock Institute for Green Chemistry	• Tells the story of the evolution of Green Chemistry • Not one graduating chemist in America is required to take classes in toxicology • There is no science for toxicity avoidance in the synthesis of new molecules • We create molecules first and then wonder later if they are toxic • We need a new tool shed for chemistry • China and India are well ahead of us
Opportunities in Green Chemistry	Paul Anastas - Professor in the Practice of Green Chemistry - Yale University Center for Green Chemistry and Engineering	• Discusses need for new thinking • We need more of a systems view - "cradle to cradle" • "The stone age didn't end because we ran out of stones" • We need to use C02 as a feedstock. • We need a new generation of pesticides that don't cause dead zones • Gave examples of new Green Chemical products that had won the President's Green Chemistry Challenge • Chemical products made from lignocellulose rather than fossil fuels ○ Serenade from AgraQuest

The Business Case for Green Chemistry	Berkeley Cue - Retired VP; Creator, Pfizer's Green Chemistry initiative	• Gave the view from a pharmaceutical manager
		• The industry needs to change its view of the "life cycle" of a product. Typically they see the life cycle as beginning when the raw materials show up on the loading dock and end when the patient takes the tablet. Instead, they need to account for the full interaction with the Earth, the wastes, the lasting environmental impacts, the toxic materials and exposures used in manufacturing, etc.
		• Need to change culture in the pharmaceutical industry: "Culture eats strategy for breakfast"
		• Need to comply with growing international regulations: REACH, WEEE, RoHS,
		  ○ http://www.rohs-weee.eu/english/index.html,
		  ○ http://www.niccomp.com/rohs.html-ssi
		• Discusses the 1.7 Kg microchip and pharm tablet - the actual weight of materials involved in making the product, even though the product weighs only a few grams
		• Example of Green Chemistry in pharm - use C02 to clean beakers and mixers, rather than expensive and toxic cleaners and reactants

		• Johnson Matthey Pharma Services is a Fort Devens and North Andover company active in Green Chem in Pharm industry
		• Shaw Carpets / tiles, EcoWorx carpet backing technology, recycling carpeting, winner Pres. Green Chem Challenge
		  o http://www.shawcontractgroup.com/html/html/capabilities/cap_sustain2.shtml
		• SC Johnson Green List (tm) patented classification, Winner of the Pres. Green Chem Challenge
		  o http://www.dowhatsright.com/greenlist.asp
		  o http://pubs.acs.org/subscribe/journals/esthag-w/2006/jul/business/nl_johnsons.html
		• Need to focus on Industrial Ecology
		• Bioaromatics - Pharm companies pay 10-times the national average for raw materials
		• Mass Opportunity, over 200 biopharm companies in Mass
		• E-Factor, measuring the environmental waste quotient of a chemical product
		• Huge savings possible for Pharm industry through Green Chem, reducing the E-Factor
		  o 10% savings greater than $10B / annually
		  o Could save 4 billion kilos of waste a year
		  o $700 M potential savings over the life of a drug
		• Maine example: Plastics from potatoes, "Brown. It's the new green". Main Green Chemistry Initiative - "Growing Maine's Green Economy"
		  o http://www.mainegreenchemistry.com/
		• Need to focus on catalytic processes, rather than stoichiometric

Green Chemistry and Regional Economic Development	Amy Cannon - Co-Founder, Beyond Benign Foundation	• Discussed the 12 principals of Green Chemistry, http://www.epa.gov/greenchemistry/pubs/principles.html • Discussed educational outreach efforts of the Beyond Benign Foundation, including the regional network of colleges and universities starting programs in Green Chemistry. • Discussed the role of Green Chemistry in assisting regional economic development. The benefits include attracting and maintaining companies, creating a steady supply of jobs, and using local resources.
Workforce Development - NECC	David Hartleb - – President, NECC	• Discussed emerging workforce development opportunities in green industries at NECC
Workforce Development - Cambridge College	Mahesh Sharma - - President, Cambridge College	• Green Chemistry program to be implemented at Cambridge College • wants to make Cambridge College an "oxidizing / reduction agent and catalyst for changing mindsets"
PM Sessions		
Analyst View- Clean Technology/Green Chemistry Market Opportunity – “Green Electronics” focus	Bruce Rayner - Vice President and Director of Research and Consulting, Technology Forecasters, Inc.	• EU laws driving reduction in hazardous materials in electronics • Sun, Dell, TI, Philips, HP, Thomson, NEC, Siemens among early adopters • Executives’ need more awareness, commitment and resource assignments to push green electronics forward • Companies need to apply Moore’s Law to design for

		environment (DfE) – goal to double capacity and environmental efforts every 18 months • Companies need to determine their place on the Corporate Social Responsibility (CSR) map • Use Eco-Checklists for all decisions impacting products and general processes • Marketing point - Green Chemistry terminology not often used in semiconductor industry; DfE more common
VC View – Clean Technology/ Green Chemistry Market Opportunity & VC Investment Criteria	Daniel Hullah – Associate, RockPort Capital Partners	• Rockport investment focus: energy and power; advanced materials; and process and prevention • RockPort investment criteria: markets; sustainable competitive advantage (technology, product business model); management; capital efficiency and exit potential • Current investments: EcoSMART Technologies (pesticide products derived from natural plant oils); Advanced Electron Beams; PPT Research (chemistry and process technology for the solar, semiconductor and other industries); and Hycrete (additive which transforms concrete into a waterproof material) • Current areas of interest: power electronics, battery technology, biofuels and building materials
Industry-Academic Collaboration to Advance Green Chemistry – The Green Chemistry and Commerce Council	Joel A. Tickner, ScD, Assistant Professor, UMASS/Lowell	• The Green Chemistry and Commerce Council (G3)—a group of some 40 industry, academic, and NGO representatives convened through the Lowell Center for Sustainable Production (LCSP) • Council's mission: to promote and support green chemistry and Design for Environment (DfE) research, practices and purchases • Recommendations: cross-industry collaboration; move beyond energy to think of other sectors where MA can be a leader; develop a clean technology vision for Massachusetts
What is Open Innovation? & yet2.com Experience and Perspective	Eugene Buff, M.D., Ph.D. Consulting Director, yet2.com, Inc.	• Open Innovation: companies share Intellectual Property (IP) and "co-develop" products; new channel for green chemistry business development • yet2.com is an on-line open innovation marketplace with supporting consulting services where technology seekers can identify a technology need and technology providers can market their IP. yet2.com is an innovation broker that connects seekers with providers • yet2.com extends reach of corporation with 100,000+ online global, cross-industry connections • Already brokering several green chemistry technology seekers and technology providers
Innocentive's Open Innovation Experience and Perspective - Green Chemistry Examples	Jon Cronin, Ph.D., Director, Sales, InnoCentive	• Practice open innovation by posing technology problems from corporations to a global community of solution providers: 130,000+ solvers, 175 countries, 60 industry disciplines and growing; the best solution is awarded a cash prize • Provide both on-line marketplace and consultation to facilitate entire process • About a 30% success ratio (solutions found); • A critical skill: framing the question • Several examples of green chemistry problems solved

Art of Technology Transfer & MTTC Experience and Perspective	Abigail A. Barrow, Ph.D., Director, Massachusetts Technology Transfer Center University of Massachusetts	• Statewide resources to support the inventor/researcher with the commercialization of their technology • Researcher education - from invention to venture • Gap Funding - proof of concept awards - $40,000 • Commercialization coaching - pitch by inventors to roundtable of industry experts - 'Dream Team' audience: investors, industry executives, professional services, entrepreneurs etc. • Facilitate Networking - Technology Showcase Conferences - early stage spin-off companies and platform technologies presented to investors and corporate executives • Marketing and PR support.