11th Annual GC3 Innovators Roundtable Session Proceedings

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SESSION V

Overcoming Barriers to Mainstreaming Green Chemistry

1) How Can We Effectively Track Progress in Green Chemistry?

Facilitator: Sally Edwards

Summary

Metrics are essential to communicating the value of green chemistry. They are needed at all levels of the supply chain and can be used to set corporate policy, track progress, measure the impact of green chemistry innovations, and facilitate communication and dialogue between buyers and suppliers around greener products and solutions. Being able to track progress and demonstrate tangible benefits of green chemistry using clear metrics is the most compelling way to communicate value and ultimately drive action. Product level metrics are very helpful because they can be directly related to sales and can be used to build a strong case for the financial impact and growth opportunities of greener products/formulations. Corporate level metrics such as the Chemical Footprint Project are also very valuable because they enable a holistic examination of how chemicals are managed within an organization and can facilitate internal dialogue. While there are many metrics currently being used, new metrics, or new ways of using existing metrics, are necessary. Particular focus is needed on metrics that can communicate the value of green chemistry innovation to key decision-makers throughout the value chain and drive action and investment in green chemistry solutions.

Important Functions of Green Chemistry Metrics:

- Tracking progress.
- Being able to communicate *benefits* using metrics.
- To tell a story about progress.
- Metrics should to matter to the target audience —e.g., identify key decision makers in the supply chain and determine what information would be compelling to them.

Priorities for Metrics Development:

- Product level metrics – are needed to be able to prominently identify products of green chemistry to:
    - enable retailers to demonstrate increased sales in those products.
    - help enable decision-making for buyers – e.g., the buyer doesn't really know what a carbon footprint is, but they know that it should be minimized because it's a corporate goal.
    - tell suppliers "we want these products, which represent this dollar amount of revenue, to be made with safer ingredients."
- Financial impact and growth opportunities of reformulation:
    - e.g., for new formulations - how much was sold after reformulation, how much of a chemical of concern was removed from the market?
    - e.g., for new products – how do sales compare to other products in that category?
- Increase in use of safer alternatives as well as elimination of chemicals of concern:
    - Walmart has done a good job of *calculating the reduction in use* of high priority chemicals for certain product categories (95 % by weight reduction).
- Innovation metrics:
    - Measuring the integration of green chemistry in the design process – e.g. do product designers in an organization have the tools needed to make good decisions? The Materials Sustainability Index at Nike has been a huge driver of innovation internally. In the end performance is the key metric - performs "as well" doesn't get much traction

Potential Next Steps:

- How can we scale up existing tools like the Chemical Footprint Project?
    - Chemical footprint project is a corporate level metric – evaluates how chemicals are systematically managed in an organization.
    - The Chemical Footprint Project can help frame a high level conversation in a firm and help to set goals and priorities for chemicals management.
    - It would be valuable to get wide participation in the Chemical Footprint Project (similar to the widespread adoption of the Carbon Disclosure Project).
- Identify ways to improve communication from buyers about the opportunities for suppliers for greener chemistries:
    - get retailers to say that they will be assessing suppliers on some key metrics to challenge suppliers and drive knowledge, dialogue and innovation.
    - data from large institutional purchasers (like group purchasing organizations in healthcare) can give an indication of what suppliers should focus on in regard to greener products.

2) What are the Key Elements of a National Green Chemistry Research and Education Summit?

Facilitator: Saskia Van Bergen

Summary
One of the actions in the GC3's Agenda to Mainstream Green Chemistry is to "convene a National Summit on Green Chemistry Research and Education." The vision for such a "White House" summit, modeled after a similar one for climate change and health, is to bring industry leaders and academic chemists and chemical engineers together with top-level state and federal officials from environmental, public health, education and funding agencies to discuss the workforce and research needs of institutions and firms working in the field of green chemistry. This group discussed ideas for what the desired outcomes and design of such a summit might be and the types of firms, federal agencies, and academic institutions that should be involved.

Key Messages:

- Green chemistry is innovation.
- Green chemistry can grow and sustain jobs.
- Green chemistry can reduce climate impacts associated with conventional chemistry.
- Green chemistry education is needed to accomplish the above.
- Funding for R&D is necessary; it can be done through re-prioritizing existing sources of funding.

Jobs, innovation, climate change, science standards, competitiveness, building a circular economy, a world with shrinking resources: green chemistry can help address these.

What Problems is the Summit Solving:

- Students are not being trained in green chemistry, partly because professors were not trained in green chemistry.
- The current way that academic programs are evaluated does not prioritize green chemistry.
- Companies are not able to find enough workers with green chemistry and green engineering expertise.
- State and federal funding drive university research priorities- more funding is needed for green chemistry-related R&D.

Who is the Audience:

- Decision-makers: federal as well as from states that support green chemistry.

- Funding agencies.
- K-12 science standards developers.
- Higher education representatives.

Desired Outcomes of Summit:

- More priority for green chemistry research and development funding.
- Academic evaluations that value green chemistry.
- Strengthen the link between industry needs and academia.
- Identify the unique role of the federal government in mainstreaming green chemistry.
- Build better relationships with federal agencies on the topics of green chemistry research, funding, and education.
- Funding for an Industry/University Cooperative Research Center on green chemistry.
- Funding for a national green chemistry center.

Programs to Highlight:

- Minnesota: $10-15K state grants to integrate green chemistry into education programs, develop a lab or change the syllabus.
- UC Berkeley: Greener Solutions course.
- Toledo: Integrating engineering into chemistry.

What Role Should the GC3 Play:

- Help to align people / facilitate a plan.

3) How Do We Increase Funding for Green Chemistry?

Facilitator: Joel Tickner

Summary

Lack of funding for green chemistry, from research through development and commercialization, is commonly stated as a critical barrier to the creation and scale up of new innovations by firms and academic researchers. This group discussed the types of public and private funding needed to develop and commercialize products of green chemistry, and ways to engage government agencies and private investors in attracting sufficient funding to grow green chemistry solutions.

What are the Funding Needs/Barriers of Different Players in the Supply Chain, from Researchers to Companies:

- Academic researchers will be hesitant to engage in green chemistry research without dedicated research funding. Yet, there are few extramural federal research programs dedicated to green chemistry.
- There are shrinking federal research dollars to support industry research, e.g., de-prioritization of sustainable chemistry funding program at NSF.
- There are some existing funding programs at EPA, DOD, DOE, and NIH that could be focused on green chemistry.

How Can the GC3 Help Overcome Those Barriers:

Education:
- Identify the realms (or lack thereof) of research funding sources for green chemistry innovations.
- Educate government extramural grant program officers about the business proposition for investing in green chemistry research through group briefings and individual meetings.
- Encourage agencies to consider green chemistry needs when establishing program funding priorities and strategies, including review criteria for grant proposals.
- Take on the role of "funding navigator" for GC3 members to help them find and access green chemistry funding opportunities.

Policy Engagement:
- Explore opportunities to leverage or establish green bonds for green chemistry innovation and process-redesign for green solutions. Many green bonds are currently attached to job creation.
- Integrate green chemistry investment into emerging policy opportunities. It could embed a revolving fund for retooling greener solutions, including green chemistry research and green engineering for process redesign research, in the COMPETES bill.
- Explore options within the Affordable Care Act – link green chemistry solutions, primary prevention and provision of products, technologies and settings for safe health care.
- Explore state funding opportunities. Several states have innovation development funds, yet none to date align with green chemistry needs.

Investor Engagement:
- Explore establishing and leveraging a GC3 angel circle fund, including exploring partnership opportunities with existing angel funds (e.g., chemicalangel.org) to provide further support for promising green chemistry research innovations.

- Link existing GC3 projects (e.g. Preservatives Project) with existing angel funds and connect end-use functions with company needs as a model for prioritizing funding.
- Explore GC3 partnerships with incubators/accelerator funds. In some cases regional opportunities may exist, e.g., Flagship Ventures in the Boston area.

4) What Will It Take to "Mainstream" Green Chemistry?

Facilitator: Amy Perlmutter

Summary

The GC3 has developed as its mission the "mainstreaming" of green chemistry. To help it accomplish this mission, it released in December, 2015, its Agenda to Mainstream Green Chemistry (the Agenda). The Agenda makes the case for green chemistry, discusses drivers, barriers and opportunities, and recommends five strategies that can be taken to accelerate the practice of green chemistry:

- Enhance market dynamics
- Foster collaborations
- Inform the marketplace
- Support smart policies
- Track progress

Green chemistry will be mainstream when:	We will need these partners to help make this happen:
It is embedded in the sustainability goals, innovation, R&D and sourcing strategies of firms through design guidelines, personnel hiring and reward practices, and metrics.	businesses across value chain
It is an integral part of all chemistry education, including workplace education.	educators, government, business
It is a core element of all government and private sector funding for chemistry and materials research and sustainability initiatives.	businesses, government, investors
Products of green chemistry are readily available throughout the value chain at high performance and reasonable cost.	businesses, researchers, advocates, consumers
An ecosystem of green chemistry entrepreneurs is flourishing.	government, business, advocates, researchers

To help clarify what is meant by mainstreaming green chemistry, and create metrics that can track progress in the right direction, the GC3 developed the vision below, and identified key partners to help make this happen. This group discussed what it would take to achieve this vision.

What are the Barriers to Mainstreaming:

- Green chemistry solutions and options from suppliers are limited due to regulatory barriers that inhibit innovation.
- There is a general consumer perception that green materials/products don't work.
- There are currently limited incentives, and therefore a need for more incentives to promote green chemistry.
- Sometimes the complexity of green chemistry is a barrier for consumer understanding and caring about the issue.
- There is limited linkage of green chemistry to sustainability, management is not always aware that green chemistry impacts sustainability.
- The GC3 is currently very U.S.-centric, but needs to be more global in thinking.
- The "innovators dilemma" is present, which means it is difficult for a small innovator to adequately supply a large company.
- Removing a hazardous material from an existing process/infrastructure for a large company is very expensive.

What Needs to Be Done to Mainstream Green Chemistry:

- There are no green chemistry metrics in the GR4 sustainability metrics, so green chemistry metrics should be proposed.
- When green is just one of many attributes for a material/product, not "the sole" attribute, the likelihood of success is much greater.
- Take out the word "green," and instead focus on "safety" and "human health" or "wellness."
- To reduce the complexity of the message, focus and communicate on an entire class of chemicals, instead of a chemical-by-chemical approach.
- Broaden the discussion and scope of what green products are to include chemistry, engineering, business, material waste, etc.
- Reach the players that have the purchasing power.
- The U.S. Green Building Council has done more to drive Green Chemistry than any other organization as a result of the LEED standard and their willingness to lead in this area. Material disclosure requirements are driving Life Cycle Analysis and other environmental impact analysis. LEED certification has significant market value in the construction industry.

Who are the Key Stakeholders:

- Academia: including both universities and accreditation bodies. Only four universities are represented at the current GC3 roundtable, and there is an opportunity to get more to join.
- NGOs, advocates, celebrities, chemical formulators, manufacturers, and government agencies are key stakeholders.

What Roles Can They Play?

- Consumers can sometimes drive what ingredients are used in products.
- Focus and communicate on an entire class of chemicals, instead of a chemical-by-chemical approach.
- Large companies are more likely to do incremental changes than breakthrough changes in the area of green chemistry.
- Universities can educate the next generation of chemists, not just about lab safety, but about green chemistry, toxicology, etc.
- ACS and ABET, the accreditation agencies, may be able to include green chemistry in their requirements.
- This is a marathon not a sprint. it is a long process to mainstream green chemistry.

How Can GC3 Engage Them:

- There is an education component to LEED certification for professional certification. GC3 or ACS can do something similar for green chemistry.
- Have a public signatory initiative to get companies to sign on to adopt green chemistry principles.
- GC3 can initiate a reward system in addition to the Presidential Green Chemistry award. It can also be a good vehicle for public relations. Competition for the award can drive future innovation.
- There is a large need for more small breakout sessions at the Roundtable and/or satellite meetings throughout the country that would be effective at getting more and valuable input from participants.
- Challenge GC3 members to adopt new chemistries and materials that are discussed at the Roundtable.