# Roundtable: Sustainable Chemistry in RD&D to Transform the Chemicals Industry

The U.S. Department of Energy's Industrial Efficiency and Decarbonization Office (IEDO) and the Green Chemistry & Commerce Council (GC3) would like to invite you to a roundtable on research, development, and demonstration (RD&D) in sustainable chemistry to achieve chemicals sector decarbonization and environmental justice. This document summarizes the motivations behind the upcoming roundtable to align participants on the scope to facilitate meaningful discussions.

***Save the Date***

**Sustainable Chemistry Roundtable**
**Cohosted by IEDO and GC3**

**March 7th, 2023**

**DoubleTree by Hilton Hotel**
**Arlington, VA**

## Previous Sustainable Chemistry Stakeholder Engagement – Looking Back

The Advanced Manufacturing Office/Industrial Efficiency and Decarbonization Office (IEDO) at the U.S. Department of Energy (DOE) and the Green Chemistry & Commerce Council (GC3) co-hosted a virtual roundtable on *Sustainable Chemistry in Manufacturing Processes* on November 17, 2020, to collect stakeholders' perspectives on incorporating sustainable chemistry manufacturing practices into the production of consumer and commercial products. Attendees participated in facilitated discussions regarding technology and commercialization barriers to sustainable chemistry and the research and development (R&D) needs to incorporate sustainable chemistry practices into the manufacturing of consumer and commercial products. Five themes were identified as scalability, information-sharing and collaboration, technoeconomic and lifecycle analyses, and chemical manufacturing processes.

The discussion concluded that R&D should aim to reduce carbon emissions, increase energy efficiency, reduce toxicity, or improve efficient material use and reuse across the value chain. The materials and processes that utilize sustainable chemistry practices need to be comparable in cost and performance to standard materials and processes as well as scalable in terms of material availability and production potential. Specific R&D opportunities identified included:

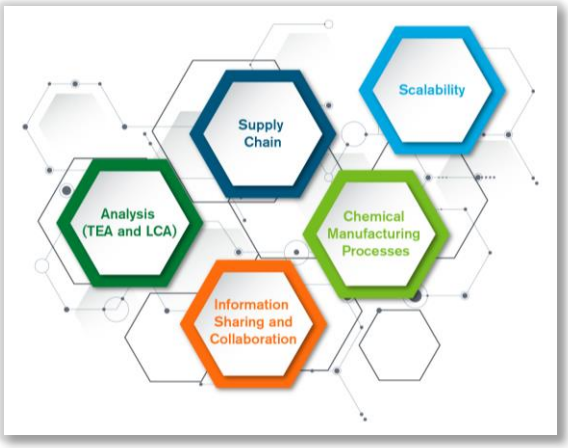


**Figure 1. Common Industry Perspective Themes for Sustainable Chemistry in Manufacturing**

Materials:

- Material and feedstock substitution via sustainable raw materials such as recycled, biobased, renewable, or industrial waste materials.
- Innovation in platform molecules that can be applied broadly across industrial sectors in key chemical functionalities and pathways. These platform materials include, but are not limited to, biocatalysts, colorants, recycled carbon, solvents, surfactants, reactants, preservatives, and emulsifiers.

Processes and practices:

- Process technologies including industrial electrification, advanced electrochemical

manufacturing, process intensification, combined heat and power, and integrating carbon capture utilization into chemical manufacturing.
- Modular and flexible processes and smart manufacturing to facilitate the incorporation of sustainable chemistry practices into manufacturing processes.
- Process technologies that allow greater molecular fine tuning, or advanced fermentation, purification, and extraction processes for selective product formation.
- Development of platform molecule libraries and the derivative chemistries that can be applied across industrial sectors enabled by chemicals manufacturing.
- Shared piloting facilities that are flexible in design, providing companies a route to rapidly assess process challenges and expected efficiencies, as well as demonstrate cost-effective and resilient operation.

The R&D needs identified from the 2020 roundtable informed DOE program planning in sustainable chemistry by targeting innovative partners who can demonstrate transformative processes to promote decarbonization and circularity. The upcoming roundtable will build upon this conversation to determine how IEDO and their collaborators can help support a path towards a decarbonized, sustainable, secure, and resilient chemicals sector.

## Current Industrial Decarbonization Strategy and Sustainable Chemistry Priorities

The Biden Administration has set an ambitious target to achieve net-zero greenhouse gas (GHG) emissions by 2050. In 2020, the industrial sector accounted for 30% of U.S. primary energy-related $CO_2$ emissions, with chemicals being the largest emitter of all industrial subsectors. The industrial sector presents unique decarbonization challenges, due in part to the diversity of energy inputs into a wide array of heterogeneous industrial processes and operations. In the last two years, Congress has committed billions of dollars in public funds to industrial decarbonization through the Bipartisan Infrastructure Law and the Inflation Reduction Act. Additionally, the Sustainable Chemistry Research and Development Act was passed in 2021 requiring the White House Office of Science and Technology Policy to develop an approach for improved federal coordination of activities supporting sustainable chemistry.

DOE recently released an Industrial Decarbonization Roadmap, to present an agenda for government, industry, and other stakeholders to work together to accelerate emissions reduction and position the U.S. industrial sector as a global leader in innovation. This roadmap identifies decarbonization strategies for the chemicals sector through four decarbonization pillars capable of reducing GHG emissions. The four decarbonization pillars are Energy Efficiency, Low Carbon Fuels, Feedstocks, and Energy Sources, Electrification, and Carbon Capture, Utilization, Storage.

Reducing industrial carbon emissions and energy input are key goals of sustainable chemistry. Sustainable chemistry is also focused on designing products and processes that have reduced natural resource impacts, less waste, and increased recycling capability across the product lifecycle. The market demand for more sustainable manufacturing practices in the chemical industry for both consumer and commercial products is a new opportunity to create significant value for U.S. manufacturing and maintain global competitiveness.

Finally, sustainable chemistry can contribute to the Biden Administration's environmental justice goals. In addition to consuming significant amounts of energy, many processes used in industrial facilities to manufacture chemicals produce air and water pollutants with harmful impacts on the health and well-being of surrounding communities. In the United States (U.S.), racial and ethnic minority groups as well as lower-income groups are disproportionately exposed to elevated levels of air pollution, water pollution, and hazardous waste and, consequently, experience higher rates of adverse health impacts compared to the general population. Addressing pollution from chemicals manufacturing is an integral step towards achieving environmental justice by remediating social, economic, and health burdens on those disproportionately harmed

by industrial sector emissions. Assessing community-level impacts and prioritizing environmental justice help ensure the benefits of industrial decarbonization are realized across all American communities.

## Sustainable Chemistry Roundtable 2023 – Looking Ahead

Broadly, sustainable chemistry can be defined as the design, development, and use of chemicals and materials that have lower energy consumption and emissions; are less toxic to human health and the environment; have reduced natural resource impacts; and are designed for reduced waste and increased recycling capability across the product lifecycle. Our motivation is to understand the opportunities and challenges for leveraging sustainable chemistry practices in the chemicals sector to promote decarbonization and environmental justice by developing lower carbon emission, safer, low-toxicity chemicals and manufacturing processes capable of reducing impacts on the environment and human health.

Roundtable attendees will include a broad mix of stakeholders from industry, government, national labs, and small businesses. Participants will include technical and business leaders from small businesses and startups due to their critical role in the development of transformational technologies in sustainable chemistry. The in-person format will serve to facilitate network building and teaming to help traditionally underrepresented institutions and small businesses leverage GC3 and IEDO's resources. These may include new markets, business partners, and R&D collaborators.

The objectives of the Roundtable are to solicit stakeholders' input:

- To identify the technical and financial opportunities and barriers to sustainable chemistry research & development, commercialization, and adoption, particularly among small and medium size business, start-up companies and economically, demographically under-represented communities.
- To identify priority RD&D goals and metrics which link sustainable chemistry to decarbonization and environmental justice.
- To identify public and private sector needs, incentives, and required technical assistance to accelerate RD&D and advance environmental justice concepts in sustainable chemistry.

The roundtable agenda will include presentations curated by industry representatives who are advancing sustainable chemistry, as well as facilitated breakout sessions focusing on the objectives outlined above. Building on the November 2020 Sustainable Chemistry Roundtable that identified sustainable chemistry principles, this event will help outline a path towards a more sustainable, resilient, and competitive manufacturing industry. The input gained from this event will inform IEDO's sustainable chemistry strategies in future program planning.