



The Chemical Catalysis for Bioenergy Consortium

March 17th, 2022

Josh Schaidle

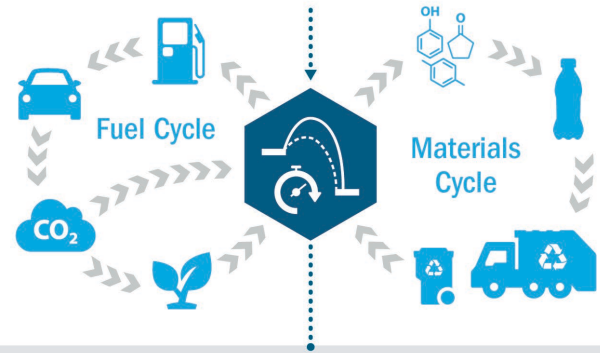


ChemCatBio Mission

Mission: Accelerate the catalyst and process development cycle for bioenergy applications

Vision: The rapid decarbonization of our economy through utilization of renewable and waste carbon feedstocks

Catalysis enables a circular carbon economy.
85% of industrial chemical processes rely on catalysts.



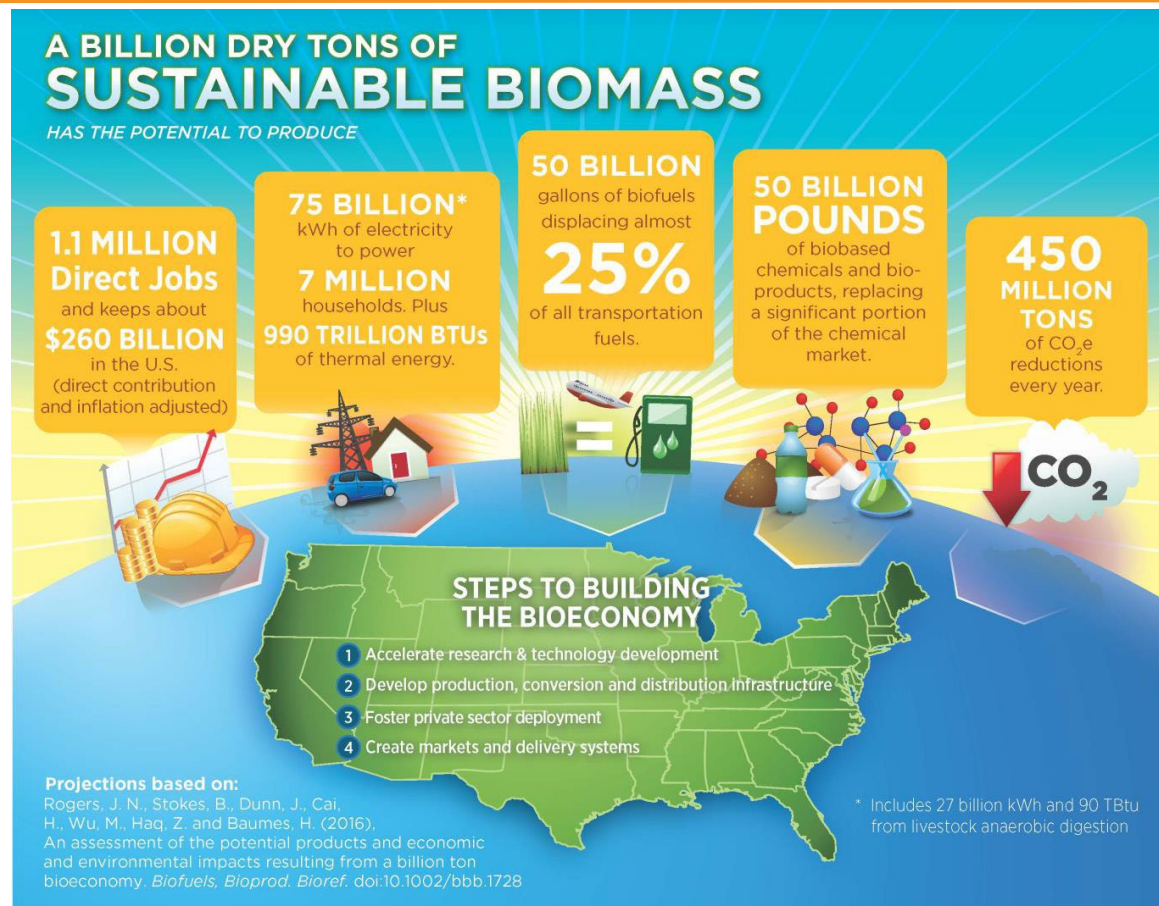
ChemCatBio is accelerating catalyst development for bioenergy applications

Potential Future Impact of Catalysis

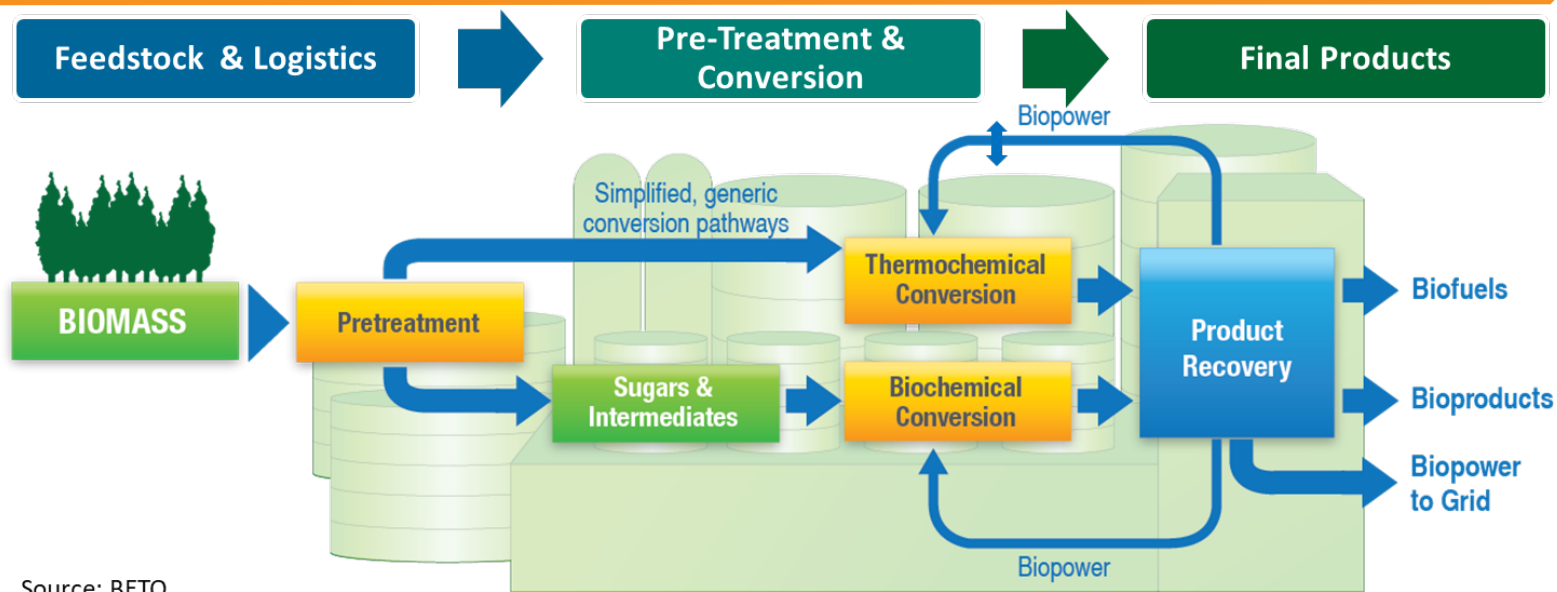
In the chemicals industry alone, improvements in catalysts and related processes could save as much as **13 exajoules of energy and 1 gigatonne of CO₂-equivalent** per year by 2050 versus a “business-as-usual” scenario.*

*International Energy Agency, [Technology Roadmap: Energy and GHG Reductions in the Chemical Industry via Catalytic Processes](#), 2013.

Potential Impact of a Billion-Ton Bioeconomy



Catalysis Challenges are Pervasive in Conversion of Biomass and Waste Feedstocks



Source: BETO

Key Catalytic Bioenergy Processes

- Catalytic Upgrading of Biological Intermediates
- Synthesis Gas Upgrading
- Catalytic Fast Pyrolysis
- Catalytic Upgrading of Aqueous/Gaseous Waste Streams
- Catalytic Hydroprocessing
- Lignin Deconstruction and Upgrading

Challenges due to Biomass Composition

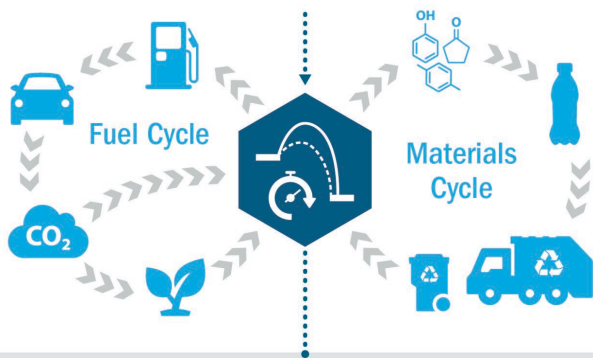
- High oxygen content → Broad reaction space
- Diverse chemical functionalities → Competing reactions
- High water content → Degradation of catalyst supports
- Impurities (S, N, alkali metals, Cl, etc.) → Poisoning
- Multiple states and compositions (solid, liquid, or gas)
- Complex, heterogeneous mixture → Difficult to model

Serving as a Central Hub of Knowledge





Accelerate market adoption by addressing *critical catalysis challenges* limiting commercialization of bioenergy technologies and *facilitating industry access* to national lab capabilities and expertise

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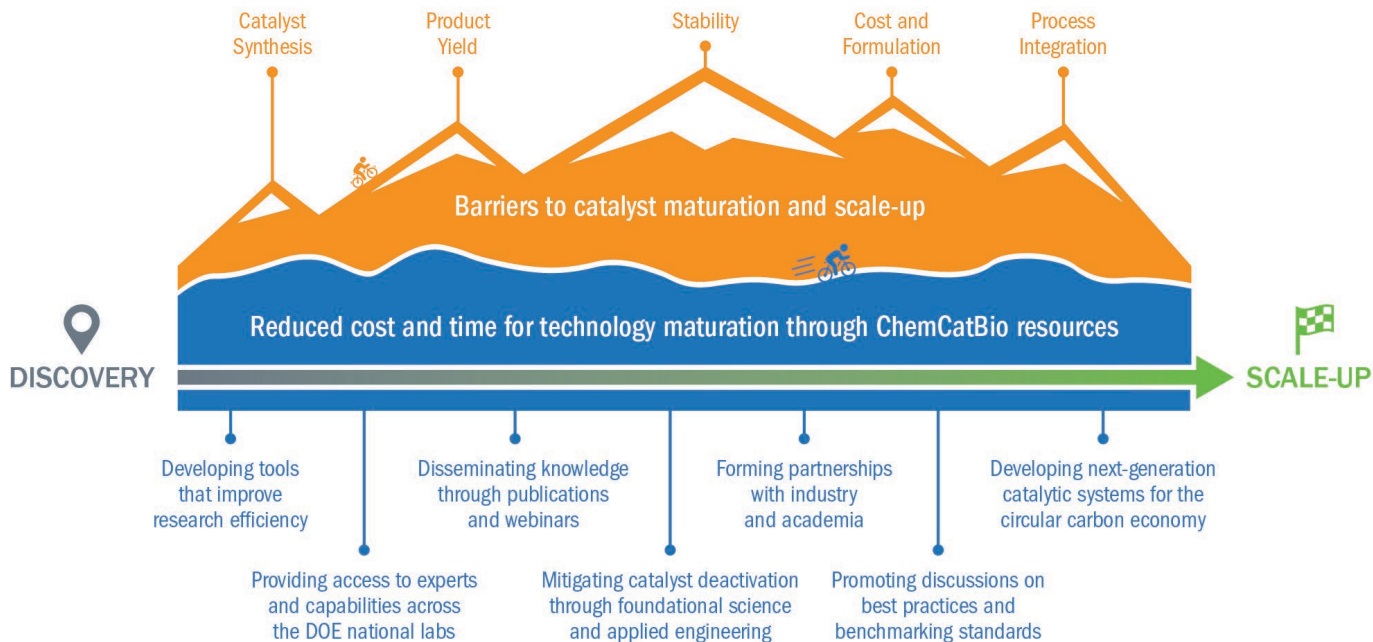
ChemCatBio is accelerating catalyst development for bioenergy applications:

 SCIENTIFIC CONTRIBUTIONS	 THE TEAM	 MARKET IMPACT	 COMMUNITY RESOURCES
>144 publications	>130 researchers	3 technology licenses	3 enabling tools CatCost, Catalyst Property Database, Surface Phase Explorer
40 h-index since 2016	8 DOE National Labs	1 software copyright	9 webinars Directed Funding Opportunities for industry
>4,100 citations	BETO -sponsored	27 issued patents and patent applications	Streamlined access to unique national lab capabilities
1 R&D100 Special Recognition	14 Industry Advisory Board Members	12 awarded projects with industry	

Maintain an updated website to facilitate community outreach: [Chemcatbio.org](https://chemcatbio.org)

Acceleration Approach

The path to catalyst deployment is slow and difficult.

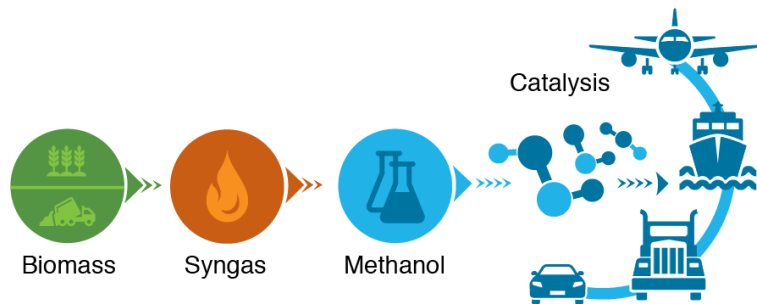


ChemCatBio is accelerating the catalyst and process development cycle.

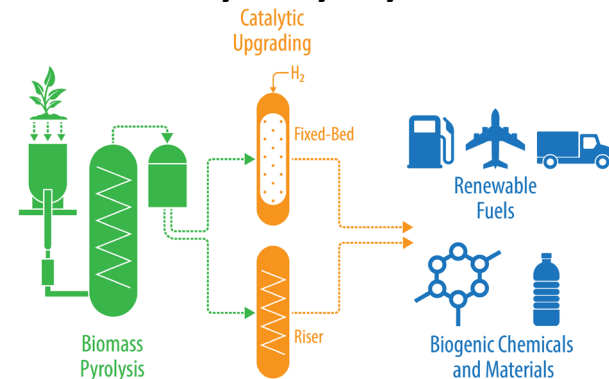
Advancing technologies across varying feedstocks

Generating energy-dense fuels and renewable chemicals from biomass and waste resources

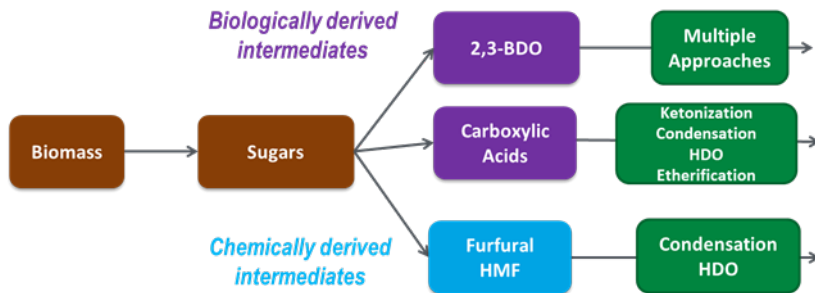
Upgrading of C1 Intermediates



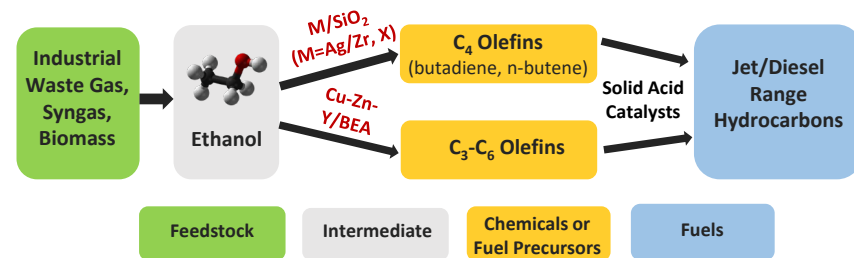
Catalytic Pyrolysis



Upgrading of Biological Intermediates

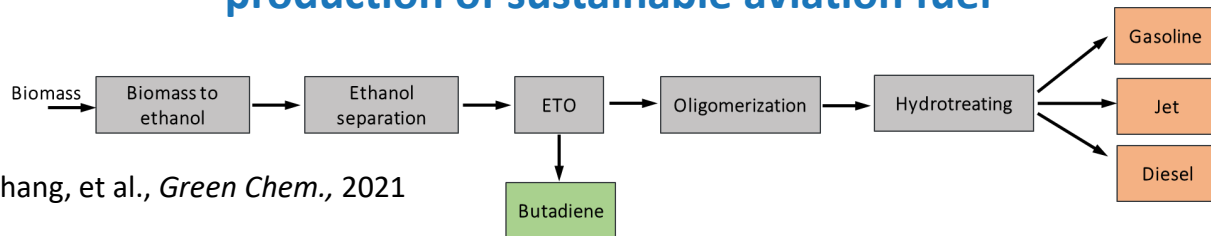


Ethanol Upgrading

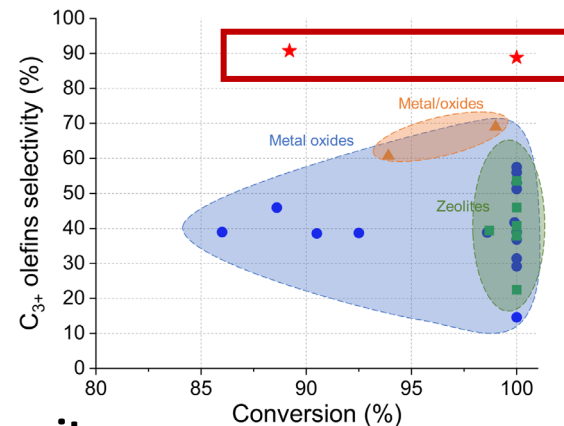


Achieving our Mission: Technology Development

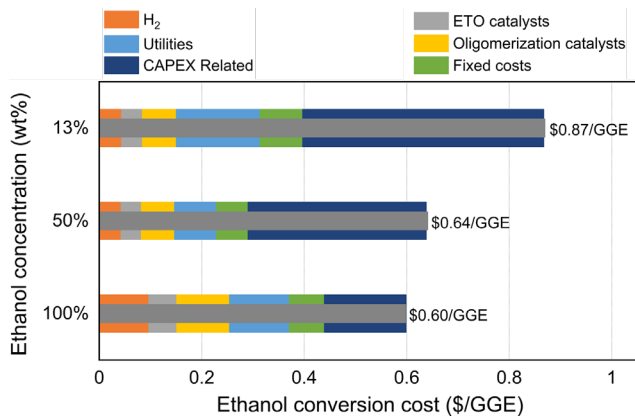
Developed a catalyst and process that achieves high yield to C₃+ olefins from ethanol in one step, reducing the cost for production of sustainable aviation fuel



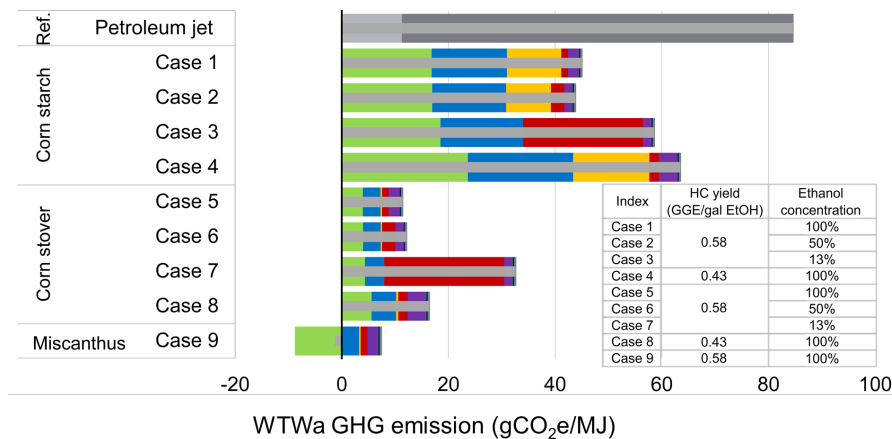
J. Zhang, et al., *Green Chem.*, 2021



Cost



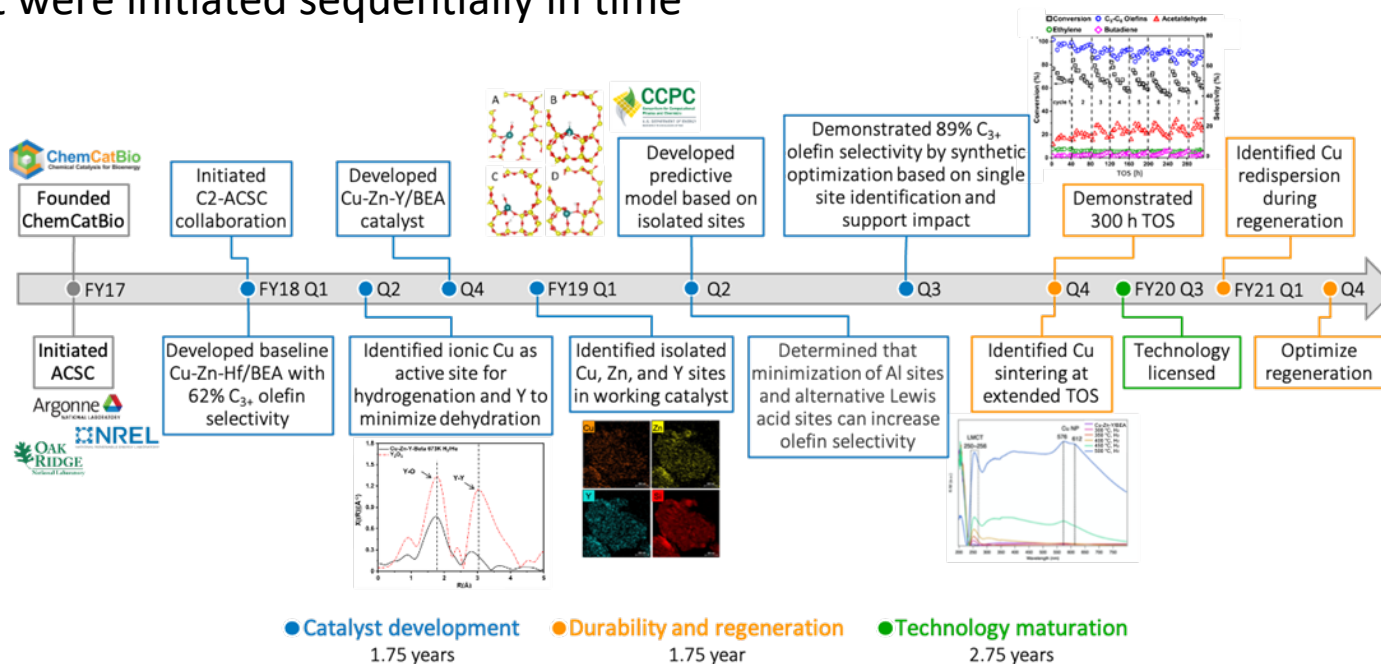
Carbon Intensity



Achieving our Mission: Acceleration

Demonstrated a **4x acceleration** of the catalyst and process development cycle

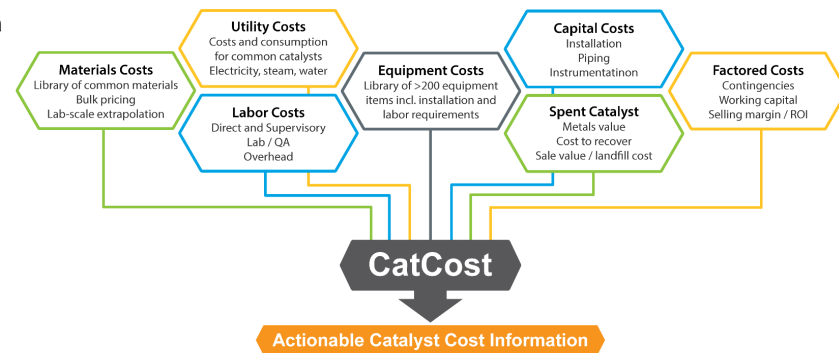
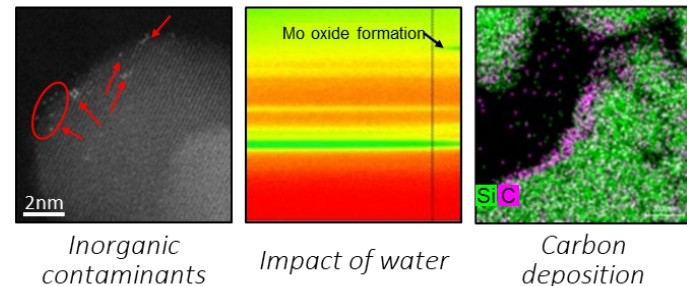
- Leveraged a design-build-test-learn cycle
- Compared catalyst development efforts across two different alcohol upgrading routes that were initiated sequentially in time



Working with Us

- Tap into our **intellectual property**
- Leverage our **capabilities and expertise** through cooperative research agreements and directed funding opportunities
 - Advanced materials characterization
 - Multi-scale computational modeling
 - Catalyst evaluation in integrated processes
- Join forces on **proposals** to competitive solicitations
- Utilize our **tools** to improve your research efficiency
 - CatCost™
 - Catalyst Property Database
- **Internships** and post-doctoral fellowships

Catalyst stability challenges



Summary

- Catalysis will play an **enabling role** in decarbonizing the fuel and chemical sectors
- Biomass as a feedstock introduces unique challenges for catalytic technologies
- ChemCatBio seeks to accelerate the catalyst and process development cycle to help shorten the time to market for renewable technologies

Learn more and subscribe to our newsletter (The Accelerator) at chemcatbio.org

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Acknowledgements



Energy Materials Network

U.S. Department of Energy



Office of **ENERGY EFFICIENCY
& RENEWABLE ENERGY**

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**Special thanks to all of our
collaborators and industry
advisory board members!**

Thank you!



ChemCatBio Team



The Chemical Catalysis for Bioenergy Consortium

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