



Microbial Biotechnology Community Science
Campaign

Open House Summary Report

December 2025

Christopher R. Anderton
Samantha N. Miller



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Richland, Washington 9935



Overview and Objectives

The Microbial Biotechnology Campaign (MBC) Open House was organized to facilitate discussions and advance microbial research strategies for biotechnology and bioeconomy applications. Details of the MBC can be found on the [Environmental Molecular Sciences Laboratory \(EMSL\) website](#). The event focused on synergizing efforts across the Department of Energy's (DOE's) Bioenergy Research Centers (BRCs) and their Shared Research Objectives (SROs), promoting cross-collaboration on microbial metabolic engineering, multi-omics integration, and transformative experimental approaches to enable advancement of DOE's bioeconomy and biotechnology goals.

** The shorthand title of the campaign was Microbial Bioeconomy Campaign but has since been changed to Microbial Biotechnology Campaign. The acronym remains MBC.*



Acronyms and Abbreviations

AI	Artificial intelligence
AMP2	Anaerobic Microbial Phenotyping Platform
BER	Biological and Environmental Research program
BRC	Bioenergy Research Center
CABBI	Center for Advanced Bioenergy and Bioproducts Innovation
CBI	Center for Bioenergy Innovation
CRISPRi	Clustered Regularly Interspaced Short Palindromic Repeats interference
DOE	Department of Energy
EMSL	Environmental Molecular Sciences Laboratory
GLBRC	Great Lakes Bioenergy Research Center
HTP	High-throughput
JBEI	Joint BioEnergy Institute
M2PC	Microbial Molecular Phenotyping Capability
MALDI	Matrix-assisted laser desorption/ionization
MBC	Microbial Biotechnology Campaign
ML	Machine learning
NMDC	National Microbiome Data Collaborative
Q&A	Question and answer
SRO	Shared research objective



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1.0 Day 1: Introduction and Brainstorming

Key highlights:

- Objective launch: Introduced the goals of the campaign and emphasized microbial synthesis advancements for biotechnology and bioeconomy-relevant products.
- Bioengineering focus:
 - Investigation of acid-tolerant systems, lignin breakdown enzymes, and synthetic microbial community libraries.
 - Multi-omics approaches and AI/machine learning (ML) pipelines for genotype-to-phenotype mapping.
- Collaborative efforts:
 - Leveraging EMSL's technologies (e.g., proteomics, metabolomics, and isotope tracing) to enhance microbial systems research.
 - Discussions included gaps in understanding microbial metabolite accumulation and transport mechanisms.

Participants' contributions:

- A central theme that emerged was cross-BRC collaboration to connect focus areas such as advanced engineering tools for strain optimization for microbial bioprocessing (Center for Bioenergy Innovation [CBI]), biomass feedstock conversion (Great Lakes Bioenergy Research Center [GLBRC]), advanced aviation fuel synthesis (Joint BioEnergy Institute [JBEI]), and inhibitor tolerance studies in drought-stressed crops (Center for Advanced Bioenergy and Bioproducts Innovation [CABBI]).

2.0 Day 2: Tools & Technical Presentations

Highlights:

- EMSL capabilities overview:
 - Presentations featured single-cell and high-throughput (HTP) transcriptomics, proteomics, and metabolomics, matrix-assisted laser desorption/ionization (MALDI) mass spectrometry imaging, and cryo-electron microscopy for microbial analysis.
- Technological opportunities:
 - Explored automation in pooled CRISPRi library screening, AI integration in multi-omics data workflows, and the use of synthetic hydrolysates for standardized microbial studies.
- Discussions:
 - Addressed challenges in sample standardization across BRCs, reproducibility across datasets, and the need for scalable experimental workflows.

Action items:

- Identified gaps and technological priorities such as enhancing metabolomics standards and streamlining data harmonization practices using National Microbiome Data Collaborative (NMDC)-compliant frameworks.

3.0 Day 3: Collaborative Planning & Future Directions

Outcomes:

- Thematic project:
 - Proposals included developing CRISPRi libraries for genotype-phenotype mapping and proteomics and metabolomics analysis for hydrolysate systems.
 - Deliverable: piloting bulk omics screening across BRC samples.
- Targeted:
 - JBEI: collaboration on lignin abiotic breakdown and biodegradation pathways of feedstock pools.
 - CBI: pathway discovery for catabolism of lignin-derived aromatics in bacterial isolates using proteomics and metabolomics.
 - GLBRC: quantifying and imaging microbially produced terpenoids.
 - CABBI: stabilization of root-derived organic matter from oil-enhanced bioenergy cropping systems.
- Survey feedback:
 - Participants provided insights into EMSL's technological priorities, favoring single-cell resolution and HTP workflows.
- Conclusion: Chris Anderton closed by thanking participants for their contributions and urging collaboration for impactful projects. Breakout sessions were emphasized as the next step for targeted and smaller-scale initiatives.

4.0 Final Summary

The three-day open house catalyzed ideas for advancing microbial biotechnology research, leveraging EMSL's capabilities for cutting-edge analyses. Participants proposed a thematic project involving CRISPRi libraries, metabolomics and proteomics integration, and cross-laboratory data harmonization. EMSL's resources and participant feedback will guide future research efforts in microbial engineering, enabling impactful solutions for bioenergy and bioproduct synthesis.



5.0 Participants

EMSL Participants:

Campaign leader: Christopher Anderton

Science area leaders: Kristin Burnum-Johnson (Functional and Systems Biology), Scott Baker (M2PC)

Integrated research platform leaders: James Evans (Structural Biology), Paul Piehowski (Biomolecular Pathways), Amir Ahkami (Rhizosphere Function)

EMSL project manager: Samantha Miller

EMSL staff: James Fulcher, Nick Reichart, Chaevien Clendinen, Nathalie Munoz, Dusan Velickovic, Marina Gritsenko, Olga Shishkov

External Participants:

Mary Albrecht, CABBI

Michaela TerAvest, GLBRC

Rounak Patra, CABBI

Hemant Choudhary, JBEI

Kankshita Swaminathan, CABBI

Aindrila Mukhopadhyay, JBEI

Wendy Yang, CABBI

Blake Simmons, JBEI

Yasuo Yoshikuni, CABBI

Paul Bayer, DOE BER

Melissa Cregger, CBI

Jeremy Semrau, DOE BER

Carrie Eckert, CBI

Adam Guss, CBI

Katie Mains, CBI

Liz Ware, CBI

Rebecca Wilkes, CBI

Michael Botts, GLBRC

Millicent Sanciangco, GLBRC

Trey Sato, GLBRC



6.0 Agenda

6.1 Day 1: December 8, 2025

All times in Pacific Time

- | | |
|--------------------------------|--|
| 9:30 a.m. – 9:35 a.m. | Welcome
Presenter: Chris Anderton |
| 9:35 a.m. – 9:45 a.m. | EMSL's Shift to Campaigns
Presenter: Kristin Burnum-Johnson |
| 9:45 a.m. – 10 a.m. | Visions of AMP2 and M2PC
Presenter: Scott Baker |
| 10 a.m. – 10:05 a.m. | Microbial Bioeconomy Campaign (MPC) Overview
Presenter: Chris Anderton |
| 10:05 a.m. – 10:10 a.m. | Q&A |
| 10:10 a.m. – 10:40 a.m. | Invited Presentations: BRC Goals
CABBI: Wendy Yang
CBI: Carrie Eckert
GLBRC: Trey Sato
JBEI: Blake Simmons |
| 10:40 a.m. – 11 a.m. | Invited Presentations: Relevant SRO Goals
Bioenergy Biodesign of Microbes: Michaela TerAvest
Enabling Technologies: Wendy Yang |
| 11 a.m. – 11:05 a.m. | Q&A |
| 11:05 a.m. – 11:15 a.m. | Break |
| 11:15 a.m. – noon | Brainstorming Session 1: Science Drivers |

6.2 Day 2: December 9, 2025

All times in Pacific Time

- | | |
|------------------------|---|
| 9:30 a.m. – 9:40 a.m. | Recap of Day 1 |
| 9:40 a.m. – 10:25 a.m. | Highlight Relevant EMSL Capabilities
Single-Cell Transcriptomics: Nick Reichart
Proteomics, Cell Sorting, Single Cells: James Fulcher
Metabolomics, Lipidomics, Fluxomics: Chaevien Clendinen |



Mass Spectrometry Imaging: Dusan Velickovic
Cryo-Electron Microscopy: James Evans

10:25 a.m. – 10:40 a.m.	Q&A
10:40 a.m. – 11 a.m.	Break + <i>Optional</i> Curated EMSL Virtual Tour
11 a.m. – noon	Brainstorming Session 2: Technical & Data Questions

6.3 Day 3: December 10, 2025

All times in Pacific Time

9:30 a.m. – 9:40 a.m.	Recaps of Days 1 & 2
9:40 a.m. – 10:45 a.m.	Brainstorming Session 3: Thematic MBC Projects
10:45 a.m. – 11 a.m.	Break + Working with EMSL Feedback
11 a.m. – noon	Breakout Groups: Brainstorm Targeted MBC Research Projects (<i>Optional</i>)

