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CAPTURE TECHNOLOGY MEETING

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August 8-12, 2016 • Pittsburgh



U.S. DEPARTMENT OF

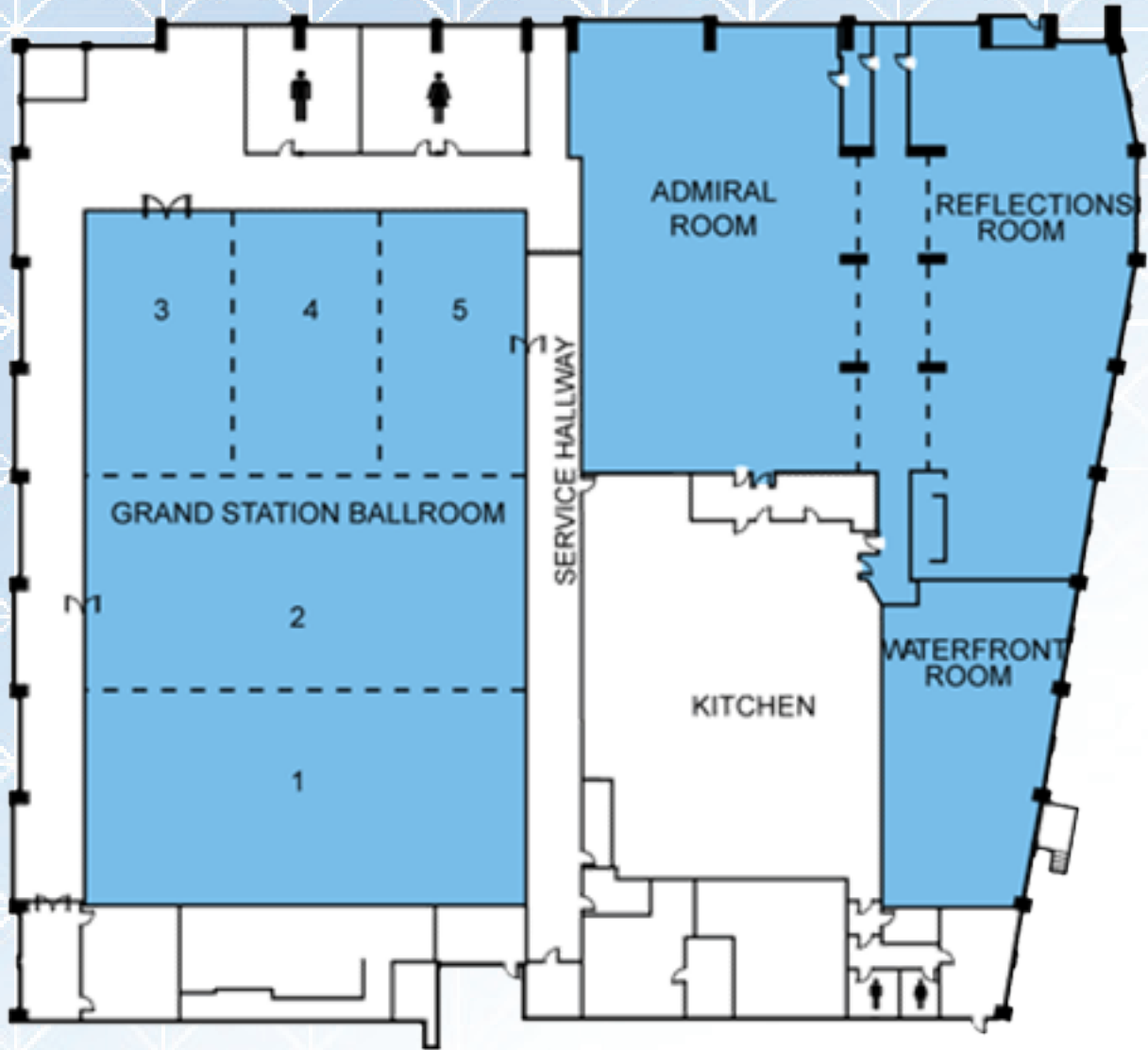
ENERGY



National Energy
Technology Laboratory

Sponsored by:
U.S. Department of Energy
Office of Fossil Energy
National Energy Technology Laboratory

▶ SHERATON STATION SQUARE FLOOR PLAN



FIRST FLOOR

DETAILED PROGRAM

MONDAY, AUGUST 8, 2016

REGISTRATION

7:00 a.m. – 8:00 a.m. Grand Station Foyer

CONTINENTAL BREAKFAST

7:00 a.m. – 8:00 a.m. Grand Station III

GRAND STATION I & II

OPENING SESSION

Moderator: *Lynn Brickett*, U.S. Department of Energy, National Energy Technology Laboratory

8:00 a.m. **Welcoming Remarks**
Lynn Brickett, U.S. Department of Energy, National Energy Technology Laboratory

8:05 a.m. **Overview of DOE's Clean Coal Program**
Angelos Kokkinos, Director, Office of Advanced Fossil Technology Systems, Office of Fossil Energy, U.S. Department of Energy

8:25 a.m. **CCS R&D at EPRI**
Abhoyjit Bhowan, Electric Power Research Institute

INTERNATIONAL PERSPECTIVES

8:45 a.m. **Pre-feasibility Study for Establishing a Carbon Capture Pilot Plant for NGCC Applications in Mexico**
Haoren Lu, Nexant, Inc.

9:05 a.m. **A Global Perspective on the Status of Carbon Capture**
John Gale, IEA Greenhouse Gas

9:25 a.m. **Demonstration of U.S.–Norway Joint Projects**
Bjørn-Erik Haugan, Gassnova SF, and Espen Steinseth Hamborg, TCM DA

9:45 a.m. **Effective CO₂ Capture Technology Development in Australia**
Paul Feron, Commonwealth Scientific and Industrial Research Organisation

10:05 a.m. **BREAK – Grand Station III**

NATIONAL CARBON CAPTURE CENTER

Moderator: *Elaine Everitt*, U.S. Department of Energy, National Energy Technology Laboratory

10:25 a.m. **Advanced Technology Testing at the National Carbon Capture Center (FE0022596)**
Justin Anthony and John Carroll, Southern Company Services, Inc.

DETAILED PROGRAM

MONDAY, AUGUST 8, 2016

NETL RESEARCH & INNOVATION CENTER

Moderator: *Elaine Everitt, U.S. Department of Energy, National Energy Technology Laboratory*

10:50 a.m. **High Throughput Computational Screening of Mixed-Matrix Membranes**
Jan Steckel, U.S. Department of Energy, National Energy Technology Laboratory

11:15 a.m. **Comprehensive Exergy Analysis and Comparison of Three IGCC Power Plants with CO₂ Capture**
Nicholas Siefert, U.S. Department of Energy, National Energy Technology Laboratory

11:40 a.m. **Automated Lab-Scale Flue Gas Permeation Membrane Testing System at the National Carbon Capture Center**
Victor Kusuma, AECOM

12:05 p.m. **LUNCH – Waterfront Room**

CO₂ COMPRESSION

Moderator: *Andrew O’Palko, U.S. Department of Energy, National Energy Technology Laboratory*

1:35 p.m. **Advanced CO₂ Compression with Supersonic Technology (FE0026727)**
Silvano Saretto, Dresser-Rand

CARBON CAPTURE SMALL PILOT-SCALE RESEARCH

Moderator: *Andrew O’Palko, U.S. Department of Energy, National Energy Technology Laboratory*

2:00 p.m. **Pilot-Scale Silicone Process for Low-Cost CO₂ Capture (FE0013755)**
Benjamin Wood, GE Global Research

2:25 p.m. **Pilot Test of a Nanoporous, Super-Hydrophobic Membrane Contactor Process for Post-Combustion CO₂ Capture (FE0012829)**
Shiguang Li, Gas Technology Institute

2:50 p.m. **Pilot Test of an Integrated Membrane/Boiler CO₂ Capture Process (FE0026414)**
Tim Merkel, Membrane Technology & Research, Inc.

3:15 p.m. **BREAK – Grand Station III**

Moderator: *Andrew O’Palko, U.S. Department of Energy, National Energy Technology Laboratory*

3:35 p.m. **Pilot Test of Novel Electrochemical Membrane System for CO₂ Capture and Power Generation (FE0026580)**
Hossein Ghezeli-Ayagh, FuelCell Energy, Inc.

4:00 p.m. **CO₂ Capture from IGCC Gas Streams Using the AC-ABC Process (FE0000896)**
Anoop Nagar, SRI International

DETAILED PROGRAM

4:25 p.m. **Pilot Testing of a Highly Efficient Pre-combustion Sorbent-Based Carbon Capture System (FE0013105)**
Gokhan Alptekin, TDA Research, Inc.

SYSTEM STUDIES AND MODELING

Moderator: *Andrew O’Palko, U.S. Department of Energy, National Energy Technology Laboratory*

4:50 p.m. **Guidelines for Parameter Measurements in Laboratory-Scale Research Efforts**
Timothy Fout, U.S. Department of Energy, National Energy Technology Laboratory

5:30 p.m. **ADJOURN**

TUESDAY, AUGUST 9, 2016

REGISTRATION

7:00 a.m. – 8:00 a.m. Grand Station Foyer

CONTINENTAL BREAKFAST

7:00 a.m. – 8:00 a.m. Grand Station III

GRAND STATION I & II

CARBON CAPTURE SMALL PILOT-SCALE RESEARCH

Moderator: *Andrew Jones, U.S. Department of Energy, National Energy Technology Laboratory*

8:00 a.m. **Slipstream Pilot-Scale Demonstration of a Novel Amine-Based Post-Combustion Process Technology for CO₂ Capture from Coal-Fired Power Plant Flue Gas (FE0007453)**
Krish Krishnamurthy, Linde, LLC

8:25 a.m. **Application of a Heat Integrated Post-Combustion CO₂ Capture System with Hitachi Advanced Solvent into Existing Coal-Fired Power Plant (FE0007395)**
Heather Nikolic, University of Kentucky Center for Applied Energy Research

8:50 a.m. **Pilot-Scale Slipstream Test of Sorbent-Based Post-Combustion CO₂ Capture (FE0012870)**
Jeannine Elliott, TDA Research, Inc.

9:15 a.m. **ION Advanced Solvent CO₂ Capture Pilot Project (FE0013303)**
Erik Meuleman, ION Engineering, LLC

9:40 a.m. **BREAK – Grand Station III**

CARBON CAPTURE SIMULATION FOR INDUSTRY IMPACT (CCSI²)

Moderator: *Andrew Jones, U.S. Department of Energy, National Energy Technology Laboratory*

10:00 a.m. **Keynote-Commercial Launch of CCSI Computational ToolSet**
Doug Hollett, Principal Deputy Assistant Secretary, Office of Fossil Energy, U.S. Department of Energy

10:45 a.m. **CCSI² Overview and Key Capabilities**
David Miller, U.S. Department of Energy, National Energy Technology Laboratory

DETAILED PROGRAM

TUESDAY, AUGUST 9, 2016

11:15 a.m. **Industrial Success Story: DOE-GE CRADA for CCSI Modeling**
Teresa Grocela-Rocha, GE Global Research

12:00 p.m. **LUNCH – Waterfront Room**

CARBON CAPTURE LARGE PILOT-SCALE RESEARCH

Moderator: *Steve Mascaro, U.S. Department of Energy, National Energy Technology Laboratory*

1:30 p.m. **Improvement of Alstom's Chilled Ammonia Process Large Pilot with the Use of Membrane Technology (FE0026589)**
David Muraskin and Barath Baburao, Alstom Power, Inc.

1:55 p.m. **Large Pilot-Scale CO₂ Capture Project Using Aminosilicone Solvent (FE0026498)**
Phil DiPietro, GE Global Research

2:20 p.m. **NRG CO₂NEPT-Confirmation of Novel Cost-Effective Emerging Post-Combustion Capture Technology (FE0026581)**
Anthony Armppriester and Matt Stevenson, NRG/Inventys

2:45 p.m. **Development and Demonstration of Waste Heat Integration (FE0007525)**
Jerrad Thomas, Southern Company Services, Inc.

3:10 p.m. **BREAK – Grand Station III**

Moderator: *Steve Mascaro, U.S. Department of Energy, National Energy Technology Laboratory*

3:30 p.m. **Phase I Results: Large Pilot Scale Testing of Linde/BASF Post-combustion CO₂ Capture Technology at the Abbott Coal-Fired Power Plant (FE0026588)**
Kevin O'Brien, University of Illinois

3:55 p.m. **Large Pilot CAER Heat Integrated Post-Combustion CO₂ Capture Technology for Reducing the Cost of Electricity (FE0026497)**
Andrew Placido, University of Kentucky Center for Applied Energy Research

4:20 p.m. **Advanced Solvent-Based Carbon Capture Technology Demonstration (FE0026590)**
Jerrad Thomas, Southern Company Services, Inc.

SYSTEM STUDIES AND MODELING

Moderator: *Steve Mascaro, U.S. Department of Energy, National Energy Technology Laboratory*

4:45 p.m. **Update on CO₂ Capture Related Systems Analysis Activities**
Timothy Fout and Eric Grol, U.S. Department of Energy, National Energy Technology Laboratory

5:20 p.m. **ADJOURN**

5:30 p.m. **POSTER SESSION – Grand Station III**

DETAILED PROGRAM

WEDNESDAY, AUGUST 10, 2016

REGISTRATION

7:00 a.m. – 8:00 a.m. Grand Station Foyer

CONTINENTAL BREAKFAST

7:00 a.m. – 8:00 a.m. Grand Station III

GRAND STATION I & II

CARBON CAPTURE LAB/BENCH-SCALE RESEARCH

Moderator: *David Lang*, U.S. Department of Energy, National Energy Technology Laboratory

8:00 a.m. **Evaluation of Piperazine with Advanced Flash Regeneration for CO₂ Capture from Coal-Fired Flue Gas (FE0005654)**
Gary Rochelle, University of Texas at Austin

8:25 a.m. **CO₂ Capture by Cold Membrane Operation (FE0013163)**
Trapti Chaubey, Air Liquide

8:50 a.m. **Bench-Scale Process for Low-Cost CO₂ Capture Using a Phase-Changing Absorbent (FE0013687)**
Tiffany Westendorf, GE Global Research

9:15 a.m. **Bench-Scale Development of a Hybrid Membrane-Absorption CO₂ Capture Process (FE0013118)**
Brice Freeman, Membrane Technology & Research, Inc.

9:40 a.m. **BREAK – Grand Station III**

Moderator: *David Lang*, U.S. Department of Energy, National Energy Technology Laboratory

10:00 a.m. **Supersonic Post-Combustion Inertial CO₂ Extraction System (FE0013122)**
Tony Castrogiovanni, ACENT Laboratories

10:25 a.m. **An Advanced Catalytic Solvent for Lower Cost Post-Combustion CO₂ Capture in a Coal-Fired Power Plant (FE0012926)**
Cameron Lippert, University of Kentucky Center for Applied Energy Research

10:50 a.m. **Bench Scale Development and Testing of Aerogel Sorbents for CO₂ Capture (FE0013127)**
Redouane Begag, Aspen Aerogels, Inc.

11:15 a.m. **Hybrid Encapsulated Ionic Liquids for Post-Combustion CO₂ Capture (FE0026465)**
Joan Brennecke, University of Notre Dame

11:40 a.m. **High Temperature Polymer-Based CO₂ Capture Membrane Systems for Pre-combustion CO₂ Capture (FWP-FE-308-13)**
Rajinder Singh, Los Alamos National Laboratory

12:05 p.m. **LUNCH – Waterfront Room**

DETAILED PROGRAM

WEDNESDAY, AUGUST 10, 2016

CARBON CAPTURE LAB/BENCH-SCALE RESEARCH

Moderator: *Jose Figueroa*, U.S. Department of Energy, National Energy Technology Laboratory

- 1:35 p.m.** **Robust and Energy Efficient Dual Stage Membrane-Based Process for Enhanced CO₂ Recovery (FE0013064)**
Richard Ciora, Media and Process Technology, Inc.
- 2:00 p.m.** **Development of Pre-combustion CO₂ Capture Process Using High-Temperature PBI Hollow Fiber Membranes (FE0012965)**
Indira Jayaweera, SRI International
- 2:25 p.m.** **A High Efficiency, Ultra-Compact Process for Pre-combustion CO₂ Capture (FE0026423)**
Theodore Tsotsis, University of Southern California
- 2:50 p.m.** **Combined Sorbent/WGS-Based CO₂ Capture Process with Integrated Heat Management for IGCC Systems (FE0026388)**
Andrew Lucero, Southern Research Institute
- 3:15 p.m.** **BREAK – Grand Station III**

CARBON CAPTURE LAB/BENCH-SCALE RESEARCH

Moderator: *Jose Figueroa*, U.S. Department of Energy, National Energy Technology Laboratory

- 3:35 p.m.** **Zeolite Membrane Reactor for Pre-combustion CO₂ Capture (FE0026435)**
Jerry Lin, Arizona State University
- 4:00 p.m.** **Sorption-Enhanced Mixed Matrix Membranes for Hydrogen Purification and CO₂ Capture (FE0026463)**
Haiqing Lin, University at Buffalo, The State University of New York
- 4:25 p.m.** **Advanced Manufacturing to Enable Enhanced Processes and New Solvents for Carbon Capture (FWP-FEW0194)**
Joshuah Stolaroff, Lawrence Livermore National Laboratory
- 4:50 p.m.** **Novel CO₂-Selective Membranes for CO₂ Capture from <1% CO₂ Sources (FE0026919)**
Winston Ho, The Ohio State University
- 5:15 p.m.** **ADJOURN**

DETAILED PROGRAM

THURSDAY, AUGUST 11, 2016

REGISTRATION

7:00 a.m. – 8:00 a.m. Grand Station Foyer

CONTINENTAL BREAKFAST

7:00 a.m. – 8:00 a.m. Grand Station III

GRAND STATION I & II

CARBON CAPTURE LAB/BENCH-SCALE RESEARCH

Moderator: *Bruce Lani*, U.S. Department of Energy, National Energy Technology Laboratory

8:00 a.m. **Bench Scale Testing of Next Generation Hollow Fiber Membrane Modules (FE0026422)**
Alex Augustine, American Air Liquide, Inc.

8:25 a.m. **Accelerating the Development of “Transformational” Solvents for CO₂ Separations (FWP-65872)**
David Heldebrant, Pacific Northwest National Laboratory

8:50 a.m. **Development of a Novel Biphasic CO₂ Absorption Process with Multiple Stages of Liquid-Liquid Phase Separation for Post-Combustion Carbon Capture (FE0026434)**
Yong Qi Lu, Illinois State Geological Survey, University of Illinois at Urbana-Champaign

9:15 a.m. **Large Bench Scale Development of Non-aqueous Solvent CO₂ Capture Process for Coal-Fired Power Plants Utilizing Real Coal-Derived Flue Gas (FE0026466)**
S. James Zhou, RTI International

9:40 a.m. **Lab-Scale Development of a Hybrid Capture System with Advanced Membrane, Solvent System, and Process Integration (FE0026464)**
David Luebke, Liquid Ion Solutions

10:05 a.m. **BREAK – Grand Station III**

Moderator: *Bruce Lani*, U.S. Department of Energy, National Energy Technology Laboratory

10:25 a.m. **Energy Efficient Go-Peek Hybrid Membrane Process for Post-Combustion CO₂ Capture (FE0026383)**
Shiguang Li, Gas Technology Institute

10:50 a.m. **Evaluation of Amine-Incorporated Porous Polymer Networks (aPPNs) as Sorbents for Post-Combustion CO₂ Capture (FE0026472)**
Hong-Gai “Joe” Zhou, Texas A&M University

11:15 a.m. **Enabling 10 mol/kg Swing Capacity via Sub-ambient Rapidly Cycled Pressure Swing Adsorption (FE0026433)**
Ryan Lively, Georgia Institute of Technology

11:40 a.m. **Lab-Scale Development of a Solid Sorbent for CO₂ Capture Process for Coal-Fired Power Plants (FE0026432)**
Mustapha Soukri, Research Triangle Institute

DETAILED PROGRAM

THURSDAY, AUGUST 11, 2016

12:05 p.m. LUNCH – Brighton 1, 2, and 3

CARBON CAPTURE LAB/BENCH-SCALE RESEARCH

Moderator: *Andrew Aurelio*, U.S. Department of Energy, National Energy Technology Laboratory

1:35 p.m. **Bench-Scale Development of a Non-aqueous Solvent CO₂ Capture Process for Coal-Fired Power Plants (FE0013685)**
Marty Lail, RTI International

2:00 p.m. **Computational Protocols for Viscosity Reduction in CO₂ Capture Organic Solvents**
Vassiliki-Alexandra “Vanda” Glezakou, Pacific Northwest National Laboratory

2:25 p.m. **Development of Mixed-Salt Technology for CO₂ Capture from Coal Power Plants (FE0012959)**
Indira Jayaweera, SRI International

2:50 p.m. **Bench-Scale Development of an Advanced Solid Sorbent-Based CO₂ Capture Process for Coal-Fired Power Plants (FE0007707)**
Thomas Nelson, RTI International

3:15 p.m. **ADJOURN**

DETAILED PROGRAM

FRIDAY, AUGUST 12, 2016

REGISTRATION

7:00 a.m. – 8:00 a.m. Grand Station Foyer

CONTINENTAL BREAKFAST

7:00 a.m. – 8:00 a.m. Grand Station III

GRAND STATION I & II

CO₂ REUSE

Moderator: *Andrew Aurelio*, U.S. Department of Energy, National Energy Technology Laboratory

8:00 a.m. **A Microalgae-Based Platform for the Beneficial Reuse of CO₂ Emissions from Power Plants (FE0026396)**
Mark Crocker, University of Kentucky

8:25 a.m. **Microalgae Commodities from Coal Plant Flue Gas CO₂ (FE0026490)**
John Benemann, MicroBio Engineering, Inc.

OXY-COMBUSTION AND CHEMICAL LOOPING

Moderator: *Douglas Straub*, U.S. Department of Energy, National Energy Technology Laboratory

8:50 a.m. **Atmospheric Iron-Based Coal Direct Chemical Looping for Power Production: 250 kW Pilot Design (FE0009761)**
Luis Velazquez-Vargas, The Babcock & Wilcox Company

9:15 a.m. **Alstom's Chemical Looping Combustion Technology with CO₂ Capture for New and Existing Coal-Fired Power Plants (FE0009484)**
Armand Levasseur, GE Power

9:40 a.m. **Improvement of Alstom's Limestone Chemical Looping Combustion Process for Higher Purity Flue Gas Production (FE0025073)**
Frederic Vitse, GE Power

10:05 a.m. **Integrated Oxygen Production and CO₂ Separation Through Chemical Looping Combustion with Oxygen Uncoupling (FE0025076)**
Matthew Hamilton, University of Utah

10:30 a.m. **BREAK – Grand Station III**

10:50 a.m. **Staged, High Pressure Oxy-combustion Technology: Development and Scale-Up, Phase 2 (FE0009702)**
Richard Axelbaum, Washington University, St. Louis

DETAILED PROGRAM

FRIDAY, AUGUST 12, 2016

- 11:15 a.m.** **Integrated Flue Gas Purification and Latent Heat Recovery for Pressurized Oxy-combustion (FE0025193)**
Richard Axelbaum, Washington University, St. Louis
- 11:40 a.m.** **Enabling Technologies for Oxy-fired Pressurized Fluidized Bed Combustor Development (FE0025160)**
William Follett, Gas Technology Institute
- 12:05 p.m.** **Advanced Oxy-combustion Technology Development and Scale-Up for New and Existing Coal-Fired Power Plants (FE0009448)**
William Follett, Gas Technology Institute
- 12:30 p.m.** **Flue Gas Water Vapor Latent Heat Recovery for Pressurized Oxy-combustion (FE0025350)**
Rick Knight, Gas Technology Institute
- 12:55 p.m.** **ADJOURN**

POSTER PRESENTATIONS

Coal-Fueled Pressurized Chemical Looping Combustion with a Spouting Fluidized Bed

Kunlei Liu, University of Kentucky Center for Applied Energy Research

Process Intensification for Carbon Capture

Kenneth Lux, Altex Technologies Corporation

Solar Energy Powered Material-Based Conversion of CO₂ to Fuels

Jeffrey Weissman, Precision Combustion, Inc.

Electrochemical Reduction of CO₂ to Hydrocarbons in Microchannel Reactors with Ionic Liquids

Brian Skinn, Faraday Technology, Inc.

Electrochemical Reduction of CO₂ to Formic Acid Using Gas Diffusion Electrode Technology

Brian Skinn, Faraday Technology, Inc.

Conversion of CO₂, Water, and Renewable Energy to Transportation Fuels

Rich Masel, Dioxide Materials

Molecular Modeling of Suspension and the Solvent-Nanoparticle Interface

Wei Shi, AECOM

Computational Designing and Screening of Solid Materials for CO₂ Capture

Yuhua Duan, U.S. Department of Energy, National Energy Technology Laboratory

Metal Organic Framework Development for CO₂ Separation Membranes

Anne Marti, U.S. Department of Energy, National Energy Technology Laboratory

Electrochemical Conversion of CO₂ to Fuels for Power-to-Gas Energy Storage

Trent Molter, Sustainable Innovations, Inc.

Methodology for Attrition Evaluation of Oxygen Carriers in Chemical Looping Systems

Srivats Srinivasachar, Envergen, LLC.

High Capacity Sorbent and Process for CO₂ Capture

Srivats Srinivasachar, Envergen, LLC.

Corrosion Study of Common Steels Exposed to 1,100+ Hours of Continuous PCC Operation: Direct Comparison of Morphological and Chemical Integrity During Test Campaign at the National Carbon Capture Center

Tyler Silverman, ION Engineering, LLC.

An Integrated Membrane-Sorbent Hybrid System for Post-Combustion Carbon Capture

Gokhan Alptekin, TDA Research, Inc.

Prediction of Foaming Based on Atomistic Simulations of Amine-Based CO₂ Capture Solvents

Surya Prakesh Tiwari, U.S. Department of Energy, National Energy Technology Laboratory

High-Throughput Computational Screening of Metal Organic Frameworks (MOFs) Based Mixed Matrix Membranes (MMM) for Gas Separation

Samir Budhathoki, U.S. Department of Energy, National Energy Technology Laboratory

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