

# **Program Announcement**

## **Power For Tomorrow**

### **The 46<sup>th</sup> International Technical Conference on Clean Energy**

**In Person & Virtual Conference**

**August 1 to 4, 2022**

**Clearwater, Florida, USA**

**To Learn More About Innovations That Are Meeting the Challenges to Energy Utilization From The World's Key Planners, Leading Engineers and Experts and "Super Scientists" in The Most Comprehensive Program on Energy Technologies With Representatives From Five Continents, Then You Must Attend**

### **The Clearwater Clean Energy Conference**



# Clearwater Clean Energy Conference

## Power For Tomorrow

### The Agenda

#### Sunday, July 31<sup>st</sup>

8:00 a.m. to 5:45 p.m. – **Conference Desk** – Lobby 3

8:00 a.m. to 5:45 p.m. – The **Island Ballroom 2** will be available all day for attendees to gather and network.

9:00 a.m. to 5:45 p.m.

#### **Four Short Courses** – Bay Room

- **9:00 a.m. – 11:00 a.m.**  
**Combustion Tuning: Why and How**  
*J.J. Letcavits, AEP, and Alan Paschedag, Covanta*
- **11:15 a.m. – 1:15 p.m.**  
**Introduction to Natural Gas Processing**  
*Dr. Evan Granite, Fossil Energy & Carbon Management, U.S. Dept. of Energy*
- **1:30 p.m. – 3:30 p.m.**  
**H<sub>2</sub>/NH<sub>3</sub> Combustion**  
*Clint Bedick and Don Ferguson, National Energy Technology Laboratory, U.S. Department of Energy, USA*
- **3:45 p.m. – 5:45 p.m.**  
**How to Develop Accurate and Reliable Simulations of Chemical Processes – Focus on Energy Technology**  
*Paul Mathias, Senior Fellow and Technical Director, Process Engineering, FLUOR*

#### Monday, August 1<sup>st</sup>

7:00 a.m. to 5:00 p.m. – **Conference Desk** – Lobby 3

7:30 a.m. – **Continental Breakfast** – Island Ballroom 2

8:00 to 10:00 a.m. – **Plenary Session** – Palm/Bay Rooms

**Domestic Keynote Speaker:** *Brian Anderson, Laboratory Director, National Energy Technology Laboratory, U.S. Department of Energy.*

**International Keynote Speaker:** *Fangqin Cheng, State Key Laboratory of Technologies for Efficient Utilization of Coal Waste Resources, Shanxi University, CHINA*

10:00 a.m. – **Break** – Island Ballroom 2

10:30 a.m. to 12:15 p.m. – **Three Concurrent Sessions**

- **Session 1: Tribute to Kevin Davis** – Coastal Room
- **Session 2: CO<sub>2</sub> I – Novel Approaches** – Palm Room
- **Session 3: Supercritical CO<sub>2</sub> Brayton Cycles** – Bay Room

12:15 p.m. to 1:45 p.m. – **Luncheon Honoring Kevin Davis** – Island Ballroom 2

1:45 p.m. – 3:15 p.m. **Three Concurrent Sessions**

- **Session 4: Hydrogen Combustion** – Coastal Room
- **Session 5: NH<sub>3</sub> Combustion I** – Palm Room
- **Session 6: Machine Learning/Data Analytics/Digital Twins/Controls I** – Bay Room

## Monday, August 1<sup>st</sup> (cont'd)

3:30 p.m. – **Break** – Island Ballroom 2

4:00 – 5:30 p.m. Three Concurrent Sessions

- Session 7: **Hydrogen Production** – Coastal Room
- Session 8: **NH<sub>3</sub> Combustion II** – Palm Room
- Session 9: **Ecoenergy** – Bay Room
- Session 10: **CO<sub>2</sub> II – Direct Air Capture I** – Island Ballroom 2

5:30 p.m. – **Networking** – Island Ballroom 2

## Tuesday, August 2<sup>nd</sup>

7:00 a.m. to 5:00 p.m. – **Conference Desk** – Lobby 3

7:30 a.m. – **Continental Breakfast** – Island Ballroom 2

8:00 to 9:30 a.m. – Four Concurrent Sessions

- Session 11: **Energy Security Issues & Approaches** – Coastal Room
- Session 12: **Net Zero Emissions** – Palm Room
- Session 13: **Emissions** – Bay Room
- Session 14: **Deriving More Value From Waste** – Gulf Room

9:30 a.m. – **Break** – Island Ballroom 2

10:00 to 11:45 a.m. – Four Concurrent Sessions

- Session 15: **CO<sub>2</sub> III – Point Sources** – Coastal Room
- Session 16: **Biomass Conversion to Power and/or Chemicals I** – Palm Room
- Session 17: **Oxy-Combustion I** – Bay Room
- Session 18: **MSW Combustion** – Gulf Room

11:45 a.m. to 1:15 p.m. – **Themed Luncheon** – Island Ballroom 2

1:15 – 2:45 p.m. Four Concurrent Sessions

- Session 19: **CO<sub>2</sub> IV** – Coastal Room
- Session 20: **Modeling & Simulation I** – Palm Room
- Session 21: **Plant Conversions & Fuel Switching** – Bay Room
- Session 22: **Biomass Conversion to Power and/or Chemicals II** – Gulf Room

2:45 p.m. – **Break** – Island Ballroom 2

## Tuesday, August 2<sup>nd</sup> (cont'd)

3:15 – 4:45 p.m. – Four Concurrent Sessions

- Session 23: **Ecofuels** – Coastal Room
- Session 24: **Chemical Looping** – Palm Room
- Session 25: **Machine Learning/Data Analytics/Digital Twins/Controls II** – Bay Room
- Session 26: **Oxy-Combustion II** – Gulf Room

## Wednesday, August 3<sup>rd</sup>

7:00 a.m. to 2:00 p.m. – Conference Desk – Lobby 3

7:30 a.m. – **Continental Breakfast** – Island Ballroom 2

8:00 to 9:30 a.m. – Four Concurrent Sessions

- Session 27: **Recovery of Rare Earth Elements** – Coastal Room
- Session 28: **Modeling & Simulation II** – Palm Room
- Session 29: **PC Fired Units** – Bay Room
- Session 30: **Combustion & Gasification** – Gulf Room

9:30 a.m. – **Break** – Island Ballroom 2

10:00 a.m. to 12 Noon – Three Concurrent Sessions

- Session 31: **Combustion Fundamentals** – Coastal Room
- Session 32: **Oxy-Combustion III** – Palm Room
- Session 33: **CO<sub>2</sub> V – Direct Air Capture II** – Bay Room
- Session 34: **Eco-recovery – Liquid/Gas Waste** – Gulf Room

12 Noon – 1:45 p.m. – **Luncheon** – Island Ballroom 2

- Presentation of the Best Student Paper Award
- Roundtable Discussion
- Conference Committee Meeting

## Thursday, August 4<sup>th</sup>

7:30 a.m. – Coffee, Juice & Danish for Big Bend Field Trip Participants Prior to Departure

8:00 a.m. Departure of field trip to Tampa Electric's **Big Bend Power Plant**

8:30 a.m. Conference Committee Co-Chairs Meeting – Coastal Room

## CONFERENCE HIGHLIGHTS

- Topics are highly relevant and advanced;
- Science and Technology driven;
- Aimed at Clean Energy Supply;
- Attendance can be actual or virtual;
- Prime location;
- Reasonably priced;
- Participants are very qualified and from many countries with 40% of the papers coming from China, Australia, Canada, Sweden, Japan, Germany, The Netherlands, Poland, and Trinidad & Tobago.

**The Keynote Presentations, Short Courses and Technical Sessions cover all the critical technological issues of the day as we explore **Power For Tomorrow**.** To accommodate international speakers, we are offering in person and virtual presentations. And this is also available to our attendees who also might not be able to attend in person.

The **Clearwater Clean Energy Conference** offers participants approximately 200 technical presentations in three days. All presentations will be offered in person and virtually.

Leading the way for us are our four committee cochairs who represent government, academia and industry:

- Dr. Lawrence E. Bool, Linde, Inc.
- Dr. Ronald Breault, National Energy Technology Laboratory, U.S. Department of Energy
- Dr. Ashwani Gupta, University of Maryland and
- Dr. Edmundo Vasquez, Clean Energy Technologies

**IN MEMORIAM** – We lost a very dear colleague with the death of Kevin Davis of Reaction Engineering International. Kevin served on the Conference Committee and was instrumental in making sure that this conference offered exceptional papers from around the world. To honor Kevin's memory, we organized a special session on the work to which he dedicated his professional life. In addition, Monday's lunch will offer tributes from Kevin's colleagues and friends.

**MISSION STATEMENT** – Increased demand – coupled with energy security issues, and uncertainty in the oil sector – **make this conference a must for those involved in all aspects of power generation** who must meet the competitive pressures and environmental concerns in the 21<sup>st</sup> century.

The current Administration continues to bring in many more opportunities for the energy sector. We plan to cover all the proposed programs and policies. As changes and additions occur, we will cover them.

### **TECHNICAL SESSION: MSW COMBUSTION**

**Chair: Prof. Lunbo Duan, and  
Co-Chair: Prof. Yueming Wang, Ph.D.,  
Southeast University, China**

The Southeast University in China (SEU) has conducted extensive research on solid waste combustion in fluidized beds. They have built the first circulating fluidized bed that purely burns MSW in China. SEU and representatives from all those involved in the project from China and other countries will offer technical presentations about the project and its results. This session will be held Tuesday morning at 10 a.m.

## MONDAY MORNING PLENARY SESSION

**Domestic Keynote Speaker:** *Brian Anderson, Laboratory Director, National Energy Technology Laboratory, U.S. Department of Energy*

**International Keynote Speaker:** *Professor Fangqin Cheng, Vice President – Research, Shanxi University, CHINA, will address utilization of low-grade coal and coal combustion by-products.*

**FIELD TRIP – Thursday, August 4<sup>th</sup>, to TECO's Clean Energy Demonstration Center** that includes solar power, at the Florida Conservation & Technology Center adjacent to the Big Bend Power Station. The bus departs at 8 a.m. and will swing by Tampa International Airport at the conclusion of the tour for those departing that day. The fee is \$125.

**SHORT COURSES** On Sunday, July 31<sup>st</sup>, we will offer four extensive Short Courses on topics important to the energy community. Participation is optional and is included in the registration fee.

- **Introduction to Natural Gas Processing**  
*Dr. Evan Granite, Fossil Energy & Carbon Management, U.S. Dept. of Energy*
- **Combustion Tuning: Why and How –** Just like your automobile a steam generator needs to be kept in tune to provide the best performance and the lowest emissions. We will discuss the whys and hows of boiler tuning.
  - *J.J. Letcavits, AEP, and Alan Paschedag, Covanta*
- **H<sub>2</sub>/NH<sub>3</sub> Combustion**  
*Clint Bedick and Don Ferguson  
National Energy Technology  
Laboratory, U.S. Department of Energy,  
USA*

- **How to Develop Accurate and Reliable Simulations of Chemical Processes – Focus on Energy Technology**  
*Paul Mathias, Senior Fellow and Technical Director  
Process Engineering, FLUOR*

## THEMED LUNCHEON

A conference favorite is the Themed Luncheon. Industry leaders host tables of 8 where a specific topic is chosen by the host for discussion during lunch.

- **Low NO<sub>x</sub> Burners**, *J.J. Letcavits, AEP*
- **Point Source and Direct Air Carbon Capture**, *Dr. Ronald Breault, National Energy Technology Laboratory, U.S. Department of Energy*
- **Gasification**, *Prof. Ashwani Gupta, University of Maryland*
- **Oxy-fuel Combustion in a Carbon Constrained World**, *Dr. Lawrence E. Boel, Linde*

Anyone with a topic to propose should write to us and if we have the space we will include it on the roster.

**BACKGROUND –** This conference has earned a reputation for excellence as one of the premiere conferences on energy technologies as it grows in size and scope since its inception in 1975. Through the Technical Sessions, Short Courses, and Keynote presentations, cutting-edge developments dealing **with technical solutions to problems; specific strategies; projects; innovations; industry trends; and/or regulatory compliance** will be offered. The program presents an extensive overview of emerging, evolving, and innovative technologies, fuels and/or equipment in the power generation industry. We seek papers from all countries worldwide. The **Clearwater Clean Energy Conference** will offer participants approximately 200 technical presentations in three days along with luncheons, breaks and Continental breakfasts.

## International Programs – Technical Developments – Policy Issues

– Papers from the international community are strongly encouraged. At the 2021 conference nine countries were represented at the conference. In addition, one-third of all attendees were from the international community. The international papers were related to energy/environmental developments throughout the world. The Committee also encourages papers that deal specifically with the topics covered in the Keynote Session, Panels, Short Courses and Plenary Sessions.

## HEADQUARTERS

**The Sheraton Sand Key has been the home of this conference for 35 years.** Sand Key is one of the 20 Best Beaches in the U.S., according to many travel and tourism organizations. **Sheraton Sand Key**, 1160 Gulf Boulevard, Clearwater, Florida – Phone: 727-595-1611 and ask for in-house group reservations and identify as a conference participant. The hotel offers the conference \$199/night for Single or Double accommodations. You may also email: [group.reservations@sheratonsandkey.com](mailto:group.reservations@sheratonsandkey.com)

Reservations should be made immediately at the Sheraton Sand Key (\$197/night), the host property. Or (727/595-1611) and request “In House Reservations “. You must request the Clearwater Clean Energy Conference 2022.

## CONFERENCE FEES

*The registration fee covers one **Proceedings**, and participation in all short courses, technical sessions and panels, breakfasts, breaks and luncheons, plus all conference materials.*

The Spouse’s Fee covers participation in the three breakfasts, six breaks and three luncheons throughout the conference.

## JOURNAL PUBLICATION

The Conference organizers plan to have a *Special issue of International Journal of Energy for a Clean Environment (IJECE)* after peer review of the papers. All authors are welcome to submit their manuscript for journal publication. Instructions for submission of papers will soon be posted on the Clearwater Clean Energy Conference website: [www.ClearwaterCleanEnergyConference.com](http://www.ClearwaterCleanEnergyConference.com)

For any further query, please contact, Dr. Ashwani Gupta, at: [akgupta@umd.edu](mailto:akgupta@umd.edu)

## BEST STUDENT PAPER AWARD

In keeping with our long tradition, we will again present this award to the Best Student Paper. Student papers are part of this comprehensive and informative program on clean energy technologies. Therefore, the Conference Committee has set high standards for student/speakers so that the conference maintains its reputation as the premier vehicle for presenting the latest technological developments in improving and enhancing these technologies. All student papers participating in the award are marked by an asterisk.



# THE CLEARWATER CLEAN ENERGY CONFERENCE

## Power For Tomorrow

**SUNDAY – July 31, 2022**

8:00 a.m. to 5:45 p.m. – Conference Desk – Lobby 3

8:00 a.m. to 5:45 p.m. – *The Island Ballroom 2 will be available all day for attendees to gather and network.*

9:00 a.m. to 5:45 p.m.

**Four Short Courses – Bay Room**

9:00 a.m. – 11:00 a.m.

- **Combustion Tuning: Why and How** – Just like your automobile a steam generator needs to be kept in tune to provide the best performance and the lowest emissions. We will discuss the whys and hows of boiler tuning.  
*J.J. Letcavits, AEP, and Alan Paschedag, Covanta, USA*

11:15 a.m. – 1:15 p.m.

- **Introduction to Natural Gas Processing**  
*Dr. Evan Granite, Fossil Energy & Carbon Management, U.S. Dept. of Energy, USA*

1:30 p.m. – 3:30 p.m.

- **H<sub>2</sub>/NH<sub>3</sub> Combustion**  
*Clint Bedick and Don Ferguson*  
*National Energy Technology Laboratory, U.S. Department of Energy, USA*

3:45 p.m. – 5:45 p.m.

- **How to Develop Accurate and Reliable Simulations of Chemical Processes – Focus on Energy Technology**  
*Paul Mathias, Senior Fellow and Technical Director*  
*Process Engineering, FLUOR*

Modern process simulators provide powerful capability for detailed design, analysis and troubleshooting of chemical processes, however they only provide the framework. The knowledge and skill of chemical engineers is required to develop simulations that solve real-world problems – and so in a timely manner. This short course will demonstrate how successful simulations can be developed through selected examples. The examples include: (1) the importance of accurate and reliable thermodynamic properties; (2) the need to include rate-based modeling; and (3) the requirement for relevant and accurate data. I will include an example of reaction-kinetic models to specifically address the concerns raised by attendees.



# THE CLEARWATER CLEAN ENERGY CONFERENCE – Power For Tomorrow

## MONDAY MORNING – August 1, 2022

7:30 a.m. – Breakfast – Island Ballroom 2

8:00 a.m. – Plenary Session

- **Welcome** – *Barbara A. Sakkestad, Clearwater Clean Energy Conference*
- **Overview** – *Dr. Ronald W. Breault, National Energy Technology Laboratory, U.S. Department of Energy & Chairman of the Clearwater Clean Energy Conference*
- **Domestic Keynote Speaker:** *Brian Anderson, Laboratory Director, National Energy Technology Laboratory, U.S. Department of Energy*
- **International Keynote Address: Utilization of Low-Grade Coal and Coal Combustion By-Products**  
*Fangqin Cheng, State Key Laboratory of Technologies for Efficient Utilization of Coal Waste Resources Shanxi University, CHINA*

10:00 a.m. – Break – Island Ballroom 2

10:30 a.m. – Three Break-Outs

	Session 1 <b>Tribute to Kevin Davis</b> <i>Dr. Marc Cremer Reaction Engineering International</i>	Session 2 <b>CO<sub>2</sub> I – Novel Approaches</b> <i>Dr. Ronald W. Breault, National Energy Technology Laboratory, U.S. Department of Energy and Andrew Hlasko, U.S. Department of Energy</i>	Session 3 <b>Supercritical CO<sub>2</sub> Brayton Cycles</b> <i>Prof. Subith Vasu Sumathi, University of Central Florida, Center for Advanced Turbomachinery and Energy Research (CATER) and Bhupesh Dhungel, Air Liquide</i>
	Coastal Room	Palm Room	Bay Room
10:30 a.m.	<b>75. Kevin Davis' Contribution to Coal and Combustion Research</b> <i>Dr. Marc Cremer, Reaction Engineering International, USA</i>	<b>19. U.S. DOE Office of Fossil Energy and Carbon Management, CCS Research and Technology Demonstration and Pilot Projects, Program Update</b> <i>Andrew M. Hlasko, P.Eng. U.S. Department of Energy, Office of Fossil Energy &amp; Carbon Management, Senior Program Manager, Point Source Carbon Capture, USA</i>	<b>7. Thermo-Fluid and Mechanical Design and Optimization of an Advanced Printed Circuit Heat Exchanger for Supercritical CO<sub>2</sub> Brayton Cycles</b> <i>Javad Khalesi, Mechanical Engineering and Engineering Science, and Nenad Sarunac, Faculty of Mechanical Engineering and Engineering Science, UNC Charlotte, USA*</i>
10:45 a.m.	<b>78. Kevin Davis' Nano Particle Research at Princeton University</b> <i>Dr Richard Axelbaum, Washington University in St. Louis, USA</i>	<b>69. Transformational Graphene Oxide-based Membrane Process for Post-Combustion CO<sub>2</sub> Capture</b> <i>Shiguang Li, Weiwei Xu, Qiaobei Dong, and Howard S. Meyer, GTI Energy; and Fan Wang, Huanghe Li, Dinesh Kumar Behera, and Miao Yu, University at Buffalo (SUNY), USA</i>	<b>11. Description and Preliminary Test Results from a High Temperature sCO<sub>2</sub> Test Facility</b> <i>Arnab Roy, Matthew Searle, Doug Straub, National Energy Technology Laboratory, U.S. Department of Energy, USA</i>
11:00 a.m.	<b>126. Kevin Davis' Postdoctoral Research at Sandia National Lab</b> <i>Dr. Chris Shaddix, Sandia National Lab, USA</i>	<b>29. High Capture Rate and Biomass Fraction Update to Technoeconomic Analysis of BECCS SYSTEMS</b> <i>Timothy Fout, National Energy Technology Laboratory, U.S. Department of Energy; and Sally Homsy, Hari Mantripragada, Kyle Buchheit, and Mark Woods, NETL Support Contractors, USA</i>	<b>38. CFD Optimization of Internal Helical Pin Arrays for Supercritical CO<sub>2</sub> Heat Exchanger Tubes</b> <i>Sridharan Ramesh (NETL Support Contractor), Doug Straub, National Energy Technology Laboratory, U.S. Department of Energy, USA</i>

11:30 a.m.	<p><b>114. Electrochemical Noise Based Technology Development for Realtime Corrosion Monitoring</b>  <i>Dr. Hong-Shig Shim, Dr. Kevin Davis, Mr. Dave Swensen, Dr. Zhonghua Zhan, Dr. Dave Wang, and Dr. Marc Cremer, Reaction Engineering International, USA</i></p>	<p><b>22. Effect of Cooling on the Efficiency of a Non-Thermal Plasma Reactor for CO<sub>2</sub> Utilisation</b>  <i>Jesse Santoso, and Dongke Zhang, Centre for Energy (M473), The University of Western Australia, AUSTRALIA</i></p>	<p><b>64. Supercritical CO<sub>2</sub> Equipment Installations at the San Rafael Energy Research Center (SRERC) for the Investigation of Heat Transfer Behavior in a Coal-fired System</b>  <i>Dr. Andrew Fry, Brigham Young University, USA</i></p>
11:45 a.m.	<p><b>127. Three Decades of Joint REI/University of Utah Combustion Research</b>  <i>Dr. Eric Eddings and Dr. Jost Wendt, University of Utah, USA</i></p>	<p><b>136. 21st Century Power Plant at City, Water, Light, and Power: Pathways to BECCS and Hydrogen</b>  <i>Dr. Kevin C. O'Brien, Illinois Sustainable Technology Center and Illinois State Water Supply, Prairie Research Institute, University of Illinois at Urbana-Champaign, USA</i></p>	<p><b>111. Model-Based Design of a Primary Heat Exchanger in an sCO<sub>2</sub> Power Cycle</b>  <i>Andrew Chiodo, Dr. Kevin Davis, Dr. Andrew Fry, and Dr. Minmin Zhou, Reaction Engineering International, USA</i></p>
Noon.	<p><b>63. Testing- and Model-based Optimization of Coal-fired Primary Heater Design for Indirect Supercritical CO<sub>2</sub> Power Cycles</b>  <i>Dr. Andrew Fry, Brigham Young University, USA</i></p>	<p><b>180. Carbon Capture and Conversion Activities within the U.S. DOE Office of Fossil Energy and Carbon Management</b>  <i>Aaron Fuller and Amishi Kumar-Claros, Division of CO<sub>2</sub> Removal, Andrew Hlasko, Raj Gaikwad, Lynn Brickett, and Dan Hancu, Division of Point Source Capture, Mark Ackiewicz, Director, Office of Carbon Management Technologies, United States Department of Energy, Office of Fossil Energy and Carbon Management; and Joseph Stoffa, National Energy Technology Laboratory, U.S. Department of Energy, USA</i></p>	<p><b>132. Operational Model of the Allam-Fetvedt Cycle Coupled with Oxygen Storage</b>  <i>Owen Pryor, Jeff Moore, Jeremy Fetvedt and Ian Cormier, Southwest Research Institute, USA</i></p>
<p><b>12:15 p.m. – Luncheon Tribute to Kevin Davis – Island Ballroom 2</b>  <i>Our colleague, Kevin Davis, had an illustrious and brilliant career in the energy arena. Throughout his academic and professional life, Kevin shone brightly, and we hope through the technical session in the morning and the personal and professional tributes at lunch, all of us will appreciate all he has done; and how much we will miss him.</i></p>			

1:45 p.m. – Three Break-Outs			
	Session 4 <b>Hydrogen Combustion</b> <i>Howard Meyer, GTI Energy</i>	Session 5 <b>NH<sub>3</sub> Combustion I</b> <i>Dr. Marc Cremer, Reaction Engineering Int'l, and Dr. Ronald Breault, National Energy Technology Laboratory, U.S. Department of Energy, USA</i>	Session 6 <b>Machine Learning/Data Analytics/Digital Twins/Controls I</b> <i>Dr. Lawrence Shadle, National Energy Technology Laboratory, U.S. Department of Energy; Richard Kephart, Emerson, USA</i>
	Coastal Room	Palm Room	Bay Room
1:45 p.m.	<b>1. Decarbonizing: The Future of Hydrogen Firing</b> <i>Marc Lemmons, Koch Engineered Solutions, USA</i>	<b>20. An Experimental Investigation into Ammonia Oxidation in an Empty-Bed and Fixed-Bed of Fused Quartz Particles</b> <i>Samuel R. Holden, Zhezi Zhang, Dongke Zhang, and Fangqin Cheng (State Key Laboratory of Technologies for Efficient Utilization of Coal Waste Resources, Shanxi University, CHINA), Centre for Energy (M473), The University of Western Australia, AUSTRALIA; and Ruiping Zhang (State Key Laboratory of Technologies for Efficient Utilization of Coal Waste Resources, Shanxi University, CHINA), and Jian Gao, Key Laboratory of Biofuels, Qingdao Institute of Bioenergy and Bioprocess Technology, Chinese Academy of Sciences, CHINA</i>	<b>82. An Introduction to Cyber-Physical Modeling of Energy Systems</b> <i>M. Bryden and H. Bonilla-Alvarado, Ames Lab and Iowa State University, and P. Pezzini, Electric Power Research Institute, USA</i>
2:00 a.m.	<b>70. Low NO<sub>x</sub> Burner Technology for the Hydrogen Fueled Renewable Energy Economy</b> <i>Darrell E. Dorman and Michael J. Turner, Riley Power, Inc., USA</i>	<b>21. Decarbonising the Ironmaking Industry with Ammonia as a Reductant: A Review</b> <i>Narasimha Naidu Nukala, Zhezi Zhang, Jesse Santoso, and Dongke Zhang, Centre for Energy (M473), The University of Western Australia, AUSTRALIA</i>	<b>14. Effects of Leading Signals on Metrics of Control Quality Indicators</b> <i>Richard Kephart, Emerson Process Management, USA; Sebastian Plamowski - Institute of Control and Computation Engineering, Warsaw University of Technology; and Paweł D. Domański, Institute of Control and Computation Engineering, Warsaw University of Technology, POLAND</i>
2:15 p.m.	<b>45. Combustion Stability Considerations of Rotating Detonation Combustion Operating on H<sub>2</sub>-Air for Gas Turbine Applications</b> <i>Don Ferguson, Justin Weber, Todd Sidwell, and Kristyn Johnson (ORISE), National Energy Technology Laboratory, U.S. Department of Energy, USA</i>	<b>17. Process Intensification for Hydrogen-Ammonia Production Pathway via an Intensified Fixed Bed Reactor</b> <i>Adrian R. Irhamna and George M. Bolas, Department of Chemical &amp; Biomolecular Engineering, University of Connecticut, USA</i>	<b>101. Leveraging Digital Twins in the Development of a Novel Solid Oxide Fuel Cell/Gas Turbine Hybrid System</b> <i>Dr. Michael Sprengel, Czero, USA</i>

2:30 p.m.	<p><b>139. Effect of Blending Hydrogen into Natural Gas on Selective Catalytic Reduction of NO<sub>x</sub> for Stationary Power Applications</b>  <i>Sahand Faraji, Department of Chemical and Biomolecular Engineering, Kyle Horiuchi and Bihter Padak, Department of Mechanical and Aerospace Engineering, University of California, Irvine, USA*</i></p>	<p><b>41. A Preliminary Experimental and Kinetic Modelling Study of Ammonia Combustion in Porous Media</b>  <i>Jianting Lin, Xiaomao Chen and Fanrui Mene(School of Materials and Metallurgy), Dongke Zhang (Centre for Energy (M743), The University of Western Australia, AUSTRALIA), and Xianchun Li (School of Chemical Engineering), Liaoning Provincial Engineering Research Centre for Advanced Coking and Coal Utilization, CHINA</i></p>	<p><b>124. Controls in Action: Power Plant Demonstrations of Advanced Controls</b>  <i>Steve Seachman, Electric Power Research Institute, USA</i></p>
2:45 p.m.	<p><b>128. Combustion of Natural Gas and Hydrogen Mixtures</b>  <i>Martin Adendorff, Robert L. Bell, Shrikar Chakravarti, Hisashi Kobayashi, William Scharmach and Dr. Lawrence E. Bool, Linde, Inc., USA</i></p>	<p><b>115. Combustion of Heavy Ammonia-Blended Methane/Air Mixtures in Inert Porous Media</b>  <i>Liang Li, Ruifang Zhang, Yang Zhang, and Hai Zhang, Key Laboratory for Thermal Science and Power Engineering of Ministry of Education, Department of Energy and Power Engineering, Tsinghua University, CHINA</i></p>	<p><b>81. Performance Evaluation of Integrated Model Predictive and Proportional-Integral-Derivative Controllers</b>  <i>S. Agbleze and F. Lima, National Energy Technology Laboratory, U.S. Department of Energy and West Virginia University, USA</i></p>
3:00 p.m.	<p><b>103. Stability and Emissions of Surface Stabilized Combustion Fueled with Hydrogen-Enriched Natural Gas</b>  <i>Tiantian Wang, Hai Zhang, Yuxin Wu, Qing Liu, and Yang Zhang, Key Laboratory for Thermal Science and Power Engineering of Ministry of Education, Department of Energy and Power Engineering, Tsinghua University, CHINA*</i></p>	<p><b>OPEN DISCUSSION</b></p>	<p><b>OPEN DISCUSSION</b></p>
<p><b>3:15 p.m. – Break – Island Ballroom 2</b></p>			

3:45 p.m. – Three Break-Outs				
	Session 7 <b>Hydrogen Production</b> <i>Howard Meyer GTI Energy</i>	Session 8 <b>NH<sub>3</sub> Combustion II</b> <i>Dongke Zhang, The University of Western Australia and Dr. Ronald Breault, National Energy Technology Laboratory, U.S. Department of Energy, USA</i>	Session 9 <b>Ecoenergy</b> <i>Dr. Edmundo Vasquez Clean Energy Technologies</i>	Session 10 <b>CO<sub>2</sub> II – Direct Air Capture I</b> <i>Dr. Ronald W/ Breault, National Energy Technology Laboratory, U.S. Department of Energy and Brian Higgins, The Babcock &amp; Wilcox Co.</i>
	Coastal Room	Palm Room	Bay Room	Gulf Room
3:45 p.m.	<b>15. Comparison of Commercial State-of-the-Art, Fossil-Based Hydrogen Production Technologies</b> <i>Eric Lewis, Shannon McNaul, Matt Jamieson, Megan S. Henrikson, Scott Matthews, Travis Shultz, Timothy J. Skone and Robert Stevens, National Energy Technology Laboratory, U.S. Department of Energy, USA</i>	<b>40. A Preliminary Experimental Study of Iron Ore Reduction by Ammonia</b> <i>Yuejun Liu and Xianchun Li (School of Materials and Metallurgy, University of Science and Technology); Wancen Sun (School of Chemical Engineering); Dongke Zhang (Liaoning Provincial Engineering Research Centre for Advanced Coking and Coal Utilization), Centre for Energy (M473), The University of Western Australia, AUSTRALIA; and Shaoyan Wang, School of Chemical Engineering, School of Materials and Metallurgy, University of Science and Technology Liaoning, CHINA</i>	<b>6. Thermochemical Energy Storage for Solar Heating Applications</b> <i>Jarosław Zuwała Professor, Ph.D., D. Sc., Eng., Institute for Chemical Processing of Coal, POLAND</i>	<b>42. NETL's Direct Air Capture Center</b> <i>Dr. Ronald Breault, National Energy Technology Laboratory, U.S. Department of Energy, USA</i>
4:00 p.m.	<b>83. 1,3-Diaminopropane Bisborane as a Hydrogen Storage Media</b> <i>Guojin Zhang, Guochen Bao, and Zhenguo Huang, School of Civil &amp; Environmental Engineering, University of Technology Sydney, AUSTRALIA</i>	<b>44. Ammonia Combustion for Gas Turbine Engine Applications</b> <i>Clint Bedick and Pete Strakey, National Energy Technology Laboratory, U.S. Department of Energy, USA</i>	<b>9. Techno-economic Analysis of Thermal Energy Storage Systems Integrated with a Power Plant</b> <i>Nenad Sarunac, Javad Khalesi, and Mahfuja Khud, UNC Charlotte; Carlos Romero, Tanumoy Banerjee, and Julio Bravo, Lehigh University; and Rick Mancini, Pramod Kulkarni and Joel Berger, Customized Energy Solutions, USA</i>	<b>31. Direct Air Capture Case Studies: Sorbent System</b> <i>Timothy Fout, National Energy Technology Laboratory, U.S. Department of Energy; and Alexander Zoelle, Sally Homsy, Jessica Valentine, Naksha Roy, Aaron Kilstofte, Mike Sturdivan, Mark Steutermann, and Mark Woods, NETL Support Contractors, USA</i>

4:15 p.m.	<p><b>59. Performance Testing of a Moving-Bed Gasifier Using Coal, Biomass, and Waste Plastic Blends to Generate White Hydrogen</b>  <i>George Booras, Electric Power Research Institute; Rolf E. Maurer and David P. Thimsen, Hamilton Maurer International, Inc., USA; and Dr. Alberto Pettinau, and Dr. Simone Menoli, Sotacarbo Società Tecnologie Avanzate Low Carbon S.p.A., ITALY</i></p>	<p><b>48. Preliminary Observations of Performance of Ammonia Combustion in a Single-Cylinder Spark-Ignition Engine</b>  <i>Xiaofei Yao, Jing Wang, and Fangqin Cheng, State Key Laboratory of Technologies for Efficient Utilization of Coal Waste Resources, Shanxi University; Yang Liu and Jian Gao, Qingdao Institute of Bioenergy and Bioprocess Technology, Chinese Academy of Sciences, CHINA; and Dongke Zhang (Centre for Energy (M473), The University of Western Australia, AUSTRALIA</i></p>	<p><b>27. An Assessment of Solar Assisted Pyrolysis for Converting Various Biomasses into Gaseous and Liquid Bio-Fuels</b>  <i>Evangeline Bulla, School of Engineering, Liberty University; Tom Eldredge, Eldredge Modeling and Analysis, LLC; and Dr. Edmundo Vasquez, Clean Energy Technologies, USA*</i></p>	<p><b>120. Enhanced Depolarized Electro-Membrance System For Direct Capture of Carbon Dioxide from Ambient Air</b>  <i>Ayokunle Omosobi, Jinwen Wang and Kunlei Liu, Center for Applied Energy Research, and Xin Gao and Emmanuel Ohiomoba, Department of Mechanical Engineering, and Jesse Thompson, Department of Chemistry, University of Kentucky; and Aaron Patrick, Louisville Gas and Electric Company and Kentucky Utilities, USA</i></p>
4:30 p.m.	<p><b>66. What To Do with End-of-Life Plastics and Tires - Fuel, Monomer, or Hydrogen?</b>  <i>Sankar Bhattacharya, Professor, Department of Chemical and Biological Engineering, Monash University, AUSTRALIA</i></p>	<p><b>49. An Experimental Study of Ammonia Dissociation in a Fixed-Bed Reactor Packed with Quartz Particles</b>  <i>Ruiping Zhang, Jing Wang, Yuanyuan Zhang, and Fangqin Cheng, State Key Laboratory of Technologies for Efficient Utilization of Coal Waste Resources, Shanxi University; Yang Liu and Jian Gao, Qingdao Institute of Bioenergy and Bioprocess Technology, Chinese Academy of Sciences, CHINA; and Samuel Ronald Holden and Dongke Zhang (Centre for Energy (M473), The University of Western Australia, AUSTRALIA</i></p>	<p><b>35. Utilizing Solar Ponds for Both Energy Storage and Electricity Generation</b>  <i>Andrew Felgate, Liberty University; Tom Eldredge, Eldredge Modeling &amp; Analysis; and Dr. Edmundo Vasquez, Clean Energy Technologies, USA</i></p>	<p><b>131. DAC - CO<sub>2</sub> Cost Structure</b>  <i>Brian Higgins, The Babcock &amp; Wilcox Co., USA</i></p>
4:45 p.m.	<p><b>68. Process Intensification for Coal and Biomass Gasification for Distributed Power and Hydrogen Production II</b>  <i>John P. Dooher, Ying of Balquhain Fellow, Adelphi University/Dooher Institute of Physics; and Marco J. Castaldi, Chemical Engineering Department, City College of New York; and Dean Modroukas, Innoveering LLC, USA</i></p>	<p><b>33. Oxy-Combustion of Ammonia as a Fuel/Co-fuel and Impact on NO<sub>x</sub> Emissions</b>  <i>J. Pedel, S. Aluri, and S. Groff, Linde, Inc., USA</i></p>	<p><b>56. Magnetically Levitated and Constrained Flywheel Energy Storage System</b>  <i>John Van Osdol, National Energy Technology Laboratory, U.S. Department of Energy, USA</i></p>	<p><b>193. Thermodynamic Evaluation of Direct Air Capture - Establishing The Technical Limits</b>  <i>Kashif Nawaz, Chang-Min Yang, Kai Li, and Steve Kowalski, Oak Ridge National Laboratory, U.S. Department of Energy, USA</i></p>

<b>5:00 p.m.</b>	<b>204. Hydrogen Utilization and Production with Solid Oxide Cells under Reversible Operation Mode</b> <i>Jian Liu, Richard Pineault, and Harry Abernathy, DOE National Energy Technology Laboratory; and Tao Yang, Yueying Fan, Yinkai Lei, Yoosuf Picard, and Bo Guan, DOE National Energy Technology Laboratory, NETL Support Contractor, USA</i>	<b>OPEN DISCUSSION</b>	<b>OPEN DISCUSSION</b>	<b>207. Direct Air Capture: The New Technology to Solve The Climate Change</b> <i>Ugo Volpato, Climeworks, SWITZERLAND</i>
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**5:15 p.m. – Conclusion of the Program**

**5:30 p.m. – Networking – Island Ballroom 2** – Join your colleagues from the world over while you enjoy the fabulous hors d’oeuvres prepared by chef as we reconnect with colleagues we haven’t seen in years. We will even be “zooming in” colleagues who can’t be with us in Clearwater.

**THE CLEARWATER CLEAN ENERGY CONFERENCE – Power For Tomorrow  
TUESDAY MORNING – August 2, 2022**

**7:30 a.m. – Breakfast – Island Ballroom 2**

**8:00 a.m. – Four Concurrent Sessions**

	<b>Session 11 Energy Security Issues &amp; Approaches</b> <i>Dr. Grant R. Johnson Decision Science, Ames Laboratory and Ben Sooter, Electric Power Research Institute</i>	<b>Session 12 Net Zero Emissions</b> <i>Massood Ramezan, KeyLogic</i>	<b>Session 13 Emissions</b> <i>Dr. Edmundo Vasquez, Clean Energy Technologies and Byron Burrows, TECO</i>	<b>Session 14 Deriving More Value From Waste</b> <i>Dr. Dave Osborne, Somerset, AUSTRALIA and Melanie Mackay, Mining Engineering, University of British Columbia, Vancouver, CANADA</i>
	<b>Coastal Room</b>	<b>Gulf Room</b>	<b>Palm Room</b>	<b>Bay Room</b>
<b>8:00 a.m.</b>	<b>179. Accelerating Blockchain Solutions for Securely Integrating Distributed Operations in Energy Delivery Systems</b> <i>Dr. Grant Johnson, and Kenneth M. Bryden, Decision Science, Ames Laboratory; and Sydni Credie, Sensors &amp; Controls, National Energy Technology Laboratory, U.S. Department of Energy, USA</i>	<b>181. Gasification Systems – A Viable Pathway for Net-Zero Emissions Energy Systems</b> <i>David Lyons, National Energy Technology Laboratory, U.S. Department of Energy, USA</i>	<b>203. Minimization of NO<sub>x</sub> Emissions from the Fluidized Bed Boiler</b> <i>Jolanta Ziaja and Janusz Lichota, Wroclaw University of Technology, POLAND</i>	<b>150. Producing Aggregates from Mine Wastes for Use in Building Materials or As a Road-Base</b> <i>Prof. Zhong Tao, Western Sydney University, AUSTRALIA</i>



8:15 a.m.	<p><b>185. Cyber Security</b>  <i>Ben Sooter, Electric Power Research Institute, USA</i></p>	<p><b>176. Decarbonization Trends &amp; Opportunities for Florida Electric Utilities</b>  <i>Byron Burrows, Tampa Electric Co., USA</i></p>	<p><b>39. Experimental Study on the Characterization of Latent Heat Recovery and SO<sub>x</sub> Reduction of Flue Gas by the Novel FGC System</b>  <i>HyeonRok Choi, Won Yang, and YongWoon Lee, Carbon Neutral Technology R&amp;D Department, Korea Institute of Industrial Technology, SOUTH KOREA</i></p>	<p><b>151. Production of Soil Conditioners from Mine Tailings, Fly-Ash and Other Industry Wastes</b>  <i>Prof. Zhonghua Chen, Western Sydney University. AUSTRALIA</i></p>
8:30 a.m.	<p><b>201. Protecting the Future of Collaboration in Energy through Collaboration in Cyber Threat Information Sharing</b>  <i>Dan Harkness, CISSP, and Scott Pinkerton, Cyber Operations Research and Situational Awareness, Strategic Security Sciences Division, Argonne National Laboratory, Department of Energy, USA</i></p>	<p><b>93. Techno-Economic Analysis of Coal-Fired with BECCS for a Net-Zero Fossil-Fueled Power Plant</b>  <i>Andrew Awtry, Nathan Fine, James Tomey, Britt Dinsdale, Jenn Atcheson, Alfred (Buz) Brown, Erik Meuleman, ION Clean Energy, USA</i></p>	<p><b>55. Effect of CaO on the Evolution of NO<sub>x</sub> Precursors During Sewage Sludge Pyrolysis</b>  <i>Jiangtao Meng, Jing Wang, Fengling Yang, and Fangqin Cheng, State Key Laboratory of Technologies for Efficient Utilization of Coal Waste Resources, Shanxi University, CHINA</i></p>	<p><b>52. Production of Coal Tailings-Based Aggregates for Road-Subbase Application</b>  <i>Atousa Khazaie, Soheil Jahandari and Zhong Tao, Centre for Infrastructure Engineering, Western Sydney University; David Osborne, Summerset International Australia Pty Ltd.; Zhonghua Chen, School of Science, Western Sydney University; and Maroun Rahme, Nu-Rock Technology Pty Ltd, AUSTRALIA</i></p>
8:45 a.m.	<p><b>205. Supply Chain Security for Grid Assets</b>  <i>Mayank Malik, Grid Integration Systems and Mobility SLAC National Accelerator Laboratory, Stanford University, USA</i></p>	<p><b>183. Gasification of Coal and Biomass: The Route to Net-Negative-Carbon Power and Hydrogen</b>  <i>Horst Hack, Electric Power Research Institute, USA</i></p>	<p><b>99. Stability and Emissions of Surface Stabilized Combustion Fueled with Hydrogen Enriched Natural Gas</b>  <i>Tiantian Wang, Hai Zhang, Yuxin Wu, Qing Liu, and Yang Zhang, Key Laboratory for Thermal Science and Power Engineering of Ministry of Education, Department of Energy and Power Engineering, Tsinghua University, CHINA</i></p>	<p><b>198. An Environmental Approach to Fine Coal Recovery</b>  <i>C.K. Lane, ARQ, AUSTRALIA</i></p>

9:00 a.m.	<b>206. Operational Technology Behavioral Analytics (OTBA) – A Data-Centric Approach for Reducing Cybersecurity Risk</b> <i>Clifton Black and Michael Thorn, Southern Company Services; Adam Carrington, TEKsystems; and Masrur Rahman, Securicon, USA</i>	<b>186. Net-Carbon-Negative Hydrogen Production Using Coal and Biomass Blends</b> <i>Josh Stanislawski, University of North Dakota Energy &amp; Environmental Research Center, USA</i>	<b>73. Effect of Calcium-Based Activating Additives on Combustion Behaviour of Coals</b> <i>Halina Pawlak-Kruczek, Krystian Krochmalny, Michał Ostrycharczyk, Krzysztof Czajka, Michał Czerep, Anna Kisiela-Czajka, Marcin Baranowski, and Monika Tkaczuk-Serafin, Wroclaw University of Science and Technology, POLAND</i>	<b>202. Engineered Rock; Zero Waste, Circular Economy, and Carbon Negative</b> <i>Maroun Rahme, Nu-Rock, AUSTRALIA</i>
9:15 a.m.	<b>OPEN DISCUSSION</b>	<b>187. Net-Carbon-Negative Electrical Generation from Coal and Biomass Blends</b> <i>—John Oleksik, University of North Dakota Energy &amp; Environmental Research Center, USA</i>	<b>OPEN DISCUSSION</b>	<b>209. CO<sub>2</sub> Reducing High-Performance Coal-Based Commercial Building Materials</b> <i>Walt Sherwood, Ryan Johnson, Ryan Trammell and William Easter, Semplastics/X-MAT; and Bruce Folkedahl and Carolyn Nyberg Energy &amp; Environmental Research Center, USA</i>
9:30 a.m. – Break – Island Ballroom 2				
10:00 a.m. – Four Break-Outs				
	<b>Session 15</b> <b>CO<sub>2</sub> III – Point Sources</b> <i>David Hopkinson and Fangming Xiang, National Energy Technology Laboratory, U.S. Department of Energy</i>	<b>Session 16</b> <b>Biomass Conversion to Power and/or Chemicals I</b> <i>Les Marshall, Consultant and Josh Stanislawski, UNDEERC</i>	<b>Session 17</b> <b>Pressurized Oxy-Combustion I</b> <i>Dr. Richard Axelbaum, Washington University in St. Louis, and Prof. Andrew Fry, Brigham Young University</i>	<b>Session 18</b> <b>MSW Combustion</b> <i>Prof. Lunbo Duan, and Prof. Yueming Wang, Ph.D., Southeast University, China and Alan Paschedag, Covanta</i>
	<b>Coastal Room</b>	<b>Gulf Room</b>	<b>Bay Room</b>	<b>Palm Room</b>
10:00 a.m.	<b>28. Updated Cost and Performance of CO<sub>2</sub> Capture and Compression from Industrial Sources</b> <i>Timothy Fout, Travis Shultz, Robert James, National Energy Technology Laboratory, U.S. Department of Energy; and Sydney Hughes, Alexander Zoelle, Sally Homsy, Sam Henry, Sandeep Pidaparti, Norma Kuehn, and Mark Woods, NETL Support Contractors, USA</i>	<b>25. Effect of Acoustic Forcing on Particulate Emissions from an Entrained Flow Reactor</b> <i>Marcelo D. B. Takehara, Muhammad A. Chishty, Kentaro Umeki and Rikard Gebart, Luleå University of Technology, Department of Engineering Sciences and Mathematics, Division of Energy Engineering, SWEDEN*</i>	<b>62. Ash Transformations and Deposition during Pressurized Oxy-Combustion of Coal</b> <i>Dr. Andrew Fry, Brigham Young University, USA</i>	<b>142. The Preparation of Glass-Ceramic Foams from Coal-Based Slags by Inorganic Gel Casting: The Effect of Structure of Slags on Weak Alkali-Activation Reactivity</b> <i>Li Zhou, Qiangqiang Ren, Mingyue Wang, Wei Li, Chen Liang and Wenyu Wang, Chinese Academy of Sciences, CHINA</i>

10:15 a.m.	<p><b>92. Pilot Design and Testing for Transformational Solvents on NGCC Flue Gas</b>  <i>Ned Brown, Greg Staab, Nathan Fine, James Tomey, Britt Dinsdale, Andrew Awtry, Jenn Atcheson, Tyler Silverman, Alfred (Buz) Brown, Erik Meuleman, ION Clean Energy, USA</i></p>	<p><b>12. Biomass to High Quality Jet Fuel via Gasified-Synthesis Route</b>  <i>Dr. Guangbo Liu, Xi Xu, Dr. Hui Wang, Dr. Zhiqi Wang, Dr. Jianqing Li, Dr. Jingli Wu, and Prof. Jinhu Wu, Key Laboratory of Biofuels, Qingdao Institute of Bioenergy and Bioprocess Technology, Chinese Academy of Sciences, CHINA</i></p>	<p><b>43. Design and Modeling of an 80 bar Oxy-Combustor for Direct Fired Supercritical CO<sub>2</sub> Applications</b>  <i>Pete Strakey, National Energy Technology Laboratory, U.S. Department of Energy, USA</i></p>	<p><b>143. Development on Biomass Fluidized Bed Gasification Technologies Coupling with Coal Power Plant</b>  <i>Wang Qinhuai, State Key Laboratory of Clean Energy Utilization, Zhejiang University, CHINA</i></p>
10:30 a.m.	<p><b>94. Modular Adaptive Packing for Integrally Cooled Absorbers</b>  <i>Nathan Fine, Greg Staab, Chuck Panaccione, Andrew Awtry, Jenn Atcheson, Tyler Silverman, Alfred (Buz) Brown, Erik Meuleman, ION Clean Energy, USA</i></p>	<p><b>60. Co-Firing of Woody Biomass in Coal Combustion Systems at High Biomass Concentrations</b>  <i>Dr. Andrew Fry, Brigham Young University, USA</i></p>	<p><b>87. Effect of Jet Speed on Formation of MILD Oxy Coal Combustion</b>  <i>Wenshi Huang, Tianyu Zhang, Yuxin Wu, Key Laboratory for Thermal Science and Power Engineering of Ministry of Education, Department of Energy and Power Engineering, Tsinghua University, CHINA</i></p>	<p><b>158. Progress on Technology of Smouldering Combustion for Treatment of Sewage Sludge</b>  <i>Yu Qiao, State Key Laboratory of Coal Combustion, Huazhong University of Science and Technology, CHINA</i></p>
10:45 a.m.	<p><b>118. Project Status Updates at the Wyoming Integrated Test Center</b>  <i>William Morris and Jason Begger, Wyoming Integrated Test Center, USA</i></p>	<p><b>86. Acceleration of Biomass Ignition under Turbulent Flow</b>  <i>Huina Guo, Yuxin Wu and Yang Zhang, Key Laboratory for Thermal Science and Power Engineering of Ministry of Education, Department of Energy and Power Engineering, Tsinghua University; and Lele Feng, School of Safety Engineering, China University of Mining and Technology, CHINA</i></p>	<p><b>61. Flame and Heat Release Profile during Pressurized Oxy-Combustion of Coal</b>  <i>Dr. Andrew Fry, Brigham Young University, USA</i></p>	<p><b>157. Process Design and Optimization on Self-Sustaining Pyrolysis and Carbonization of Municipal Sewage Sludge</b>  <i>Ao Zhou, Xuebin Wang, Hrvoje Mikulčić, Yixiang Zhang, and Jianjun Wang, MOE Key Laboratory of Thermo-Fluid Science and Engineering, Xi'an Jiaotong University, Xi'an, CHINA</i></p>
11:00 a.m.	<p><b>121. Synthesis of a Novel K<sub>2</sub>CO<sub>3</sub> /Humic Acid Microspherical Adsorbent for Post-Combustion CO<sub>2</sub> Capture</b>  <i>Abdelmalek Bellal, Xiaodong Hou, Junior Nash, Johannes Van der Watt, Daniel Laudal, Institute for Energy Studies, College of Engineering and Mines, University of North Dakota, USA</i></p>	<p><b>84. Evolution from Biomass to Hydrochar under a Constant Pressure</b>  <i>Shijie Yu, Xiaoxiao Yang, Peng Zhao, Qinghai Li, Hui Zhou, Yanguo Zhang, Key Laboratory for Thermal Science and Power Engineering of Ministry of Education, Beijing Key Laboratory of CO<sub>2</sub> Utilization and Reduction Technology, Department of Energy and Power Engineering, Tsinghua University, CHINA</i></p>	<p><b>155. Characteristics of Particulate Matter Generated from Pressurized Air-and Oxy-Coal Combustion in a 10kW<sub>th</sub> Fluidized Bed</b>  <i>Yueming Wang, Xinglei Qiu, Yuanqiang Duan, Lunbo Duan, Key Laboratory of Energy Thermal Conversion and Control, Ministry of Education, School of Energy and Environment, Southeast University, CHINA</i></p>	<p><b>145. N-Containing Gas Emission Behavior During Single Compound of Shoe Manufacturing Waste Pyrolysis</b>  <i>Guang Sun, Yuanqiang Duan, Lin Li and Lunbo Duan, Key Laboratory of Energy Thermal Conversion and Control, Ministry of Education, School of Energy and Environment, Southeast University, CHINA</i></p>

11:15 a.m.	<p><b>30. High CO<sub>2</sub> Capture Rate Cost and Performance Baseline Results for Natural Gas Combined Cycles (NGCC)</b>  <i>Timothy Fout, Travis Shultz, Robert James, National Energy Technology Laboratory, U.S. Department of Energy; and Tommy Schmitt, Sarah Leptinsky, Marc Turner, Sydney Hughes, Alexander Zoelle, Charles White and Mark Woods, NETL Support Contractors, USA</i></p>	<p><b>149. The Modeling Study on the Reason Why High CO Unburned in Pure Biomass Firing CFB Boiler</b>  <i>Jinpeng Xie, Man Zhang, Xinhua Yang and Hairui Yang, State Key Laboratory of Power Systems, Department of Energy and Power Engineering, Tsinghua University, CHINA</i></p>	<p><b>129. Remote Steam Reheat Using Direct Contact Oxy-Fuel Combustion</b>  <i>L. Bool, K. Tian, and G. Panuccio, Linde, Inc., USA</i></p>	<p><b>146. Pilot- and Full-Scale Demonstration of Industrial Solid Waste Combustion in Circulating Fluidized Bed</b>  <i>Yueming Wang, Yuanqiang Duan and Lunbo Duan, Key Laboratory of Energy Thermal Conversion and Control, Ministry of Education, School of Energy and Environment, Southeast University, CHINA</i></p>
11:30 a.m.	<p><b>208. Mixed Matrix Membrane with Porous Organic Cage for Post-combustion CO<sub>2</sub> Separation</b>  <i>Fangming Xiang (Leidos Research Support Team) and David P. Hopkinson, National Energy Technology Laboratory, U.S. Department of Energy, USA</i></p>	<p><b>89. Operation Characteristics of Biomass-Fired Circulating Fluidized Bed Boiler with High Steam Parameters</b>  <i>Xiwei Ke, Yizhen Zhang, Xuemin Liu, Yuxin Wu, Zhong Huang, Man Zhang, Junfu Lyu, and Tuo Zhou, Key Laboratory for Thermal Science and Power Engineering of Ministry of Education, Department of Energy and Power Engineering, Tsinghua University, CHINA</i></p>	<p><b>74. Effects of Additively Manufactured Surface Roughness on Small Diameter Plenums with Multiple Side Discharges for High Temperature Gas Turbine Blade Cooling Applications</b>  <i>M. Yip, R.W. Breault, D. Straub, (E. Robey and R. Arnab (Leidos)), National Energy Technology Laboratory, U.S. Department of Energy, USA</i></p>	<p><b>Open Discussion</b>  <i>The Southeast University in China (SEU) has conducted extensive research on solid waste combustion in fluidized beds. They have built the first circulating fluidized bed that purely burns MSW in China. SEU and other researchers offer an extensive session about MSW combustion.</i></p>
<p><b>11:45 a.m. to 1:15 p.m. – Themed Luncheon – Island Ballroom 2</b></p> <ul style="list-style-type: none"> <li>• <b>Low NO<sub>x</sub> Burners</b>, J.J. Letcavits, AEP</li> <li>• <b>Point Source and Direct Air Carbon Capture</b>, Dr. Ronald Breault, National Energy Technology Laboratory, U.S. Department of Energy</li> <li>• <b>Gasification</b>, Prof. Ashwani Gupta, University of Maryland</li> <li>• <b>Oxy-fuel Combustion in a Carbon Constrained World</b>, Dr. Lawrence E. Bool, Linde</li> <li>• <b>Thermal Conversion of Biomass</b>, Raj Gupta, University of Alberta, Canada</li> <li>• <b>Hydrogen</b>, Howard Meyer, GTI Energy</li> </ul>				

## TUESDAY AFTERNOON – August 2, 2022

**1:15 p.m. – Four Break-Outs**

	Session 19 <b>CO<sub>2</sub> IV</b> <i>Dr. Ronald W. Breault, National Energy Technology Laboratory, U.S. Department of Energy</i>	Session 20 <b>Modeling &amp; Simulation I</b> <i>Dr. Edmundo Vasquez Clean Energy Technologies</i>	Session 21 <b>Plant Conversions and Fuel Switching</b> <i>Tom Flynn, The Babcock &amp; Wilcox Co., and Brian Vitalis, Riley Power</i>	Session 22 <b>Biomass Conversion to Power and/or Chemicals II</b> <i>Les Marshall, Consultant and Josh Stanislowski, UNDEERC</i>
	<b>Coastal Room</b>	<b>Palm Room</b>	<b>Palm Room</b>	<b>Gulf Room</b>
<b>1:15 p.m.</b>	<p><b>122. Carbon Capture as Part of the Energy Transition</b> <i>Danielle Flagg, Sargent &amp; Lundy, USA</i></p>	<p><b>159. First-Principles Kinetic Modeling of Waste Plastic Pyrolysis</b> <i>Pratyush Agarwal, David Tremblay, Zhen Hou and Shu Wang, Aspen Technology, Inc., USA</i></p>	<p><b>8. A Novel Ash-Fouling-Free Regenerative Air Preheater</b> <i>Pengfei He, Len Goodpaster, Heather Nikolic, and Kunlei Liu, Center for Applied Energy Research, University of Kentucky; and Samuel Kelty, and Aron Patrick, LG&amp;E and KU, USA</i></p>	<p><b>72. Supercritical CO<sub>2</sub>-Assisted Liquefaction Pathway for High-Quality Liquid Biofuels</b> <i>Kiran Raj Goud Burra, Ashwani K. Gupta, University of Maryland, Department of Mechanical Engineering, USA</i></p>
<b>1:30 p.m.</b>	<p><b>134. Simulations-Guided Development of Custom Sorbents for Boron Capture from Coal Combustion Impoundment Leachates</b> <i>John Findley, Evan Granite, Eric Grol, and Jan Steckel, National Energy Technology Laboratory, U.S. Department of Energy, USA</i></p>	<p><b>163. Simulation of Hydrogen Production via Alkaline Electrolysis Stack Model within Aspen Plus and Aspen HYSYS</b> <i>Ravi Khandelwal and David Tremblay, Aspen Technology, Inc., USA</i></p>	<p><b>95. Startup and Shutdown Readiness Assessment for a Combined Cycle Unit</b> <i>Chet Acharya and Mark Faurot, Southern Company Services; Steve Seachman, Electric Power Research Institute; and Don Parker and Neil Ronan, Provecta Process Automation LLC, USA</i></p>	<p><b>105. In-situ Reforming of Bio-oil Based on CO<sub>2</sub> Capture: The Effect of Structural Properties of CaO Catalysts on the Composition of Biomass Pyrolysis Products</b> <i>Yujie Zhang, Jiaofei Wang and Guangsuo Yu (Institute of Clean Coal Technology, East China University of Science and Technology) State Key Laboratory of High-efficiency Utilization of Coal and Green Chemical Engineering, School of Chemistry and Chemical Engineering, Ningxia University, CHINA</i></p>

1:45 p.m.	<p><b>135. Assessment of Water Supply Risk under Climate Change Using a Hydrologic Model for Power Generation and Carbon Capture in Prairie State Generating Company in Illinois</b>  <i>Dr. Zhenxing Zhang, Elias Getahun, Laura Keefer, Guanping Qie, and Andres Felipe Prada Sepulveda, Water Supply Hydrologist, Illinois State Water Supply, Prairie Research Institute, University of Illinois at Urbana-Champaign, USA</i></p>	<p><b>164. Dynamic Modeling of Vehicular Hydrogen Filling Station Using Aspen HYSYS</b>  <i>Erika Belmont and Ravi Khandelwal, Aspen Technology, Inc., USA</i></p>	<p><b>104. Fuel Conversion Projects at Power Utility Boilers – It’s Not Just a Burner Swap</b>  <i>Stephen Johnston, Riley Power Inc., USA</i></p>	<p><b>54. Effect of Temperature and Gasifying Agents on Gasification Behavior of Biomass Char</b>  <i>Yuxin Wang and Ryo Yoshiie, Department of Mechanical Systems Engineering, Nagoya University, Tokai National Higher Education and Research; and Yasuaki Ueki and Ichiro Naruse, Institute of Materials and Systems for Sustainability, Nagoya University, Tokai National Higher Education and Research, JAPAN*</i></p>
2:00 p.m.	<p><b>153. Highly Active MIL-68(In)-Derived In<sub>2</sub>O<sub>3</sub> Hollow Tubes Catalysts to Boost CO<sub>2</sub> Hydrogenation to Methanol</b>  <i>Yuchen Shi and Weiguang Su (College of Chemistry and Chemical Engineering, Ningxia University), Guangsuo Yu (Institute of Clean Coal Technology, East China University of Science and Technology) State Key Laboratory of High-efficiency Utilization of Coal and Green Chemical Engineering, Ningxia University, CHINA</i></p>	<p><b>165. Process Simulation and Optimization for Bio-Refineries via Aspen Engineering Suite</b>  <i>Zhen Hou, Pratyush Agarwal, Pushpesh Sharma, Christopher Quan, Shu Wang, and Darin M. Campbell, Aspen Technology, Inc., USA; and Lili Yu and Lingxiang Li, Aspen Technology – Shanghai, CHINA</i></p>	<p><b>147. Mitigation of Aerosol Impacts from Coal Combustion Processes</b>  <i>Temitope Bankefa, Junior Nasah, Michael Mann and Joshua Oluwayomi, University of North Dakota; Dr. Srivats Srinivasachar and Teagan Nelson, Envergenx LLC; Steve Benson, Microbeam Technologies; and Nicole Nguyen, Barr Engineering, USA</i></p>	<p><b>119. Szego Mill Scale-Up for Biomass Processing</b>  <i>Dr. Olev Trass, Department of Chemical Engineering, University of Toronto, CANADA</i></p>
2:15 p.m.	<p><b>100. Conversion of CO<sub>2</sub> and CH<sub>4</sub> to Value-Added Oxygenates and Olefins</b>  <i>A. K. M. Kazi Aurnob, Kunlun Ding and James J. Spivey, Cain Department of Chemical Engineering, Louisiana State University; and Doug Kauffman, National Energy Technology Laboratory, U.S. Department of Energy, USA</i></p>	<p><b>166. Single-Column Cryogenic Air Separation: Enabling Efficient Oxygen Production with Rapid Startup and Low Capital Costs— Application to Low-Carbon Fossil-Fuel Plants</b>  <i>Mao Cheng, Piyush Verma, Zhiwei Yang, and Richard L. Axelbaum, Energy, Environmental and Chemical Engineering, Consortium for Clean Coal Utilization, Washington University in Saint Louis, USA</i></p>	<p><b>169. Boiler and Gas Turbine Conversions to Hydrogen Firing</b>  <i>Tony Facchiano, Electric Power Research Institute, USA</i></p>	<p><b>23. The Effect of Al<sub>2</sub>O<sub>3</sub>, CeO<sub>2</sub>, and ZrO<sub>2</sub> on the Performance of Cu/ZnO Catalyst for Methanol Production from Biomass Pyrolysis Syngas</b>  <i>Sabar Pangihutan Simanungkalit, Isabelle Jones (School of Molecular Sciences), Zhezi Zhang, and Dongke Zhang, Centre for Energy (M473), The University of Western Australia, AUSTRALIA</i></p>

2:30 p.m.		<p><b>57. Calculation of the Heat Transfer Coefficient in the Outer Body for a Rotational Detonation Engine</b>  <i>John Van Osdol, National Energy Technology Laboratory, U.S. Department of Energy, USA</i></p>	<p><b>170. Plant Modernization Environmental &amp; Resilience Challenges</b>  <i>Byron T. Burrows, PE, BCEE, Tampa Electric Company, USA</i></p>	<p><b>3. Ex-situ Catalytic Pyrolysis of Biomass in Fluidized Bed Reactor to Produce High-Quality Biocrude</b>  <i>Ziyi Shi, Tong Han, Rikard Svanberg, and Weihong Yang, KTH Royal Institute of Technology (KTH), SWEDEN*</i></p>
<b>2:45 p.m. – Break – Island Ballroom 2</b>				
<b>3:15 p.m. – Four Break Outs</b>				
	<p><b>Session 23 Ecofuels</b>  <i>Dr. Edmundo Vasquez Clean Energy Technologies and Dr. Dave Osborne Somerset Coal, Australia</i></p>	<p><b>Session 24 Chemical Looping</b>  <i>Andrew Tong, Susteon and Dr. Robert Stevens, National Energy Technology Laboratory, U.S. Department of Energy, USA</i></p>	<p><b>Session 25 Machine Learning/Data Analytics/Digital Twins/Controls II</b>  <i>Dr. Lawrence Shadle, National Energy Technology Laboratory, U.S. Department of Energy; Richard Kephart, Emerson; and Dr. Robert Hovsopian, National Renewable Energy Lab, USA</i></p>	<p><b>Session 26 Pressurized Oxy-Combustion II</b>  <i>Dr. Richard Axelbaum, Washington University in St. Louis, and Prof. Andrew Fry, Brigham Young University</i></p>
	<b>Coastal Room</b>	<b>Palm Room</b>	<b>Bay Room</b>	<b>Gulf Room</b>
3:15 p.m.	<p><b>65. Effect of Hydrothermal Carbonization Pretreatment on the Pyrolytic Products of the Digestate of Agricultural Waste</b>  <i>Yuming Wen, Shule Wang, Ziyi Shi, Pär Göran Jönsson, and Weihong Yang, KTH Royal Institute of Technology, Department of Materials Science and Engineering, SWEDEN; and Lukasz Niedzwiecki, Marcin Baranowski, Michał Czerep, Halina Pawlak-Kruczek, Wroclaw University of Science and Technology, POLAND*</i></p>	<p><b>175. Techno-Economic Considerations for the Production of Low-Carbon Intensity Hydrogen with Chemical Looping</b>  <i>Will Latta, Kyle Thorp, Luis Velazquez-Vargas, Eric Warren, Jim Watson, Ruby Zhang, Kevin Larson, Denis Osowski and Jim Watson, The Babcock &amp; Wilcox Company; and Ohio State University, USA</i></p>	<p><b>162. Infrastructure Needs to Support the Application of AI/ML to Key Zero Emissions Technologies</b>  <i>D. Mollot, U.S. Department of Energy; and K. Rose and D. Miller, National Energy Technology Laboratory, U.S. Department of Energy, USA</i></p>	<p><b>173. Experimental and CFD Modelling Study on NO<sub>x</sub> Evolution in Oxy-Biomass Combustion at a Wide Range of Temperature: 700-1300 °C</b>  <i>Zia ur Rahman, Xuebin Wang, Houzhang Tan, Jiaye Zhang, MOE Key Laboratory of Thermo-Fluid Science and Engineering, Xi'an Jiaotong University, CHINA; and Richard L. Axelbaum, Department of Energy, Environmental &amp; Chemical Engineering, Consortium for Clean Coal Utilization, Washington University in St. Louis, USA</i></p>



3:30 p.m.	<p><b>34. Catalytic Steam Reforming of Biomass Pyrolysis Vapors Over a Ni-Doped 3D Printed Catalyst</b>  <i>Jose Juan Bolivar Caballero, Tong Han, Rikard Svanberg, Pengcheng Cao, Thomas Lewin, and Weihong Yang, Department of Materials Science and Engineering, KTH Royal Institute of Technology, SWEDEN*</i></p>	<p><b>18. Techno-Economic Analysis for a Low Cost and Recyclable Oxygen Carrier</b>  <i>Junior Nasah, Johannes Van der Watt and Mark Musich, University of North Dakota; Teagan Nelson and Srivats Srinivasachar, Envergenx LLC, USA</i></p>	<p><b>192. Power Plant Efficiency – Neural Network Efficiency</b>  <i>Dr. Andrew Fry, Brigham Young University, USA</i></p>	<p><b>91. Experimental Study on NO<sub>x</sub> Formation and Reduction during Pressurized Oxy-Coal Combustion</b>  <i>Jiaye Zhang, Xuebin Wang, Yu Zhenga, and Gaofeng Daia, MOE Key Laboratory of Thermo-Fluid Science and Engineering, Xi'an Jiaotong University, CHINA; and Dr. Richard L. Axelbaum, Department of Energy, Environmental &amp; Chemical Engineering, Consortium for Clean Coal Utilization, Washington University, USA</i></p>
3:45 p.m.	<p><b>117. Hydrothermal Carbonization of Woody Biomass: Structure Evolution and Reactivity Analysis</b>  <i>Qing He, Guangsuo Yu, Lu Ding, Qinghua Guo, Yan Gong, and Fuchen Wang, East China University of Science and Technology, CHINA</i></p>	<p><b>88. The Demonstration of 4MWth Chemical Looping Combustion Unit</b>  <i>Zhenshan Li, Tsinghua University, CHINA; Weicheng Li, Dongfang Boiler, CHINA; Nils Erland L. Haugen, Yngve Larring and Øyvind Langoren, SINTEF Energi AS, NORWAY; Vincent Gouraud, and Aoling Zhang, Total Energies, FRANCE; Stéphane Bertholin, IFP Energies Nouvelles, FRANCE; Kun Luo, Zhejiang University, CHINA; Andrzej Szlek, Silesian University, POLAND; and Todd A. Flach, Bellona, NORWAY</i></p>	<p><b>97. Integrating Reinforcement Learning with Model Predictive Control for Adaptive Control of Energy Systems</b>  <i>Elijah Hedrick, Katherine Reynolds, Debansu Bhattacharyya, Department of Chemical and Biomedical Engineering, West Virginia University and Stephen E. Zitney and Benjamin Omell, National Energy Technology Laboratory, U.S. Department of Energy, USA</i></p>	<p><b>106. Performance Evaluation of a Pressurized Oxy-Fuel Combustion Power Plant with a Hybrid Flue Gas Condenser (DCC and ICC) According to Wet and Dry Flue Gas Recirculation</b>  <i>Seongil Kim, Yongwoon Lee, and Won Yang, Carbon Neutral Technology R&amp;D Department, Research Institute of Clean Manufacturing System, Korea Institute of Industrial Technology; and HoSoo Lee, Samsung Electronics Co., Ltd., KOREA</i></p>
4:00 p.m.	<p><b>125. Experimental Analysis and Performance of a Waste Plastics Pyrolysis System for Biofuel Production</b>  <i>Adeyanju A. Anthony and Manohar Krishpersad, Department of Mechanical and Manufacturing Engineering, The University of the West Indies, TRINIDAD &amp; TOBAGO</i></p>	<p><b>138. Effect of Sulfur Dioxide on the Reactivity of Cu-Mn Oxygen Carrier for Chemical Looping with Oxygen Uncoupling</b>  <i>Turna Barua and Madeline H. Talebi, Department of Chemical and Biomolecular Engineering and Bihter Padak, Department of Mechanical and Aerospace Engineering, University of California, Irvine, USA</i></p>	<p><b>160. Getting More from Solar by Finding Synergies in Hybrid Systems with Combustible Fuels</b>  <i>Prof. Kody Powell, University of Utah, USA</i></p>	<p><b>168. A Development of Critical Components for the Modular Staged Pressurized Oxy-Combustion Power Plant</b>  <i>Duarte Magalhaes, Zhiwei Yang, Piyush Verma, Mao Cheng, Anand Sankaranarayanan, and Richard L. Axelbaum, Energy, Environmental and Chemical Engineering, Consortium for Clean Coal Utilization, Washington University in St. Louis, USA</i></p>

4:15 p.m.	<p><b>85. Steam Gasification of Refuse Derived Fuel with CaO Modification for Hydrogen-Rich Syngas Production</b>  <i>Ranwei Ren, (Haiming Wang and Changfu You (Shanxi Research Institute for Clean Energy, Tsinghua University) Key Laboratory for Thermal Science and Power Engineering of Ministry of Education, Department of Energy and Power Engineering, Tsinghua University, CHINA</i></p>	<p><b>16. Alleviating Lean Methane Emission via an Intensified Reactor</b>  <i>Adrian R. Irhamna and George M. Bollas, Department of Chemical &amp; Biomolecular Engineering, University of Connecticut, USA</i></p>	<p><b>161. Dynamic Optimization of Power Plants Using Machine Learning Models</b>  <i>Dr. Jake Tuttle, Taber International; and Prof. Kody Powell, University of Utah, USA</i></p>	<p><b>130. Comparison of Plasma and Oxy-Fuel Burners in Aluminum Smelting Rotary Kilns</b>  <i>Abhishek Dahiya, Adrian Gunnarsson, Klas Andersson, Department of Space Earth &amp; Environment, Chalmers University of Technology, SWEDEN</i></p>
4:30 p.m.	<p><b>152. Development and Testing of a Thermal Battery Based on Cementitious Materials and Thermosiphons for Power Plant Flexibilization</b>  <i>Julio Bravo, Justin Caspar, Dominic Matrone, Hans Agarwal, Sudhakar Neti, Zheng Yao, Alparslan Oztekin, and Carlos Romero, Lehigh University Energy Research Center; Ahmed Abdulridha, Shuoyu Wang, Clay Naito, Muhannad Suleiman, and Spencer Quiel, Lehigh University ATLSS Engineering Research Center; and Yue Xiao, Devon Jensen, Chien-Hua Chen, Advanced Cooling Technologies, USA*</i></p>	<p><b>140. Effect of Nitrogen Oxide on the Reactivity of Cu-Mn Oxygen Carrier for Chemical Looping with Oxygen Uncoupling</b>  <i>Turna Barua, Department of Chemical and Biomolecular Engineering and Bihter Padak, Department of Mechanical and Aerospace Engineering, University of California, Irvine, USA</i></p>	<p><b>46. Machine Learning Approach to Real-Time Combustion Diagnostics in a Rotating Detonation Engine Using Image Classification</b>  <i>Don Ferguson, Kristyn Johnson and Andrew Nix (ORISE and West Virginia University), National Energy Technology Laboratory, U.S. Department of Energy, USA</i></p>	<p><b>174. Nitrogen Oxide Formation and Reduction Behavior During Pressurized Oxy-Coal Combustion</b>  <i>Jiaye Zhang, Xuebin Wang, and Houzhang Tan, MOE Key Laboratory of Thermo-Fluid Science and Engineering, Xi'an Jiaotong University, CHINA; Richard L Axelbuam, Dept. of Energy, Environmental &amp; Chemical Engineering, Washington University in St. Louis, USA</i></p>
4:45 p.m.	<p><b>24. Power Generation and Recovery of Higher Hydrocarbons Utilising Cold Energy During LNG Regasification</b>  <i>Shing-hon Wong and Gongkui Xiao (Department of Chemical Engineering), and Dongke Zhang, Centre for Energy (M473), The University of Western Australia, AUSTRALIA</i></p>	<p><b>148. Thermodynamics, Experimental Results, and Screening Analysis of a Chemical Looping Process for Hydrogen Production</b>  <i>Sam Bayham, Robert Stevens, Tony Burgard and Ranjani Siriwardane, National Energy Technology Laboratory, U.S. Department of Energy; Richard Newby and Dale Keairns, KeyLogic, Jarrett Riley, Michael Bobek and Christopher Atallah, LIEDOS, USA</i></p>	<p><b>199. Prediction of Spontaneous Combustion in a Coal Stockpile Using Machine Learning</b>  <i>Beom Seog Kim, Seong Wan Hong, Myung Kyu Choi, Jae Gyu Hwang and Hang Seok Choi, Department of Environmental Engineering, Yonsei University, KOREA</i></p>	<p><b>107. A Numerical Investigation of Coal Particle Effects on the Inlet Section of Pressurized Oxy-Combustion Facility</b>  <i>Lei Li, West Virginia University, USA</i></p>

**5:00 p.m. – Conclusion of the Technical Program**

# THE CLEARWATER CLEAN ENERGY CONFERENCE – Power For Tomorrow

## WEDNESDAY MORNING – August 3, 2022

7:30 a.m. – Breakfast – Island Ballroom 2

8:00 a.m. – Four Break-Outs

	Session 27 <b>Recovery of Rare Earth Elements</b> <i>Dr. Evan Granite, National Energy Technology Laboratory, U.S. Department of Energy</i>	Session 28 <b>Modeling &amp; Simulation II</b> <i>Dr. Edmundo Vasquez Clean Energy Technologies</i>	Session 29 <b>PC Fired Units</b> <i>J.J. Letcavits, AEP and Alan Paschedag, Covanta</i>	Session 30 <b>Combustion &amp; Gasification</b> <i>Dr. Ashwani Gupta, University of Maryland, and Massood Ramezan, KeyLogic</i>
	<b>Coastal Room</b>	<b>Palm Room</b>	<b>Bay Room</b>	<b>Gulf Room</b>
<b>8:00 a.m.</b>	<b>53. Coal Mining Waste as a Resource for Recovery of Rare Earth Elements and for Geopolymer Concrete Production</b> <i>Philip Ofori, Clint McNally, and Jane Hodgkinson, CSIRO Sustainable Mining Technologies, AUSTRALIA</i>	<b>36. A Digital Twin Model of a Fluidized Bed Reactor for Carbon Capture</b> <i>Anchal Jatale, Shailesh Ozarkar, Muhammad Sami, and Jose Luis Gonzalez Hernandez, ANSYS Inc., USA</i>	<b>109. Real Time Sensor Measurements to Evaluate Impacts of Load Cycling on High-Temperature Fire-Side Corrosion in a PC Boiler</b> <i>Dr. Hong-Shig Shim, Dr. Zhonghua Zhan, and Dr. Kevin Davis, Reaction Engineering International; and Mr. Michael Dayton, PacifiCorp., USA</i>	<b>102. Catalytic Mechanism by Na-Ca Binary Catalyst in Char Gasification</b> <i>Junqin Yu, Lu Ding, Chen Cheng, Qinghua Guo, Guangsuo Yu and Yan Gong East China University of Science and Technology, CHINA</i>
<b>8:15 a.m.</b>	<b>96. A Pilot Plant Study of Rare Earth and Critical Material Extraction and Purification from Coal-Based Sources</b> <i>Rick Honaker, Xinbo Yang and Josh Werner, University of Kentucky; Michael Free, University of Utah; and Aaron Noble and Wencai Zhang, Virginia Tech, USA</i>	<b>37. Simulation Helping the Development of Hydrogen Cycle – From Production to Utilization to Safety Analyses</b> <i>Muhammad Sami, Anchal Jatale, Naseem Ansari, Didier Bessette and Stefano Orsino, ANSYS Inc., USA</i>	<b>116. Measurements to Control NO<sub>x</sub> Emission in Pulverized Coal-Ammonia Co-fired Boilers</b> <i>Zhaoxing Li, Yang Zhang, and Hai Zhang, Key Laboratory for Thermal Science and Power Engineering of Ministry of Education, Department of Energy and Power Engineering, Tsinghua University, CHINA</i>	<b>98. Combustion Oscillation Characteristics of Impinging Flame in an Opposed Multi-burner Entrained-Flow Gasifier</b> <i>Jiabao Yang, PhD candidate, Qinghua Guo, Xinming Tian, Yan Gong, Lu Ding, Fuchen Wang and Guangsuo Yu, East China University of Science and Technology, CHINA*</i>
<b>8:30 a.m.</b>	<b>123. The Department of Energy's Advances Towards a Sustainable CM/REE Supply Chain</b> <i>Savannah Rice, Anna Wendt, Grant Bromhal, Evan Granite, and Maryanne Alvin, Oak Ridge Institute for Science and Education, Department of</i>	<b>90. Energy Balance Assessment on a Treatment System of Municipal Sewage Sludge by Pyrolysis and Partial-Combustion: ASPEN PLUS Model</b> <i>Ao Zhou, Xuebin Wang, Hrvoje Mikulčić, Yixiang Zhang, Houzhang Tan, and</i>	<b>113. Emissions and Thermal Performance Evaluation of Coal and Gas Co-Firing in PC Boilers</b> <i>Dr. Marc Cremer, Dr. Zhonghua Zhan, and Dr. Dave Wang, Reaction Engineering International; and Brian King, Burns and</i>	<b>154. Corrosion of Different Coal Slags on High-Chrome Refractory Brick for an Opposed Multi-Burner Coal-Water Slurry Gasifier</b> <i>Jinghong Gao, Weiguang Su, and Guangsuo Yu (Institute of Clean Coal Technology, East China University of Science and Technology),</i>

	<i>Energy, National Energy Technology Laboratory, USA</i>	<i>Shuanghui Deng, MOE Key Laboratory of Thermo-Fluid Science and Engineering, Xi'an Jiaotong University, CHINA</i>	<i>McDonnell Corporation, USA</i>	<i>State Key Laboratory of High-efficiency Utilization of Coal and Green Chemical Engineering, College of Chemistry and Chemical Engineering, Ningxia University, CHINA</i>
<b>8:45 a.m.</b>	<b>141. A Process for Integrating Acid Mine Drainage Treatment with REE/CM recovery</b> <i>Dr. Aaron Noble, Virginia Tech; and Dr. Paul Ziemkiewicz, West Virginia University, USA</i>	<b>71. Comparison of Flame Characteristics in a Bluff-body Stabilized Burner with Ammonia, Methane and Propane at Low Reynolds Number</b> <i>Rishi Roy, Eliza Melia and Ashwani K. Gupta, Department of Mechanical Engineering, University of Maryland, USA</i>	<b>112. Full-Scale Burner Testing of JOC Patented High Temperature Oxy-Coal Burner</b> <i>Andrew Chiodo, Dr. Kevin Davis, and Brydger Van Otten, Reaction Engineering International; and Steve Krinsky, Jupiter Oxygen Corporation, USA</i>	<b>171. Pilot-Scale Study of RDF Gasification in Pilot-Scale HTW @2.0 Gasifier</b> <i>Elyas Moghaddam, Dobrin Toporov, Alireza Mohammadi, Chris van der Zande, and Wim van der Zande, GIDARA Energy B.V., THE NETHERLANDS</i>
<b>9:00 a.m.</b>	<b>190. Williston Basin Carbon Ore, Rare Earth, and Critical Minerals (CORE-CM) Program</b> <i>John Kay, Jason D. Laumb, Bruce C. Folkedahl, Todd Brasel, Charlene R. Crocker and Stacy J. Kouba, Energy &amp; Environmental Research Center; and Nolan Theaker, Institute for Energy Studies, University of North Dakota, USA</i>	<b>110. Advanced Decision Support Software for Next Generation Energy Systems</b> <i>Dave Swensen and Dr. Martin Denison, Reaction Engineering International, USA</i>	<b>50. Effect of Particle Size on Simultaneous Calcination and Sulfation of Limestone</b> <i>Yuanyuan Zhang, and Fangqin Cheng (Centre for Energy (M473), The University of Western Australia, AUSTRALIA) Xiangying Cheng, Jiangting Zhao, and Fengling Yang, Engineering Research Center of CO<sub>2</sub> Emission Reduction and Resource Utilization - Ministry of Education of the People's Republic of China, Shanxi University, CHINA</i>	<b>172. Co-gasification of Waste Plastic and Waste Coal for Thermochemical Recycling</b> <i>Nicholas Means, Sittichai Natesakhawat, Fan Shi, (NETL Support Contractor) and Jonathan W. Lekse, McMahan Gray, and Ping Wang, National Energy Technology Laboratory, U.S. Department of Energy, USA</i>
<b>9:15 a.m.</b>	<b>58. North American Steelmaking Slags – A Source for Critical Elements</b> <i>Melanie Mackay, Scott Dunbar, Maria Holuszko, and Norman B. Keevil, Mining Engineering, University of British Columbia, Vancouver, CANADA</i>	<b>Open Discussion</b>	<b>Open Discussion</b>	<b>191. Multiphysics Simulations of Supercritical CO<sub>2</sub> Gasification for Hydrogen Production</b> <i>Alexander Prlina and Eric Eddings, Department of Chemical Engineering, University of Utah; and Dr. Ronald W. Breault, National Energy Technology Laboratory, U.S. Department of Energy, USA</i>
<b>9:30 a.m. – Break – Island Ballroom 2</b>				

10:00 a.m. – Three Break Outs				
	Session 31 Combustion Fundamentals <i>Dr. Ashwani Gupta, University of Maryland, and Massood Ramezan, KeyLogic</i>	Session 32 Pressurized Oxy-Combustion III <i>Dr. Richard Axelbaum, Washington University in St. Louis, and Prof. Andrew Fry, Brigham Young University</i>	Session 33 CO <sub>2</sub> V – Direct Air Capture II <i>Dr. Ronald W/ Breault, National Energy Technology Laboratory, U.S. Department of Energy and Brian Higgins, The Babcock &amp; Wilcox Co.</i>	Session 34 Eco-Recovery – Liquid/Gas Waste <i>Prof. Klas Andersson, Chalmers University of Technology, Sweden</i>
	Coastal Room	Palm Room	Bay Room	Gulf Room
10:15 a.m.	<b>4. Optimization of a Setup to Investigate the Morphology and Emissivity of Coal and Biomass Particles During Burnout</b> <i>L. Pörtner and M. Schiemann, Energy Plant Technology, Ruhr-University Bochum, GERMANY*</i>	<b>177. Parametric Analysis of the Formation of SO<sub>x</sub>, NO<sub>x</sub>, and CO in 100 kW<sub>th</sub> Pressurized Oxy-Coal Combustor</b> <i>Piyush Verma, Zhiwei Yang, and Richard L. Axelbaum, Energy, Environmental and Chemical Engineering, Consortium for Clean Coal Utilization, Washington University in Saint Louis, USA</i>	<b>194. D-DAC Distributed Direct Air Capture - A new Paradigm of DAC Technology</b> <i>Kashif Nawaz, Kai Li, Michelle Kidder, Costas Tsouris, Steve Kowalski, and Brian Fricke, Oak Ridge National Laboratory, U.S. Department of Energy, USA</i>	<b>195. Investigations into the Catalytic Cracking of Pyrolysis Oil Obtained from Plastic Wastes</b> <i>Snehesh Shivananda Ail, Golam Chaudhry, and Marco J Castaldi; Department of Chemical Engineering, The City College of New York; and Lucas Dorazio, Jian Shi; James C. Fu, and C. P. Kelkar, BASF, Refinery Catalysis R&amp;D, USA</i>
10:45 p.m.	<b>182. An Experimental Study of the Formation Characteristics of NO, NO<sub>2</sub> and N<sub>2</sub>O during Fluidised Bed Combustion of Low Calorific Value Coals in a O<sub>2</sub>/Ar Mixture</b> <i>Xiangying Cheng, Haibo Xing, Yuanyuan Zhang, and Fangqin Cheng, State Key Laboratory of Technologies for Efficient Utilization of Coal Waste Resources, Shanxi University; Juan Zhang and Jian Gao, Qingdao Institute of Bioenergy and Bioprocess Technology, Chinese Academy of Sciences, CHINA; and Dongke Zhang, Centre for Energy (M473), The University of Western Australia, AUSTRALIA</i>	<b>178. A Direct Contact Cooler Design for Simultaneously Recovering Latent Heat and Capturing SO<sub>x</sub> and NO<sub>x</sub> from Pressurized Flue Gas</b> <i>Piyush Verma, Zhiwei Yang, and Richard L. Axelbaum, Energy, Environmental and Chemical Engineering, Consortium for Clean Coal Utilization, Washington University in Saint Louis, USA</i>	<b>133. Metal Oxide Functionalized Nano Porous Coal Sorbents for Low Concentrated CO<sub>2</sub> Capture Applications</b> <i>Ali K. Sekizkardes, Ping Wang, Patrick Muldoon, Nicholas Means, Victor Kusuma, David Hopkinson and Janice Steckel, National Energy Technology Laboratory, U.S. Department of Energy, USA</i>	<b>5. Polycyclic Aromatic Hydrocarbons Emission and the Mitigation in the Valuable Products from the Thermal Recycling of Used Mineral Oil</b> <i>Linlin Xu, Jie Yu, Gan Wan and Lushi Sun, State Key Laboratory of Coal Combustion, Huazhong University of Science and Technology, Wuhan, CHINA*</i>

11:00 a.m.	<p><b>13. Char Burnout of Walnut Shells Using Optical Measurement Techniques and First Comparison of the Experimental Data to the CCK Model</b>  <i>D. Tarlinski, E. Freisewinkel, M. Schiemann, and V. Scherer, Energy Plant Technology, and T. Eisenbach and R. Span, Thermodynamics, Ruhr-University, GERMANY*</i></p>	<p><b>108. Thermal Radiation Analysis of a Simplified Numerical Model of Pressurized Oxy-Combustion Facility with Discrete Ordinate Model</b>  <i>Lei Li, West Virginia University, USA</i></p>	<p><b>189. Aerosol Transformations during Lignite Coal Combustion and Impact on Carbon Capture</b>  <i>Josh Strege, University of North Dakota Energy &amp; Environmental Research Center, USA</i></p>	<p><b>200. A Study on the Gasification of Livestock Manure in a Fixed Bed Reactor</b>  <i>Seong Wan Hong, Beom Seog Kim, Myung Kyu Choi, Jae Gyu Hwang, Department of Environmental Engineering, Yonsei University, KOREA</i></p>
11:15 a.m.	<p><b>32. Deterioration Mechanism of Selective Catalytic Oxidation of NH<sub>3</sub> to N<sub>2</sub> Over CeZrO<sub>4</sub> by Incorporation of Alkali Metals and Calcium</b>  <i>Zhong Wang, Shuangju Li, Da Wang, and Xuebing Li, Key Laboratory of Biofuels, Qingdao Institute of Bioenergy and Bioprocess Technology, Chinese Academy of Sciences, CHINA</i></p>	<p><b>167. A Novel Flow Cell for Optical Particle Analyzers—Application to Measurements of Malvern Insitac under High Pressure and Temperature</b>  <i>Mao Cheng, Zachariah Wargel, and Richard L. Axelbaum, Energy, Environmental and Chemical Engineering, Consortium for Clean Coal Utilization, Washington University in Saint Louis, USA</i></p>	<p><b>188. Timeline for Implementation of Full-Scale Carbon Capture Projects</b>  <i>Jason Laumb, University of North Dakota Energy &amp; Environmental Research Center, USA</i></p>	<p><b>210. Particulate Emission from Municipal Solid Waste Combustion: Effect of CaO/ CaCO<sub>3</sub>/ TiO<sub>2</sub> Additives for Its Mitigation</b>  <i>Dr. Raj Gupta, University of Alberta, CANADA</i></p>
11:30 a.m.	<p><b>137. A Method for Characterizing Induced Breakdown Spectroscopy</b>  <i>Runmin Wu, Xudong Song, and Guangsuo Yu (Institute of Clean Coal Technology, East China University of Science and Technology), State Key Laboratory of High-efficiency Utilization of Coal and Green Chemical Engineering, School of Chemistry and Chemical Engineering, Ningxia University, CHINA</i></p>	<p><b>10. Experimental Investigation of Oxyfuel Combustion of RDF and Wood Chips in a Grate Incineration System</b>  <i>A. Mack, J. Maier, and G. Scheffknecht, Institute for Combustion and Power Plant Technology, University of Stuttgart, GERMANY</i></p>	<p><b>196. Active-Site-Enhanced Novel Sorbents for Direct CO<sub>2</sub> Capture from Atmosphere</b>  <i>Milad Yavari, John Chau, Palitha Jayaweera and Indira Jayaweera, SRI International, USA</i></p>	<p><b>211. SAA Set Up in a Large Quantity Generator Facility</b>  <i>Prakash Acharya, Jacobs Technology, USA</i></p>

<p><b>11:45 a.m..</b></p>	<p><b>156. Influence of Flame Pattern on the Combustion Synthesis of Ceramic Electrolytes</b>  <i>Jiaye Zhang, Lei Lei, Kunpeng Cai, Peng Gao and Yang Zhang, Key Laboratory for Thermal Science and Power Engineering of Ministry of Education Department of Energy and Power Engineering, Tsinghua University, CHINA</i></p>	<p><b>197. Plasma-Based Heat Treatment Processes - Towards Pilot Scale Trials</b>  <i>Adrian Gunnarsson, John Petersson and Klas Andersson, Department of Space, Earth &amp; Environment, Chalmers University of Technology, SWEDEN</i></p>		<p><b>OPEN DISCUSSION</b></p>
<p><b>12 Noon – Luncheon – Island Ballroom 2</b></p> <ul style="list-style-type: none"> <li>• <b>Presentation of the Best Student Paper Award</b></li> <li>• <b>Roundtable Wrap-up &amp;</b></li> <li>• <b>Conference Committee Meeting</b></li> </ul>				



## **THURSDAY MORNING – August 4, 2022**

**7:30 a.m. – Coffee & Danish for Field Trip Participants**

**8:00 a.m. – Departure to TECO's Clean Energy Demonstration Center at the Florida Conservation & Technology Center adjacent to the Big Bend Power Station.**

The Big Bend Modernization project is installing state-of-the-art combined-cycle technology and will eliminate coal as the fuel for Unit 1. Unit 2 will be retired. When complete in 2023, the project will be capable of producing 1,090 MW. This project will improve the land, water and air emissions at Big Bend. When this project is complete, Tampa Electric will use less coal to generate electricity, use less water, produce less wastewater and reduce air emissions. The project will save our customers money, and, coupled with our significant increase in solar power, will make Tampa Electric substantially cleaner and greener than it is today.

On the agenda:

Tour of Clean Energy Center with demonstrations of solar, flow battery storage and wind generation

- 1 MW floating solar array with 2 types of panels regular & bi-facial
- 1 MW agrivoltaic facility (farming and solar on one site) (in final phases of construction)

What can be included if there is interest by the attendees: tours of our partner facilities:

- Manatee Viewing Center boardwalk (manatee viewing unlikely at this time but a good view of the coal plant)
- FL Aquarium Turtle Rescue Center
- University of FL Coral Research Center
- FL Fish & Wildlife Conservation Commission (FWC) – Youth Conservation Center
- FWC Marine Fish Hatchery

After the tour the bus will swing by the airport to drop off those who have flights that afternoon. The bus should be at the airport around 2 p.m.

The fee is \$125.

For additional details about the project visit: [tampaelectric.com](http://tampaelectric.com)

**8:30 a.m. – Conference Committee Co-Chairs Meeting – Coastal Room**

**Mark Your Calendars!**

**Next year's conference: July 23 to 28, 2023**

**Sheraton Sand Key, Clearwater, Florida, USA**

# 46<sup>th</sup> International Technical Conference on Clean Energy

August 1 to 4, 2022

Sheraton Sand Key  
Clearwater, Florida, USA

## REGISTRATION

### Immediately:

\$795 In Person  
\$450 Virtual  
\$400 Students

### May 31<sup>st</sup> to June 15, 2022

\$895 In Person  
\$500 Virtual  
\$450 Students

### June 16<sup>th</sup> to the conference

\$995 In Person  
\$550 Virtual  
\$550 Students

Name

First Name for Badge

Title

Company

Address

City

State

Zip

Country

Phone

Email

Registration Fee: \$ \_\_\_\_\_

Field Trip: \$125 \$ \_\_\_\_\_

Spouse Fee: \$250 \$ \_\_\_\_\_

TOTAL: \$ \_\_\_\_\_

### Method of Payment:

- Check enclosed (payable to CTA); remit to  
Post Office Box 1130  
Louisa, VA 23093; or

- We accept:



- 

Name of Person Making Credit Card  
Payment:

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## The Clearwater Clean Energy Conference

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