

# **Program Announcement**

## **The 45<sup>th</sup> International Technical Conference on Clean Energy**

**June 20 to 25, 2021**

**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**



## A Message To Our Attendees

These are very trying times. As you see, we won't have our 45<sup>th</sup> conference in 2020 but next year. We are offering an excellent program and hope that you will bear with us as we move forward. There is no doubt that there will be changes ahead, and we will keep you fully informed. We are prepared to add additional sessions as the need arises. If you don't see your specific topic, don't be put off just send us your abstract and we will take it from there.

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

- Dr. Lawrence E. Bool, Praxair
- Dr. Ronald Breault, National Energy Technology Laboratory, U.S. Department of Energy
- Dr. Ashwani Gupta, University of Maryland

They and the entire Conference Committee will work to bring to you a comprehensive program covering what is happening now and what will be important in the future.

Our conference has earned a reputation for excellence as one of the premiere conferences on energy technologies as it has grown in size and scope since its inception in 1975. The 2020 conference would have been special to me because it is my fortieth. My first conference was in 1980 with the 5<sup>th</sup> conference in Lake Tahoe, Nevada. I hope that we will all be together next year to celebrate my personal milestone.

Your suggestion, comments and ideas are always welcome, and I look forward to hearing from many of you. Let us all stay safe and healthy.

### Barbara

Barbara A. Sakkestad  
Clearwater Clean Energy Conference  
P.O. Box 1130  
Louisa, VA 23093  
240-751-0900  
[barbarasak@aol.com](mailto:barbarasak@aol.com)

P.S. An area of interest that we want to include on next year's program is **Advances in Batteries and Energy Storage**. We see this as a topic of special interest as we continue to seek greater use of renewable energy. We'd like papers on fundamental advances in energy storage, and applied technology development and applications. If you have contacts in this area, please let us know or let your colleague(s) know about the conference.

## Clearwater Clean Energy Conference Agenda

**Mission Statement** – Increased demand – coupled with energy security issues, environmental concerns, uncertainty in the oil sector, and changing environmental regulations – **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.

Through the Technical Sessions, Short Courses, and Panels, 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.

### Sunday, June 20<sup>th</sup>

9:00 a.m. to 3:30 p.m. **Bay Room**  
**Six Concurrent Short Courses**

9:00 a.m. – 11:00 a.m.

**NO<sub>x</sub> Guarantees: What Do They Really Mean?**

*J.J. Letcavits, AEP, and Alan Paschedag, Covanta*

or

**Introduction to Sorbents and Catalysts**

*Evan Granite, National Energy Technology Laboratory, U.S. Department of Energy*

11:15 a.m. – 1:15 p.m.

**Applications and Basics of Oxy-Fuel Combustion**

*Dr. Lawrence E. Bool, Praxair*

or

**TBA**

1:30 p.m. – 3:30 p.m.

**Radiation Fundamentals in Combustion Systems**

*Prof. Brad Adams, Brigham Young University*

or

**Introduction to Natural Gas Processing**

*Evan Granite, National Energy Technology Laboratory, U.S. Department of Energy*

### Monday, June 21<sup>st</sup>

8:30 a.m. **Continental Breakfast**

9:00 a.m. **Grand Ballroom**

- **Keynote Address:** *Michelle Bloodworth, President and CEO, America's Power*
- **Panel: Decarbonization and Hydrogen**  
*Moderator: Brian Weeks, Regional Manager, Corporate Development, Gas Technology Institute*

11:30 a.m. **Lunch – Island Ballroom**

1:00 p.m. – **Grand Ballroom**

- **International Keynote Address:** **TBA**

- **Panel: Technology Development Around the World for the Future**  
Moderator: *Dr. Edmundo Vasquez, Clean Energy Technologies*

2:45 p.m. **Break – Island Ballroom**

3:15 p.m. **Four Concurrent Sessions**

**Session 1 Gulf Room  
Biomass Co-firing**

*Les Marshall, Ontario Power Generation, Canada*

**Session 2 Palm Room  
Oxy-Combustion**

*Prof. Andrew Fry, Brigham Young University, and Klas Andersson, Chalmers University, Sweden*

**Session 3 Bay Room  
Recovery of Rare Earth Elements**

*Mary Anne Alvin and Thomas Tarka, National Energy Technology Laboratory, U.S. Department of Energy*

**Session 4 Sand Key Room  
Advances in Batteries & Energy Storage**

*Dr. Ashwani Gupta, University of Maryland*

5:15 p.m. **Reception – Island Ballroom**

**Tuesday, June 22<sup>nd</sup>**

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

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

**Session 5 Sand Key Room  
Energy From Waste**

*Alan Paschedag, Covanta*

**Session 6 Gulf Room  
Modeling**

*Dr. Edmundo Vasquez, Clean Energy Technologies*

**Session 7 Palm Room  
Advanced Controls I – Data Analytics/Machine Learning**

*Dr. Martín Gascón, Intertek AIM*

**Session 8 Bay Room  
Gasification for Power & Chemicals**

*Massood Ramezan, KeyLogic and Kunlei Liu, University of Kentucky*

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

10:30 a.m. **Four Concurrent Sessions**

**Session 9 Sand Key Room  
Upgrading & Gasification**

*Gerri Botte, Texas Tech University, Massood Ramezan, KeyLogic and Kunlei Liu, University of Kentucky*

**Session 10 Gulf Room  
Emissions**

*Dr. Edmundo Vasquez, Clean Energy Technologies, and Byron Burrows, TECO*

**Session 11 Bay Room**  
**IDAES Modeling & Analysis**  
**Platform to Support Fossil Energy**  
**Systems**

*David Miller, National Energy  
Technology Laboratory, U.S  
Department of Energy*

**Session 12 Palm Room**  
**Supercritical CO<sub>2</sub> I**

*Prof. Subith Vasu, University of Central  
Florida; Josh Stanislawski, UNDEERC;  
and Bhupesh Dhungel, Air Liquide*

12:10 p.m. **Themed Lunch – Island  
Ballroom**

1:30 p.m. **Four Concurrent Sessions**

**Session 13 Sand Key Room**  
**Radiation**

*Prof. Bradley Adams, Brigham Young  
University*

**Session 14 Palm Room**  
**Chemical Looping**

*Dr. JoAnn Lighty, Boise State  
University; and Andrew Tong, The Ohio  
State University*

**Session 15 Bay Room**  
**Advanced Controls II– Digital Twins**

*Dr. Rob Hovsopian, National Energy  
Technology Laboratory, U.S.  
Department of Energy and Dr.  
Debangshu Bhattacharaya, West  
Virginia University*

**Session 16 Gulf Room**  
**Supercritical CO<sub>2</sub> II**

*Prof. Subith Vasu, University of Central  
Florida; Josh Stanislawski, UNDEERC;  
and Bhupesh Dhungel, Air Liquide*

2:50 p.m. **Break – Island Ballroom**

3:20 p.m. **Grand Ballroom**

- **Workshop: Hunter Plant  
Biomass Co-firing  
Demonstration**  
*Les Marshall, Ontario Power  
Generation*

5:45 p.m. – **Conclusion of the  
Technical Program**

**Wednesday, June 23<sup>rd</sup>**

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

8:00 a.m. **Grand Ballroom**

- **Panel – Emerging Oxygen  
Supply for Industrial  
Applications**  
**Moderator:** *David Lyons,  
National Energy Technology  
Laboratory, U.S. Department of  
Energy*

9:30 a.m. **Break – Island Ballroom**

10:00 a.m. **Four Concurrent Sessions**

**Session 17 Gulf Room**  
**COAL FIRST**

*Robert Stevens, National Energy  
Technology Laboratory, U.S.  
Department of Energy*

**Session 18 Palm Room**  
**Case Studies in Plant Conversions**

*Tom Flynn, Babcock & Wilcox and  
Brian Vitalis, Riley Power*

**Session 19 Bay Room**  
**Combustion & Gasification I**

*Dr. Ashwani Gupta  
University of Maryland*

**Session 20 – Sand Key Room  
Advanced Controls III**

*TBA*

**Noon – Island Ballroom**

**1:30 p.m. Four Concurrent Sessions**

**Session 21 Sand Key Room  
Fluidized Bed Units**

*James DeSellem, Babcock & Wilcox*

**Session 22 Gulf Room  
PC Fired Units**

*J.J. Letcavits, AEP and  
Alan Paschedag, Covanta*

**Session 23 Palm Room  
Transportation Fuels**

*Dushyant Shekhawat and Jonathan V.  
Lekse, National Energy Technology  
Laboratory, U.S. Department of Energy*

**Session 24 Bay Room  
Combustion & Gasification II**

*Dr. Ashwani Gupta  
University of Maryland*

**3:30 p.m. – Conclusion of the  
Technical Program**

**Thursday, June 24<sup>th</sup>**

**8:00 a.m. – Plenary Session  
Panel:**

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

**10:30 a.m. – Three Concurrent  
Sessions**

**Session 25 Gulf Room  
Hydrogen to Power**

*Howard Meyer, Gas Technology  
Institute*

**Session 26 Palm Room  
CO<sub>2</sub> Utilization**

*Zi Tong, National Energy Technology  
Laboratory, U.S. Department of Energy*

**Session 27 Bay Room  
Advanced Controls IV– Advanced  
Control**

*Dr. Larry Shadle, National Energy  
Technology Laboratory, U.S.  
Department of Energy and Rick  
Kephart, Emerson*

**12:10 p.m. Luncheon – Island  
Ballroom**

- **Presentation of the Best Student Paper Award &**
- **Conference Committee Meeting**

# THE CLEARWATER CLEAN ENERGY CONFERENCE

SUNDAY – JUNE 20, 2021

**Short Courses & Workshop** – The Sunday Short Courses cover a wide variety of topics important to the energy community. The Wednesday Workshop is an intensive overview on the use of biomass to displace some fraction of coal in electric power production.

**9:00 – 11:00 a.m. – Two Concurrent Short Courses**

## **NO<sub>x</sub> Guarantees: What Do They Really Mean?**

*J.J. Letcavits, AEP, and Alan Paschedag, Covanta*

When procuring new combustion equipment, equipment upgrades and/or tuning services in order to meet NO<sub>x</sub> limits, it is important to understand the science of combustion for low NO<sub>x</sub> burners. Thus, the guarantees possible are plant specific and include performance of much more equipment than just the burners. This short course will cover how combustion is affected by all aspects of the various streams that flow through the burners. A better understanding of why guarantees at one plant do not mean similar guarantees at another plant.

## **Introduction to Sorbents and Catalysts for Fossil Fuels and Pollution Control**

*Evan J. Granite, United States Department of Energy, University of Pittsburgh*

Catalysts and sorbents are widely employed in the processing of fossil fuels. Atoms and molecules are not faithful partners on the surface of a solid, with competitive adsorption (“forming a couple”), desorption (“kicking a spouse to the curb”), and reaction (“a most radical makeover”) occurring over, and over, again. The surface of a catalyst or sorbent is a “chemical soap opera”, and not for the faint of heart. The drama occurring on the surface of a catalyst, and its close cousin the sorbent, easily exceeds that of any Hollywood movie. Like the ancient marriage brokers, these solids help make extraordinary unions and transformations of atoms and molecules. Our modern economy would not be possible without these magical materials, and many important examples will be shown for the processing of coal, natural gas, and petroleum.

Catalysts or sorbents typically transform atoms and molecules through the Langmuir-Hinshelwood, Mars-Maessen, or Eley-Rideal mechanisms, and these will be illustrated. The “seven sacred steps” that occur during the use of any catalyst or sorbent will be shown. Poisoning, deactivation, pressure drop, sintering, mass and heater transfer, characterization techniques, regeneration, sorbent breakthrough curves, cost considerations, and future research challenges will be discussed. The instructor will make information available from his research, as well as his courses on chemical kinetics and

	petroleum and natural gas processing, available to interested students.
<b>11:15 a.m. – 1:15 p.m. – Two Concurrent Short Courses</b>	
<p><b>Applications and Basics of Oxy-Fuel Combustion</b>  <i>Dr. Lawrence E. Bool, Linde</i></p> <p>Oxy-fuel combustion has been used in many industries to enhance productivity and address environmental concerns. This short course will provide background for oxy-fuel combustion, including identifying flue gas behavior more pronounced with oxygen enrichment.</p> <p>Examples of industrial applications will also be included.</p>	TBA
<b>1:30 p.m. – 3:30 p.m. – Two Concurrent Short Courses</b>	
<p><b>Radiation Fundamentals in Combustion Systems</b>  <i>Prof. Brad Adams, Brigham Young University</i></p> <p>This Short Course covers the role of radiation in overall energy balance, how radiation affects heat transfer in a boiler, radiative properties of gas, particles and surfaces (and how said properties impact radiative transfer), and radiation measurements.</p> <p><b>(This Short Course concludes at 3 p.m.)</b></p>	<p><b>Introduction to Natural Gas Processing</b>  <i>Evan Granite, National Energy Technology Laboratory, U.S. Department of Energy</i></p> <p>Methane, the simplest hydrocarbon, is the major constituent of natural gas. Much of the methane produced worldwide is flared due to lack of pipelines. The prime use of methane is as a fuel for home heating and cooking, as well as electricity production. Natural gas is used to generate over 38% of the electricity in the United States.</p> <p>Natural gas is the cleanest fossil fuel. Nevertheless, raw natural gas is fascinating stew containing methane, ethane, propane, isobutane, n-butane, isopentane, n-pentane, hexane, helium, oxygen, hydrogen, water, nitrogen, carbon dioxide, hydrogen sulfide, mercury, and entrained particles. The moisture, hydrogen sulfide, carbon dioxide, and mercury are typically removed, and the wet gas (C2 and higher hydrocarbons) are separated for the chemical industry. The processes for processing natural gas will be highlighted. The instructor will make information available from his research, as well as his courses on petroleum and natural gas processing, available to interested students.</p>



# THE CLEARWATER CLEAN ENERGY CONFERENCE

## MONDAY MORNING – June 21, 2021

8:30 a.m. **Continental Breakfast – Island Ballroom**

9:00 a.m. **Grand Ballroom**

**Welcome** – *Barbara Sakkestad, Clearwater Clean Energy Conference*

**Overview** – *Dr. Ronald Breault, National Energy Technology Laboratory, U.S. Department of Energy*

**Presentation of the Percy Nichols Award** by *Distinguished Professor Ashwani K. Gupta, University of Maryland*

**Domestic Keynote Address & Panel – Gulf/Palm/Bay Rooms**

*Michelle Bloodworth, President and CEO, America's Power*

**Panel: Hydrogen's Role in a Decarbonizing World**

Moderator: *Brian Weeks, Regional Manager, Corporate Development, Gas Technology Institute*

Possible participants:

- DOE NETL – hydrogen from fossil sources for power generation
- DOE EERE - hydrogen from renewable sources for power generation – H2@scale
- Southern Company – combined utility perspective
- IEAGHG – The Future of Hydrogen study
- UK – BEIS (Department for Business, Energy, & Industrial Strategy) agency, how Great Britain is moving to hydrogen
- Hydrogen Turbine Vendor – Siemens or GE
- EPRI – hydrogen for power generation utilities
- Hydrogen Council

11:30 a.m. **Lunch – Island Ballroom**

## MONDAY AFTERNOON – June 21, 2021

1:00 p.m. **Grand Ballroom**

**International Keynote Address: TBA**

**Panel: Technology Development Around the World for the Future**

Moderator: *Dr. Edmundo Vasquez, Clean Energy Technologies*

- **Fossil Fuels** – *Andrew Hlasko, P.Eng., U.S. Department of Energy, Office of Advanced Fossil Technology Systems, Program Manager, Crosscutting R&D and System Integration, USA*
- **National Laboratories/EE&RE** – *Kevin Lynn, Director of Grid Modernization, U.S. Department of Energy, USA*
- **Bioenergy (non-fossil) and CCS (from fossil and non-fossil sources)** – *Max Schmidt, University of Stuttgart, Germany*
- *Representative from Australia – TBD*

3:00 p.m. **Break – Island Ballroom**

3:30 p.m. – Four Concurrent Sessions

	<p><b>Session 1</b>  <b>Sand Key</b>  <b>Biomass Co-firing</b>  <i>Les Marshall, Ontario Power Generation, Canada</i></p>	<p><b>Session 2</b>  <b>Gulf Room</b>  <b>Oxy-Combustion</b>  <i>Prof. Andrew Fry, Brigham Young University, and Klas Andersson, Chalmers University, Sweden</i></p>	<p><b>Session 3</b>  <b>Bay Room</b>  <b>Recovery of Rare Earth Elements</b>  <i>Mary Anne Alvin and Thomas Tarka, National Energy Technology Laboratory, U.S. Department of Energy</i></p>	<p><b>Session 4</b>  <b>Advances in Batteries &amp; Energy Storage</b>  <i>Dr. Ashwani Gupta, University of Maryland</i></p>
<p><b>3:30 p.m.</b></p>	<p><b>13. Co-Firing NO Emission and Ash Melting Characteristics of Distillers' Grains/Coal Blending for Power Plant Operation</b>  <i>Xiteng Wu, Danxia Xu, Lun Ma, Xinyu Ning, Qiang Cheng, Zixue Luo, State Key Laboratory of Coal Combustion, Huazhong University of Science and Technology, CHINA</i></p>	<p><b>119. Oxy-PFBC Combustor Design Evolution through Cold Flow Testing and Multi-Stage Combustor Modeling</b>  <i>William Follett, Dr. Doug Heim, and Scott Halloran, GTI, USA</i></p>	<p><b>65. Comparison between Electrochemical and Chemical Extraction of Rare Earth Metals from Coal and Coal By-Products</b>  <i>Alamgir M. Haque and Gerardine G. Botte, Chemical-Electrochemical Technology and Innovation Laboratory, Department of Chemical Engineering, Whitacre College of Engineering Texas Tech University, USA</i></p>	<p>TBA</p>
<p><b>3:50 p.m.</b></p>	<p><b>15. Mineral Additive to Mitigate Deposition and Corrosion Problems in Pulverized Biomass Boilers</b>  <i>Manoj Paneru, Alexander Mack, Jörg Maier, Günter Scheffknecht, Institute of Combustion and Power Plant Technology, GERMANY</i></p>	<p><b>23. Performance Evaluation of Pressurized Oxy-fuel Combustion by Pressure and Flue Gas Recirculation</b>  <i>YongWoon Lee, SeongIl Kim, HoSoo Lee, Won Yang, SeeHoon Lee, Thermochemical Energy System R&amp;D Group, Korea Institute of Industrial Technology, Mineral Resources &amp; Energy Engineering, Jeonbuk National University, KOREA</i></p>	<p><b>117. A Review of Rare Earth Elements in Central Appalachian Coal Utilization Byproducts</b>  <i>Circe A. Verba, Jon Yang, Scott N. Montross, and Mark L. McKoy, National Energy Technology Laboratory, U.S. Department of Energy USA</i></p>	

4:10 p.m.	<p><b>41. From 100% Coal to 100% Biomass – Technical Feasibility of Torrefied Biomass Combustion in an Existing PC Unit</b>  <i>Jaroslav Zuwała Ph.D., D. Sc., Eng., Janusz Lasek Ph.D., Eng., Krzysztof Głód, MSc., Eng., Institute for Chemical Processing of Coal, POLAND</i></p>	<p><b>61. On the Formation of Alkali Aerosols and Depositions during Co-Combustion with Chinese Rice Husk with Coal during Air and Oxy-Fuel Conditions</b>  <i>Thomas Allguren and Klas Andersson, Department of Space Earth &amp; Environment, Chalmers University of Technology, SWEDEN</i>  <i>Yueming Wang, Xiaolong Li, Jost O. L. Wendt, Department of Chemical Engineering, University of Utah, USA, Jan Viljanen, Photonics Laboratory, Physics Unit, Tampere University, FINLAND,</i>  <i>Jianqun Wu, Jingkun Han, Dunxi Yu, Minghou Xu, State Key Laboratory of Coal Combustion, Huazhong University, CHINA</i></p>	<p><b>125. Refining the Characterization of Western Coal Stocks: Occurrence and Distribution of Rare Earth Elements in the Powder River Basin, Wyoming</b>  <i>D. Bagdonas, R. Thomas, K. Rose, E. Phillips, and S. Quillinan. University of Wyoming School of Energy Resources, USA</i></p>	
4:30 p.m.	<p><b>50. Understanding Biomass Utility Boiler Operations through Large Eddy Simulations and Operational Data from the Atikokan Power Station</b>  <i>Philip J. Smith, Sean T. Smith, Oscar H. Diaz-Ibarra, John C. Parra-Álvarez, Jeremy Thornock, Jennifer Spinti and N. Stanley Harding, Institute for Clean and Secure Energy, The University of Utah, USA; and Les Marshall and Braden Fischer, Ontario Power Generation, Hamilton, CANADA</i></p>	<p><b>97. Experimental Study on Combustion Characteristics and NO<sub>x</sub> Emissions in Pilot-scale Pressurized Oxy-fuel Combustion with Methane and Pure Oxygen</b>  <i>Donghee Kim, Won Yang, and Youngjae Lee, Thermochemical Energy System, Korea Institute of Industrial Technology; and Kang Y. Huh, Department of Mechanical Engineering, Pohang University of Science and Technology, KOREA</i></p>	<p><b>126. Extracting Rare Earth Elements from Coal: NETL's REE Portfolio</b>  <i>Thomas Tarka, National Energy Technology Laboratory, U.S. Department of Energy, USA</i></p>	

<b>4:50 p.m.</b>	<p><b>96. Activation of Different Types of Biomass Using HTC and CA Plasma</b>  <i>Łukasz Niedźwiecki, Krystian Krochmalny, Monika Serafin-Tkaczuk, Tomasz Czapka, Mateusz Jackowski, Wrocław University of Science and Technology; and Anna Pajdak, Norbert Skoczylas, Mateusz Kudasi, The Strata Mechanics Research Institute of The Polish Academy of Sciences, POLAND</i></p>	<p><b>106. Shakedown and Operation of a 100 kW Pressurized Oxy-coal Combustor</b>  <i>Andrew Fry, Dale Tree and Brad Adams, Chemical Engineering, Brigham Young University, USA</i></p>	<p><b>121. Recent Achievements in DOE's Rare Earth Elements and Critical Minerals Program</b>  <i>Mary Anne Alvin, REE-CM Technology Manager, National Energy Technology Laboratory, U.S. Department of Energy, USA</i></p>	
<b>5:15 p.m. – Reception – Island Ballroom</b>				

# THE CLEARWATER CLEAN ENERGY CONFERENCE

## TUESDAY MORNING – June 22, 2021

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

8:00 a.m. Four Concurrent Technical Sessions

	<b>Session 5</b> <b>Sand Key Room</b> <b>Energy From Waste</b> <i>Alan Paschedag, Covanta</i>	<b>Session 6</b> <b>Gulf Room</b> <b>Modeling</b> <i>Dr. Edmundo Vasquez,</i> <i>Clean Energy Technologies</i>	<b>Session 7</b> <b>Palm Room</b> <b>Advanced Controls I–</b> <b>Data Analytics/-</b> <b>Machine Learning</b> <i>Dr. Martín Gascón, Intertek</i> <i>AIM</i>	<b>Session 8</b> <b>Bay Room</b> <b>Gasification for</b> <b>Power &amp; Chemicals</b> <i>Massood Ramezan,</i> <i>KeyLogic and Kunlei Liu,</i> <i>University of Kentucky</i>
8:00 a.m.	<b>60. Unlocking Hidden Combustion Properties of Waste Streams</b> <i>James F. DeSellem and Karl M. Heil, The Babcock &amp; Wilcox Company, USA</i>	<b>10. CFD Modeling of the Two-stage Entrained-bed Gasification of Coal with a Detailed Tar Cracking Model</b> <i>Rui Gao, Doctoral candidate, East China University of Science and Technology, CHINA</i>	<b>3. Machine Learning of Initial Values of Complex Models for Accelerating Convergence</b> <i>Peng Qiu, Doctoral candidate, East China University of Science and Technology, CHINA</i>	<b>16. Modeling Study of Structural Optimization of Refractory Layer in Single Nozzle Coal Water Slurry Gasifier</b> <i>Kuo Lin, and Prof. Haifeng Liu, East China University of Science and Technology, CHINA</i>
8:20 a.m.	<b>79. Oxygen Enhanced Biomass Combustion for the Power Sector</b> <i>Dr. Lawrence Bool, Praxair, Inc., USA</i>	<b>66. A Numerical Investigation into the Two-stage Ignition of n-alkanes: Anomalous First-to-Second Stage Transition Promoted by Decomposition of Hydroperoxides</b> <i>Shanshan Zhu, Jiaying Pan, Jian Gao, Mingming Zhu, Dongke Zhang, Key Laboratory of Biofuels, Qingdao Institute of Bioenergy and Bioprocess Technology, Chinese Academy of Sciences, and State Key Laboratory of Engines, Tianjin University, CHINA, Centre for Energy (M473), The University of Western Australia, AUSTRALIA</i>	<b>102. Controlling Time-Delay Systems Using Model Predictive Controllers Augmented by Reinforcement Learning</b> <i>Elijah Hedrick, Katherine Reynolds, Vinayak Dwivedy Debangsu 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>	<b>44. Sewage Sludge Fluidized Bed Gasification for Synthetic Fuel and Raw Material Production</b> <i>Max Schmid, and Günter Scheffknecht, Institute of Combustion and Power Plant Technology, GERMANY</i>

8:40 a.m.	<p><b>95. Use of Thermal Plasma for Activation of Sewage Sludge</b>  <i>Łukasz Niedźwieck, Halina Pawlak-Kruczek, Marcin Baranowski, Artur Chorążyczewski, Michał Czerep, Krystian Krochmalny, Wrocław University of Science and Technology</i> <b>POLAND</b></p>	<p><b>87. Design Development and CFD-based Performance Evaluation of a Hot Oxygen Coke Oven Gas Reformer</b>  <i>Marc Cremer, Huafeng (Dave) Wang, Reaction Engineering International, and Dr. Lawrence E. Bool, and Bradley Damstedt, Praxair, USA</i></p>	<p><b>69. Machine Learning and Real Time Simulation to Analyze the Dynamic Behavior of Thermal Systems and Their Transient Interactions with Other Paired Energy Technologies</b>  <i>Robert Hovsapian, National Energy Technology Laboratory, U.S. Department of Energy, USA</i></p>	<p><b>46. A Novel Catalytic Membrane Reactor for Renewable DME Synthesis from Carbon Dioxide and Hydrogen</b>  <i>Shiguang Li, Weiwei Xu, Travis Pyrzynski, Naomi B. Klinghoffer, Howard S. Meyer, Gas Technology Institute, Xinhua Liang, Xiao Fan, Missouri University of Science and Technology, Miao Yu, Huazheng Li, Rensselaer Polytechnic Institute (RPI), USA</i></p>
9:00 a.m.	<p><b>124. Particulate Emission in Municipal Solid Waste (MSW) Combustion and Use of Si-Al Based Additives to Mitigate These Emissions</b>  <i>Yang Wu, Li Wei, Song Zijian, Wang Ben, and Sun Lushi, State Key Laboratory of Coal Combustion, Huazhong University of Science and Technology, CHINA; and Deepak Pudasainee, Rajender Gupta, Department of Chemical and Material Engineering, University of Alberta, CANADA</i></p>	<p><b>19. Large Eddy Simulations of Supercritical CO<sub>2</sub> Combustor</b>  <i>K. R. V. Manikantachari, Postdoc Scholar, and Assoc. Prof. Subith Vasu, Center for Advanced Turbomachinery and Energy Research (CATER), University of Central Florida; and Scott Martin, Research Scientist, Eagle Flight Research Center, Embry-Riddle Aeronautical University, USA</i></p>	<p><b>74. Energy Storage Optimization Tool Box</b>  <i>Sanjeev Srivastava, National Energy Technology Laboratory, U.S. Department of Energy, USA</i></p>	<p><b>48. Alternative Routes for Ammonia Synthesis as a Hydrogen Carrier: A Review</b>  <i>Zhezi Zhang, Mingming Zhu, Gia Hung Pham, Herry Lesmana, Dongke Zhang and Jesse Santoso, Centre for Energy (M473), The University of Western Australia, AUSTRALIA; Jian Gao, Key Laboratory of Biofuels, Qingdao Institute of Bioenergy and Bioprocess Technology, Chinese Academy of Sciences; Junzhi Wu, Shanxi Institute of Energy, CHINA</i></p>
9:20 a.m.	<p><b>85. Thermo-economic Optimization of a Municipal Solid Waste Driven Water Purification</b>  <i>J.R. Galeano and J.C. Ordonez, Florida State University, USA</i></p>	TBA	<p><b>100. Applying Machine learning to Predict Boiler Tube Failures</b>  <i>Dr. Martín Gascón, Nikhil Kumar and Rana Ghosh, Intertek AIM, USA</i></p>	<p><b>63. Development and Application of Zonal-Process Model for a Downdraft Fixed-Bed Gasifier</b>  <i>Dr. Hong-Shig Shim, Martin Denison Jost Wendt (University of Utah), Hong-Shig Shim, Kevin Davis, Reaction Engineering International, USA</i></p>

9:40 a.m.	TBA	TBA	<p><b>120. Dynamic Modeling, Control, and Operational Analysis of a 10 MWe Supercritical CO<sub>2</sub> Recompression Closed Brayton Cycle</b>  <i>Stephen E. Zitney, Eric A. Liese, and Jacob Albright, National Energy Technology Laboratory, U.S.</i>  <i>Department of Energy, USA</i></p>	<p><b>64. Process Intensification for Coal and Biomass Gasification for Distributed Power and Hydrogen Production</b>  <i>John P. Doohar, Ying of Balquhain Fellow, Adelphi University/Dooher Institute of Physics and Energy;</i>  <i>Marco J. Castaldi, Chemical Engineering Department, City College of New York City University of New York;</i>  <i>and Dean Modroukas, Innoveering LLC, USA</i></p>
10:00 a.m. <b>Break in the Island Ballroom</b>				
10:30 a.m. <b>Four Concurrent Technical Sessions</b>				
	<p><b>Session 9 Sand Key Room Gasification &amp; Upgrading</b>  <i>Gerri Botte, Texas Tech University, Massood Ramezan, KeyLogic and Kunlei Liu, University of Kentucky</i></p>	<p><b>Session 10 Gulf Room Emissions</b>  <i>Edmundo Vasquez, Clean Energy Technologies, and Byron Burrows, TECO</i></p>	<p><b>Session 11 Bay Room IDAES Modeling &amp; Analysis Platform to Support Fossil Energy Systems</b>  <i>David Miller, National Energy Technology Laboratory, U.S Department of Energy</i></p>	<p><b>Session 12 Palm Room Supercritical CO<sub>2</sub> I</b>  <i>Prof. Subith Vasu, University of Central Florida; Josh Stanislawski, UNDEERC; and Bhupesh Dhungel, Air Liquide</i></p>
10:30 a.m.	<p><b>28. Chemicals from Natural Gas via Microwave Plasma</b>  <i>George Skoptsov, Aayush Mantri and Vignesh Viswanathan; H Quest Vanguard, Inc., USA</i></p>	<p><b>21. Upgrade of a Coal-fired Chain Grate Stoker Boiler for CO Reductions and Efficiency Improvement</b>  <i>Dr. Harun Bilirgen and Fatma Bilirgen, TABi Engineering and Energy Technologies Inc., Cukurova University Technopark; Mahmut Şafak Çınar, Cem Murat, Perihan Özkan, and Hülya Herdem, Kayseri Sugar Factory Inc., TURKEY; and Martin Denison, Kevin Davis, and Hong-Shig Shim, Reaction Engineering International, USA</i></p>	<p><b>53. IDAES Overview</b></p>	<p><b>129. Supercritical CO<sub>2</sub>-based Coal-Fired Power Plant Design Program Status</b>  <i>Timothy J. Held, Jason Miller, Jason Mallinak, Echogen; Jason Lee, Riley Power; Andrew Maxson, EPRI; and Tiffany Wu, Mitsubishi, USA</i></p>

<p style="text-align: center;"><b>10:50 a.m.</b></p>	<p><b>29. Microwave Plasma Flash Pyrolysis for Coal-To-Products Applications</b>  <i>George Skoptsov, Aayush Mantri and Vignesh Viswanathan; H Quest Vanguard, Inc., USA</i></p>	<p><b>81. Experimental Study on Injection Variation Effect of Coal and Air on NO Emission in Fluidized-bed Reactor</b>  <i>Min-Kyu Jeon, Young-Kon Choi, Min-Su Kim, Chung-Kyu Lee, Sang-In Keel and Jin-Han Yun, Department of Environmental Machinery, Korea Institute of Machinery &amp; Materials, KOREA</i></p>	<p><b>54. Application to Existing Fleet</b></p>	<p><b>18. The Effect of Working Fluid Composition on Heat Transfer in a Direct Supercritical CO<sub>2</sub> Power Cycle Recuperator</b>  <i>Matthew Searle, Doug Straub, and Jim Black, National Energy Technology Laboratory, U.S. Department of Energy, USA</i></p>
<p style="text-align: center;"><b>11:10 a.m.</b></p>	<p><b>68. Upgrading Natural Gas to Chemical Feedstock</b>  <i>Jared Ciferno, Technology Manager, Oil &amp; Natural Gas Program, National Energy Technology Laboratory, U.S. Department of Energy; and John Marano, JM Energy Consulting, USA</i></p>	<p><b>86. Numerical Modelling of deNO<sub>x</sub> Process with Various Low-Temperature Catalyst in Selective Catalytic Reduction (SCR) Reactor</b>  <i>Min-Su Kim, Min-Kyu Jeon, Young-Kon Choi, Chung-Kyu Lee, Sang-In Keel and Jin-Han Yun, Department of Environmental Machinery, Korea Institute of Machinery &amp; Materials, KOREA</i></p>	<p><b>55. Application to Coal Plant of the Future</b></p>	<p><b>22. High-Speed Imaging of Ignition and Flame Development in Oxy-Natural Gas/sCO<sub>2</sub></b>  <i>Suhyeon Park, Gihun Kim, Anthony C. Terracciano, Subith Vasu, Center for Advanced Turbomachinery and Energy Research (CATER), Mechanical and Aerospace Engineering, University of Central Florida; Timothy C. Allison, Southwest Research Institute, San Antonio, USA; Sungho Chang, KEPCO Research Institute; and Chansun Lim, Yuin Jin, Hanwha Power Systems, KOREA</i></p>



<p><b>11:30 a.m.</b></p>	<p><b>67. A Study on the Gasification of Biocrude-oil: Tar Reduction and Improvement of Syngas Quality</b>  <i>Jae Gyu Hwang, Myung Kyu Choi, Dong Hyuk Choi, Seong Wan Hong, Seung Hyeon Hong, Hang Seok Choi, Department of Environmental Engineering, Yonsei University, KOREA</i></p>	<p><b>118. An Experimental Study on High Temperature ESP under Coal Pyrolysis Gas</b>  <i>Quanlin Chen, DR. Jianmeng Cen, Mengxiang Fang, and Qinhui Wang, State Key Lab of Clean Energy Utilization, Zhejiang University, CHINA</i></p>	<p><b>56. Application to Carbon Capture and/or Chemical Looping</b></p>	<p><b>52. Optimization of Additively Manufactured Recuperator for Supercritical CO<sub>2</sub> Power Cycles</b>  <i>James Black, Ed Robey, Sridharan Ramesh, Doug Straub, Matthew Searle, Arnab Roy, and Joe Yip, National Energy Technology Laboratory, U.S. Department of Energy; and Adrian Sabau, Fred List III, Keith Carver, Abas Abdoli, T Kelvin Oak Ridge National Laboratory, USA</i></p>
<p><b>11:50 a.m.</b></p>	<p><b>116. Gasification Characteristics and Evaluation of Coal with/without Natural Gas in the Entrained Flow Gasifier</b>  <i>Kunlei Liu (Department of Mechanical Engineering), Zhongjie Shen, Ph.D., Landon S. Caudill, University of Kentucky Center for Applied Energy Research, USA</i></p>	<p>TBA</p>	<p><b>57. Multiscale Modeling of Power Plant Interactions through Grid Market Mechanisms</b></p>	<p><b>62. Advanced Tools for Assessment of Direct-Fired sCO<sub>2</sub> Power Cycles</b>  <i>Andrew Chiodo, Huafeng (Dave) Wang, Marc Cremer, Kevin Davis, Reaction Engineering International; and Frederick Dryer, Sang Hee Won, and Tanvir Farouk Mechanical Engineering, University of South Carolina, USA</i></p>
<p><b>12:10 p.m. Themed Lunch – Island Ballroom</b></p>				

# THE CLEARWATER CLEAN ENERGY CONFERENCE

## TUESDAY AFTERNOON – June 22, 2021

### 1:30 p.m. Four Concurrent Technical Sessions

	<b>Session 13</b> <b>Sand Key Room</b> <b>Radiation</b> <i>Prof. Bradley Adams, Brigham Young University</i>	<b>Session 14</b> <b>Palm Room</b> <b>Chemical Looping</b> <i>Dr. JoAnn Lighty, Boise State University; and Andrew Tong, The Ohio State University</i>	<b>Session 15</b> <b>Bay Room</b> <b>Advanced Controls II – Digital Twins</b> <i>Dr. Rob Hovsopian, National Energy Technology Laboratory, U.S. Department of Energy and Dr. Debangshu Bhattacharaya, West Virginia University</i>	<b>Session 16</b> <b>Gulf Room</b> <b>Supercritical CO<sub>2</sub> II</b> <i>Prof. Subith Vasu, University of Central Florida; Josh Stanislawski, UNDEERC; and Bhupesh Dhungel, Air Liquide</i>
<b>1:30 p.m.</b>	<b>24. Investigation of the Transition from Single to Group Coal Particle Combustion by Measuring the OH-Radical, Particle Temperature and Burnout Progress under Oxy-Fuel Conditions</b> <i>30. Schiemann, C. Geschwindner, T. Li, A. Dreizler, B. Böhm, Energy Plant Technology, Ruhr-University Bochum, GERMANY</i>	<b>78. Operation of a 50-kW Chemical Looping Combustion System with Natural Gas and a Copper-Iron Oxygen Carrier</b> <i>Michael Bobek and William Benincosa, Oak Ridge Institute for Science and Education, Doug Straub, Justin Weber, Sam Bayham and Ranjani Siriwardane, National Energy Technology Laboratory, U.S. Department of Energy; and Jarrett Riley, Leidos, USA</i>	<b>83. MG Design Using Digital Twins</b> <i>Mayank Panwar, NREL, USA</i>	<b>109. Design and Commissioning of Oxy-Fuel Combustor for Supercritical CO<sub>2</sub> Power Cycle</b> <i>Bhupesh Dhungel, Bikram Roychowdhury, Jiefu Ma, Kenneth Kaiser, Meng Hou, Scott Liedel, and Chendhil Periasamy, Air Liquide, Innovation Campus, USA</i>
<b>1:50 p.m.</b>	<b>58. Improved Computational Efficiency for Discrete Ordinate Calculations Using a Dimensionally Adaptive Mesh</b> <i>T. Williams and B. Adams; Brigham Young University, USA</i>	<b>104. Chemical Looping Paper</b> <i>Fanxing Li, PhD, Associate Professor and University Faculty Scholar, Chemical and Biomolecular Engineering Department, North Carolina State University, USA</i>	<b>84. The Blue Lake Rancheria Migrogrid Design Using Digital Twin</b> <i>Manish Mohanpurkar, INL, USA</i>	<b>Paper from Rich Dennis</b>
<b>2:10 p.m.</b>	<b>59. Development of an Improved Narrow Angle Radiometer for Combustion Systems</b>	<b>115. Overview of Recent Calcium Looping Activities at the IFK's 200 kW<sub>th</sub> DFB Pilot Plant</b>	<b>107. Digital Twins for Flexible Operation and Control of Coal-Fired</b>	<b>Paper from Peregrine</b>

	<p><i>N. Burchfield, A. Fry, B. Adams; Brigham Young University, USA</i></p>	<p><i>Matthias Hornberger, Joseba Moreno, Max Schmid, and Günter Scheffknecht, Institute of Combustion and Power Plant Technology, GERMANY</i></p>	<p><b>and Gas-Fired Power Plants</b>  <i>Stephen E. Zitney, Vinayak Dwivedy, Elijah Hedrick, Debangsu Bhattacharyya, Benjamin Omell, National Energy Technology Laboratory, U.S. Department of Energy ; and Katherine Reynolds, Department of Chemical and Biomedical Engineering, West Virginia University, USA</i></p>	
<p><b>2:30 p.m.</b></p>	<p><b>101. Heat Transfer in a Convective Heat Exchanger at Elevated Pressures</b>  <i>Zhiwei Yang, Pan Du, Richard L. Axelbaum Department of Energy, Environmental &amp; Chemical Engineering, Consortium for Clean Coal Utilization, Washington University in St. Louis, USA</i></p>		<p><b>51. The Atikokan Digital Twin: Bayesian Physics-Based Machine Learning for Low-Load Firing in the Atikokan Biomass Utility Boiler</b>  <i>Philip J. Smith, Sean T. Smith, Oscar H. Diaz-Ibarra, John C. Parra-Álvarez, Jeremy Thornock, Jennifer Spinti and N. Stanley Harding, Institute for Clean and Secure Energy, The University of Utah, USA; and Les Marshall and Braden Fischer, Ontario Power Generation, Hamilton, CANADA</i></p>	<p><b>Paper from 8 Rivers</b></p>
<p><b>2:50 p.m. - Break - Island Ballroom</b></p>				

## **THE CLEARWATER CLEAN ENERGY CONFERENCE**

**TUESDAY AFTERNOON – June 22, 2021**

3:20 p.m. – Grand Ballroom

**Workshop: Hunter Plant Biomass Co-firing Demonstration**

*Moderator: Les Marshall, Ontario Power Generation*

The use of biomass to displace some fraction of coal in electric power production (biomass co-firing) has been viewed as one option for reducing the net carbon emissions from a coal-fired power plant. The University of Utah, Brigham Young University and Chalmers University have partnered with Pacificorp/Rocky Mountain Power to stage a full-scale demonstration of modified biomass co-firing at the Hunter Unit 3 500 MWe power plant, located near Castle Dale, Utah. The multi-year program included:

- 1) milling trials to assess the impact of co-feeding modified biomass and coal on pulverizer operation;
- 2) study of the mechanical stability of the biomass fuels;
- 3) life-cycle analysis of harvesting wood for use in co-firing;
- 4) bench- and pilot-scale firing of the coal and biomass blends;
- 5) production of ~750 tons each of torrefied and steam-exploded biomass pellets; and
- 6) full-scale demonstration of the firing of coal and biomass blends at the Hunter power plant.

The program explored a wide range of impacts at three physical scales, and this workshop will provide a series of presentations that address co-firing impacts on aerosol formation, deposition, NO<sub>x</sub> emissions, heat flux, and other balance-of-plant considerations, as well as provide CFD model analysis comparing results at multiple scales.

### **30. Overview of a Comprehensive Program to Assess the Impact of Co-firing Biomass with Coal in a 480 MW Power Plant**

*Eric Eddings, Department of Chemical Engineering, University of Utah; Andrew Fry, Department of Chemical Engineering, Brigham Young University, USA; and Klas Andersson, Department of Space, Earth and Environment, Energy Technology, Chalmers University, SWEDEN*

### **31. Demonstration of Woody Biomass and Coal Co-firing at PacifiCorp's Hunter, Unit 3 (Plant Impacts)**

*Andrew Fry, Department of Chemical Engineering, Brigham Young University; and Ken Clark, Lauren Huntsman, Rocky Mountain Power, Pacificorp, USA*

**32. Aerosol Behavior while Firing a Woody Biomass/Coal Blend at Lab, Pilot and Industrial Scales**

*Xiaolong Li, Jost Wendt, Department of Chemical Engineering, University of Utah; and Andrew Fry, Department of Chemical Engineering, Brigham Young University, USA*

**33. Mineral Matter Deposition Behavior while Firing a Woody Biomass/Coal Blend at Lab, Pilot and Industrial Scales**

*Andrew Fry, Seyedhassan Fakourian, Department of Chemical Engineering, Brigham Young University; and Xiaolong Li, Jost Wendt, Department of Chemical Engineering, University of Utah, USA*

**34. A Comparison of Pilot- and Industrial-scale Radiometer Measurements between Pulverized-coal and 85% Coal/15% Biomass Co-firing Combustion**

*Teri Draper, Kaitlyn Scheib, Terry Ring, and Eric Eddings, Department of Chemical Engineering, University of Utah; Stan Harding, Andrew Fry, Department of Chemical Engineering, Brigham Young University, USA; and Adrian Gunnarsson, Klas Andersson, Department of Space, Earth and Environment, Energy Technology, Chalmers University, SWEDEN*

**35. NO<sub>x</sub> Formation during Co-combustion of Coal and Biomass in a 480MWe Power Plant**

*Thomas Allguren, Klas Andersson, Department of Space Earth & Environment, Chalmers University of Technology, SWEDEN; Andrew Fry, Department of Chemical Engineering, Brigham Young University; and Eric G. Eddings, Department of Chemical Engineering, University of Utah, USA*

**36. CFD and Process Model Simulations of Woody Biomass/Coal Co-firing at Lab, Pilot and Industrial Scales**

*Andrew Fry, Department of Chemical Engineering, Brigham Young University; Jost Wendt, Department of Chemical Engineering, University of Utah, USA; Hong Shig-Shim, Kevin Davis, Reaction Engineering International, USA*

5:45 p.m. **Conclusion of the Technical Program**

# THE CLEARWATER CLEAN ENERGY CONFERENCE

## WEDNESDAY MORNING – June 23, 2021

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

8:00 a.m. Grand Ballroom

**Panel – Emerging Oxygen Supply for Industrial Applications**

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

9:30 a.m. Break – Island Ballroom

10:00 a.m. Four Concurrent Technical Sessions

	<b>Session 17</b> <b>Gulf Room</b> <b>COAL FIRST</b> <i>Robert Stevens,</i> <i>National Energy</i> <i>Technology</i> <i>Laboratory, U.S.</i> <i>Department of Energy</i>	<b>Session 18</b> <b>Palm Room</b> <b>Case Studies in Plant</b> <b>Conversions</b> <i>Thomas J. Flynn,</i> <i>Babcock &amp; Wilcox and</i> <i>Brian Vitalis, Riley</i> <i>Power</i>	<b>Session 19</b> <b>Bay Room</b> <b>Combustion &amp;</b> <b>Gasification I</b> <i>Dr. Ashwani Gupta</i> <i>University of Maryland</i>	<b>Session 20</b> <b>Sand Key Room</b> <b>Advanced Controls</b> <b>III</b> <i>TBA</i>
10:00 a.m.	<b>91. U. S. Department of Energy's Transformative Power Generation Program: "A Focus on Technologies for Existing Coal-Fired Plants"</b> <i>John Rockey, National Energy Technology Laboratory, U.S. Department of Energy, and Justin Strock, Keylogic, USA</i>	<b>94. Natural Gas Additions and Conversions at Coal Fired Boilers</b> <i>Stephen Black, Riley Power Inc., USA</i>	<b>4. Effect of Iron-Based Catalyst on the Gasification Reactivity of HM Coal</b> <i>Yuchen Huang, Master candidate, East China University of Science and Technology, CHINA</i>	<b>137. Applying Machine Learning to Predict Thermal Power Plant Retirements</b> <i>Dr. Martín Gascón, Interdek, USA, Nikhil Kumar</i>
10:20 a.m.	<b>127. Coal FIRST Coal Plant of the Future Hybrid Gas/Coal Combustion</b> <i>Chad Haugen and Nicole Haugen and William Hardegger, Barr, USA</i>	<b>92. Converting a CFB Boiler to 100% Natural Gas</b> <i>Marc Lemmons, Sargent &amp; Lundy LLC, USA</i>	<b>11. A Study of the Role of Porous Properties and Acidity of Zeolites on Catalytic Pyrolysis of Lignin</b> <i>Hanmin Yang, Tong Han, Weihong Yang, Linda Sandström, Pär Jönsson, KTH Royal Institute of Technology, SWEDEN</i>	<b>138. A Transformation of Thermal Power Plants Using Anomaly Detection</b> <i>Dr. Martín Gascón Interdek, USA</i>
10:40 a.m.	TBA	<b>110. A 21st Century Coal-fired Steam</b>	<b>12. Dynamic Simulation of</b>	

		<b>Generator Design Featuring High-Efficiency w/Integral Pollution Emissions Control</b> <i>Keith Moore, CastleLight Energy Corp., USA</i>	<b>Abnormal Conditions in Coal Gasification Process</b> <i>Shuhang Zhang, Master candidate, East China University of Science and Technology, CHINA</i>	
11:00 a.m.	TBA	<b>122. Xcel Energy's Black Dog Generating Station</b> <i>Robert G. Wyly, Excel Energy Black Dog Generating Station, USA</i>	<b>14. Investigation of Optical Properties of Pulverized Solid Fuel Particles</b> <i>L. Pörtner, Y. Gu, M. Schiemann, Energy Plant Technology, Ruhr-University Bochum, GERMANY and Zhejiang Ocean University, CHINA</i>	
11:20 a.m.	TBA	TBA	<b>17. Development and Evaluation of Biomass Torrefaction System for Domestic Thermal Power Plant</b> <i>Ho Lim, Yong Woon Lee, Jae Wook Lee, Tae Young Chae, Won Yang, Thermochemical Energy System R&amp;D Group, Korea Institute of Industrial Technology, KOREA</i>	
11:40 a.m.	TBA	TBA	<b>40. Experimental Study on the Burning Behavior and Soot Characteristic of Single Coal Particle Combustion</b> <i>Anzhen Wang, Mengting Si, Qiang Cheng, Zixue Luo, State Key Laboratory of Coal Combustion, School of Energy and Power Engineering, Huazhong University of Science and Technology, CHINA</i>	
<b>Noon – Lunch – Island Ballroom</b>				

## WEDNESDAY AFTERNOON – June 24, 2021

1:30 p.m. **Four Concurrent Technical Sessions**

	<p><b>Session 21</b>  <b>Sand Key Room</b>  <b>Fluidized Bed Units</b>  <i>James DeSellem</i>  <i>Babcock &amp; Wilcox</i></p>	<p><b>Session 22</b>  <b>Gulf Room</b>  <b>PC Fired Units</b>  <i>J.J. Letcavits, AEP and</i>  <i>Alan Paschedag,</i>  <i>Covanta</i></p>	<p><b>Session 23</b>  <b>Palm Room</b>  <b>Transportation Fuels</b>  <i>Dushyant Shekhawat</i>  <i>and Jonathan V. Lekse,</i>  <i>National Energy</i>  <i>Technology</i>  <i>Laboratory, U.S.</i>  <i>Department of Energy</i></p>	<p><b>Session 24</b>  <b>Bay Room</b>  <b>Combustion &amp; Gasification II</b>  <i>Dr. Ashwani Gupta,</i>  <i>University of Maryland</i></p>
<p><b>1:30 p.m.</b></p>	<p><b>25. Transient Reacting Flow Simulation of Biomass Combustion in a Pilot-Scale Circulating Fluidized Bed Combustor</b>  <i>Subhodeep Banerjee,</i>  <i>Mehrdad Shahnam, William A. Rogers, National Energy Technology Laboratory, U.S. Department of Energy, USA</i></p>	<p><b>26. High-Temperature Multi-Process Sensor Development for a PC-fired Unit</b>  <i>Hong-Shig Shim, Jacob Beutler, Andrew Chiodo, Kevin Davis, Reaction Engineering International, USA</i></p>	<p><b>114. Synthetic Transportation Fuels at Scale with Microwave Plasma Co-conversion of Natural Gas and Il#6 Coal</b>  <i>George Skoptsov, Vignesh Viswanathan and Aayush Mantri, H Quest Vanguard, Inc., USA</i></p>	<p><b>43. Thermal Decomposition of Pinewood in Supercritical CO<sub>2</sub> for Activated Char and Liquid Fuel Production</b>  <i>Zhiwei Wang, K. G. Burra, Jinhu Li, Nick Daristotle, Ashwani K. Gupta, The Combustion Laboratory, Department of Mechanical Engineering, University of Maryland, Energy Research Institute Co. Ltd., Henan Academy of Sciences, Henan Key Lab of Biomass Energy, School of Safety Engineering, China University of Mining and Technology, CHINA CHECK MISTAKE</i></p>



<p style="text-align: center;"><b>1:50 p.m.</b></p>	<p><b>27. Study of Bed-to-Tube Heat Transfer Characteristics with an Immersed Horizontal Tube in the Oxy-fuel Pressurized Fluidized Bed at High Temperature</b>  <i>Lunbo Duan, Zhongkai Bao, Yuanqiang Duan, Key Laboratory of Energy Thermal Conversion and Control, Ministry of Education, School of Energy and Environment, Southeast University, CHINA</i></p>	<p><b>72. Combustion, Heat Transfer and Emissions Impacts during the Conversion of a PC-fired Boiler from Coal to Natural Gas</b>  <i>Marc Cremer, Andrew Chiodo, Reaction Engineering International; and Brian King, Burns and McDonnell, USA</i></p>	<p><b>90. Methane–Carbon Dioxide (CH<sub>4</sub>-CO<sub>2</sub>) Activated Synergistic Biomass Gasification for Hydrogen (H<sub>2</sub>)-Rich Syngas Production</b>  <i>Amoolya Lalsare, Jianli (John) Hu, Department of Chemical &amp; Biomedical Engineering, West Virginia University, USA</i></p>	<p><b>42. Visualization Study on Particle Flow Behaviors during Atomization in an Impinging Entrained-Flow Gasifier</b>  <i>Xiaoxiang Wu, Doctoral candidate, East China University of Science and Technology, CHINA</i></p>
<p style="text-align: center;"><b>2:10 p.m.</b></p>	<p><b>76. Computational Modeling of a Pilot Scale Circulating Fluidized Bed under Extreme Turndown</b>  <i>Justin Weber, National Energy Technology Laboratory, U.S. Department of Energy, USA</i></p>	<p><b>71. Combustion Related Issues Faced in the Retrofit of a Pulverized Coal Fired Boiler Utilizing Oxy-coal Technology</b>  <i>Dr. Hong-Shig Shim, Bridger Van Otten, and Andrew Chiodo, Reaction Engineering International and Steve Kimsky, Jupiter Oxygen, USA</i></p>	<p><b>105. Demonstration of Microwave-enhanced Conversion of Coal and Natural Gas,</b>  <i>M.W. Smith, V. Abdelsayed, C. Wildfire, M. Spencer, C. Ellison, D. Miller, D. Shekhawat, National Energy Technology Laboratory, Department of Energy, USA</i></p>	<p><b>49. An Experimental Study of the Effect of Spark Gap on the Flammability Limits of Partially Dissociated NH<sub>3</sub> and Air Mixtures</b>  <i>Herry Lesmana, Mingming Zhu, Zhezi Zhang, and Junzhi Wu, Dongke Zhang (Shanxi Institute of Energy), Centre for Energy (M473), The University of Western Australia, AUSTRALIA; and Jian Gao, Key Laboratory of Biofuels, Qingdao Institute of Bioenergy and Bioprocess Technology, Chinese Academy of Sciences, CHINA</i></p>

2:30 p.m.	<p><b>82. Non-thermal Plasma and Microwave Assisted Fluidised Bed Gasification of Sewage Sludge and Waste Coal for Synthetic Fuel Gas</b>  <i>Kai Zhang, North China Electric Power University, CHINA</i></p>	<p><b>45. Mineral Re-distribution from PF Coal to Ash in Commercial Power Stations</b>  <i>Rohan Stanger, Quang Anh Tran and Terry Wall, Chemical Engineering, University of Newcastle, AUSTRALIA, and Chris Spero, CS Energy, Brisbane, AUSTRALIA</i></p>	<p><b>111. Oxygen Production using Perovskite Carriers: Material Design to Reactor Modelling</b>  <i>Jonathan W. Lekse, Eric J. Popczun, Sittichai Natesakhawat, De Nyago Tafen, Dominic Alfonso, Ting Jia, Yuhua Duan, William A. Rogers, Subhodeep Banerjee, Mary Ann Clarke, and Pankaj Saha, National Energy Technology Laboratory, U.S. Department of Energy, USA</i></p>	<p><b>75. Flexible Modular Vortex Gasifier for Deployable Power</b>  <i>Justin Weber, National Energy Technology Laboratory, U.S. Department of Energy, USA</i></p>
2:50 p.m.	<p><b>77. Solid Fuel Fluidized Bed Reactor Chemical Looping Studies</b>  <i>Michael Bobek,, Oak Ridge Institute for Science and Education, Sam Bayham and Ranjani Siriwardane, National Energy Technology Laboratory, U.S. Department of Energy; and Jarrett Riley, Leidos, USA</i></p>	<p><b>130. Techno-economic Analysis of Coal Dual-bed Pyrolysis Polygeneration System Coupled with Pulverized Power Plant</b>  <i>Kaikun Li, PhD Student, Qinhui Wang, Chunjiang Yu, Mengxiang Fang, and Zhongyang Luo, State Key Laboratory of Clean Energy Utilization, Institute for Thermal Power Engineering, Zhejiang University, CHINA</i></p>	<p><b>113. Reduction of Lifecycle Greenhouse Gas Emissions of SMR Hydrogen Plants via Production of High-Value Carbons from CO<sub>2</sub>-Rich Tail Gas</b>  <i>George Skoptsov, Vignesh Viswanathan and Aayush Mantri, H Quest Vanguard, Inc., USA</i></p>	<p><b>112. Assessment of Pulse Detonation Engines and Its Limitations</b>  <i>Bhupendra Khandelwal, Mechancial Engineering Department, University of Alabama, Tuscaloosa, Alabama, USA; and Tobias Apletree, Amedeo De Cristofano, Lewis Jepps, Sorin Lucanu, Brandon O'Connell, Michael Pearman, Gurkamal Sandher, Krishna Sethuraman, and Mathew Thomas, Mechanical Engineering Department, University of Sheffield, Sheffield, UNITED KINGDOM</i></p>

3:10 p.m.	TBA	TBA	TBA	<p><b>20. Experimental Demonstration and Model Validation in Chemical Looping Reforming in Packed Bed Reactors Operated in High Pressure</b></p> <p><i>Alexandros Argyris , Christopher De Leeuwe , Vincenzo Spallina, Department of Chemical Engineering and Analytical Science, University of Manchester, Manchester, UNITED KINGDOM</i></p>
3:30 p.m. <b>Conclusion of the Technical Conference</b>				

# THE CLEARWATER CLEAN ENERGY CONFERENCE

## THURSDAY MORNING – June 25, 2021

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

8:00 a.m. Grand Ballroom – Plenary Session

Panel: TBA

10:00 a.m. – Break – Island Ballroom

10:30 p.m. Three Concurrent Technical Sessions

	<b>Session 25 Gulf Room</b> <b>Hydrogen To Power</b> <i>Howard Meyer, Gas Technology Institute</i>	<b>Session 26 Palm Room</b> <b>CO<sub>2</sub> Utilization</b> <i>Zi Tong, National Energy Technology Laboratory, U.S. Department of Energy</i>	<b>Session 27 Bay Room</b> <b>Advanced Controls IV-Advanced Control</b> <i>Dr. Larry Shadle, National Energy Technology Laboratory, U.S. Department of Energy and Rick Kephart, Emerson</i>
10:30 a.m.	<b>132. Hydrogen Production for Power Generation, Including Cost</b>	<b>1. U.S. DOE Office of Fossil Energy, CCUS Research and Technology Demonstration Projects, Program Update</b> <i>Andrew Hlasko P.Eng., U.S. Department of Energy, Office of Advanced Fossil Technology Systems, Program Manager, Crosscutting R&amp;D and System Integration, USA</i>	<b>5. Coal Ball Mill Temperature Control at Off Design</b> <i>Bonilla, Pezzini, Shadle, and Bryden; Iowa State University, Ames Lab, and National Energy Technology Laboratory, U.S. Department of Energy, USA</i>
10:50 a.m.	<b>133. Hydrogen Storage</b>	<b>39. Investigations into Mn-Hercynite for Thermo-chemical Redox Conversion of CO<sub>2</sub> to CO</b> <i>K. Burra and A. K. Gupta, The Combustion Laboratory, Department of Mechanical Engineering, University of Maryland, USA</i>	<b>6. Sensitivity Study of Leak Detection Using On-Line System Analysis on Turbomachinery</b> <i>Agbleze, Lima, Indrawan, Panday, Pezzini, Bryden, and Shadle; WVU, ISU, AL, Leidos (LSRT), NETL</i>
11:10 a.m.	<b>134. Hydrogen Safety</b>	<b>47. Hollow Fiber Membrane Contactor: A Compact, Modular Approach for CO<sub>2</sub> Capture</b> <i>Shiguang Li, Travis Pyrzyński, and Howard Meyer, Gas Technology Institute, Yong Ding (Air Liquide Advanced Separations, USA</i>	<b>7. MSW Syngas Coupling Hybrids for Microgrid</b> <i>Indrawan, Harun, Tucker, Maloney, Shadle; LSRT and NETL</i>

<b>11:30 a.m.</b>	<b>135. Hydrogen as a Fuel Beyond Power Generation</b>	<b>128. Paper from Zi Tong</b>	<b>8. Kalman Filter for Boiler Leak Detection from Coal Power Plant Data</b> <i>Panday, Pezzini, Shadle; LSRT, AL, NETL</i>
<b>11:50 a.m.</b>	<b>136. Hydrogen Infrastructure Needs</b>	<b>131. U.S. Department of Energy National Carbon Capture Center, Supporting Technology Scale-up and International Collaboration</b> <i>Doug McCarty, National Carbon Capture Center, Southern Company, USA</i>	<b>9. Comparison of PID and Basic MPC Controllers (DMC) for Steam Superheat Temperature Control of a Coal Fired Subcritical Boiler</b> <i>Agbleze, Panday, Indrawan, Pezzini, and Lima; WVU, LSRT, AL, NETL</i>
<b>12:10 p.m. – Island Ballroom – Lunch</b> <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>			

## Mark Your Calendars!

**Next year's conference: June 26 – 30, 2022**

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

## IMPORTANT INFORMATION

**Headquarters** – Sand Key is one of the 20 Best Beaches, 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 \$193/night for Single or Double accommodations. You may also email:

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*The registration fee covers one **Proceedings**, all continental breakfasts; all lunches; evening events; all breaks; and participation in all tutorials, panels and technical sessions, plus, the conference materials distributed at the conference.*

The **Clearwater Clean Energy Conference** offers participants about 150 technical presentations in four days.

Buffet style luncheons in the Island Ballroom (an area dedicated for the use of attendees all day), Continental breakfasts, refreshment breaks and a fabulous reception offer numerous networking opportunities.

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However, the \$150 fee covers the Reception, four luncheons, Continental breakfasts and all morning and afternoon refreshment breaks.

**Keep in mind, the on-site spouse's registration is \$175.**

**Mark Your Calendars!**

**Next year's conference dates:**

**June 26 – 30, 2022**

**Sheraton Sand Key**

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