The 44th International Technical Conference on Clean Energy

The Clearwater Clean Energy Conference

June 16 to 21, 2019

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 Six Continents, Then You Must Attend

The Clearwater Clean Energy Conference

THE CLEARWATER CLEAN ENERGY CONFERENCE

The Agenda

Sunday, June 16th

9:00 – 11:00 a.m. – **Fundamental Experiments and Modeling for Direct-Fired Supercritical CO_2 Combustion**
Prof. Subith Vasu, Center for Advanced Turbomachinery and Energy Research (CATER), University of Central Florida

11:15 a.m. – 1:15 p.m. – **Combustion Tuning: Why and How**
Alan Paschedag, Covanta, Inc., and J.J. Letcavits, American Electric Power

1:30 p.m. – 3:30 p.m. – **Catalysts and Sorbents for Pollution Control**
Evan Granite, National Energy Technology Laboratory, U.S. Department of Energy

3:45 p.m. – 5:45 p.m. – **Combustion Fundamentals**
Prof. Ashwani Gupta, University of Maryland

Monday, June 17th

8:30 a.m.—**Continental Breakfast in the Exhibit Center – Exhibit Center**

9:00 a.m. – **Morning Keynote Address & Panel:**
Keynote: *Dr. Randy Gentry, Chief Research Officer and Deputy Director, Science & Technology, National Energy Technology Laboratory, U.S. Department of Energy*

Panel: Commercialization of R&D Technologies
Chair: Dr. Massood Ramezan, KeyLogic

11:30 a.m. – **Lunch in the Exhibit Center**

12:45 p.m. – **Afternoon Keynote Address & Panel:**
Industrial Boiler Dispatched during Energy Emergencies
Robert Bessette, Council of Industrial Boiler Operators

Panel: Impact of Renewables on Grid Stabilization
Dr. Ronald Breault, National Energy Technology Laboratory, U.S. Department of Energy

3:15 p.m. **Break in the Exhibit Center**

3:45 p.m. – **Four Concurrent Technical Sessions**

Session 1 - Sand Key
CO_2 Capture, Storage & Reuse I
Dave Hopkinson, National Energy Technology Laboratory, U.S. Department of Energy, and Victor Kusuma, Battelle

Session 2 - Gulf Room
Grid Stability
Dr. Ronald Breault, National Energy Technology Laboratory, U.S. Department of Energy

Session 3 - Palm Room
Oxy-Combustion I
Prof. Terry Wall, University of Newcastle, Australia & Klas Andersson, Chalmers University, Sweden

Session 4 - Beach Room
Coal Upgrading for Value Added Products
Gerardine Botte, Ohio University

5:30 p.m. **Beach Party** *(Poolside, Weather Permitting)*

Tuesday, June 18th

7:30 a.m. **Continental Breakfast in the Exhibit Center**

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

Session 5 - Sand Key Room
Advances in Analytical and Testing Techniques
Dave Osborne, Somerset Coal, Australia

Session 6 - Modeling
Dr. Edmundo Vasquez
Clean Energy Technologies

Session 7 - Palm Room
Data Analytics and Advanced Control Strategies I
Larry Shadle, National Energy Technology Laboratory, U.S. Department of Energy

Session 8 - Bay Room
Gasification for Power & Chemicals I
Dr. Massood Ramezan, KeyLogic and Kunlei Liu, University of Kentucky

10:00 a.m. Break – Exhibit Center

10:30 a.m. – Plenary: The Legacy of Prof. Janos M. Beer, Massachusetts Institute of Technology
Dr. Ashwani Gupta, University of Maryland

12:10 p.m. – **Lunch – Exhibit Center**

1:30 p.m. – **Panel: Waste To Energy**
Chair: *Dr. Ashwani Gupta*
University of Maryland

3:30 p.m. – **Break – Exhibit Center**

4:00 p.m. **Four Concurrent Technical Sessions**

Session 9 - Sand Key Room
Radiation
Brad Adams, Brigham Young University

Session 10 - Gulf Room
CO_2 Capture, Storage & Reuse II
Dave Hopkinson, National Energy Technology Laboratory, U.S. Department of Energy, and Victor Kusuma, Battelle

Session 11 - Palm Room
Advanced Cycles for Power Generation
Horst Hack, EPRI

Session 12 - Bay Room
Data Analytics and Advanced Control Strategies II
Dr. Ronald Breault, National Energy Technology Laboratory, U.S. Department of Energy

Wednesday, June 19th

7:30 a.m. **Continental Breakfast in the Exhibit Center**

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

Session 13 - Sand Key Room
Recovery of Rare Earth Minerals
Eric Eddings, University of Utah

Session 14 - Gulf Room
Biomass & Biomass Cofiring I
Les Marshall
Ontario Power Generation, Canada

Session 15 - Palm Room
Chemical Looping I
JoAnn Lighty, Boise State University

Session 16 - Bay Room
Combustion & Gasification I
Ashwani Gupta, University of Maryland and Weihong Yang, KTH Royal Institute of Technology, Sweden

10:00 a.m. – Break – Exhibit Center

Wednesday, June 19th (cont'd)

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

Session 17 - Sand Key Room
Energy From Waste
Alan Paschedag, Covanta

Session 18 - Gulf Room
Combustion Emissions
Dr. Edmundo Vasquez, Clean Energy Technologies and Byron Burrows, TECO

Session 19 - Palm Room
Chemical Looping II
Robert Stevens, National Energy Technology Laboratory, U.S. Department of Energy and Andrew Tong, Ohio State

Session 20 - Beach Room
PC Fired Units
J.J. Letcavits, AEP

11:50 a.m. – Themed Luncheon in the Exhibit Center

1:30 p.m. Two Concurrent Panels –

Treating and Recovering Value from Mineral Residues
Dave Osborne, Somerset Coal, Australia

Emissions: The Current Status
Chair: Dr. Edmundo Vasquez
Clean Energy Technologies

3:30 p.m. – Break in the Exhibit Center

4:00 p.m. – Four Concurrent Technical Sessions

Session 21 - Sand Key Room
Oxy-Combustion II
Prof. Terry Wall, University of Newcastle, Australia and Klas Andersson, Chalmers University, Sweden

Session 22 - Gulf Room
Supercritical CO_2
Suhyeon Park, University of Central Florida and Josh Stanislowski, UNDEERC

Session 23 - Palm Room
Fuels Production
Dushyant Shekhawat, National Energy Technology Laboratory, U.S. Department of Energy

Session 24 - Bay Room
Combustion & Gasification II
J.J. Letcavits, AEP &
Alan Paschedag, Covanta

5:45 p.m. – Conference Committee Meeting – Sand Key Room

Thursday, June 20th

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

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

Session 25 - Sand Key Room
Advanced Benefication
Dave Osborne, Somerset Coal, Australia

Session 26 - Gulf Room
Data Analytics and Advanced Control Strategies III
Dr. Ronald Breault, National Energy Technology Laboratory, U.S. Department of Energy

Session 27 - Palm Room
Alternative Fuels for Gas Turbines
Dr. Ashwani Gupta, University of Maryland

Session 28 - Bay Room
Gasification for Power & Chemicals II
Dr. Massood Ramezan, KeyLogic and Kunlei Liu, University of Kentucky

9:40 a.m. – Break – Island Ballroom

Thursday, June 20th (cont'd)

10:10 a.m. – Four Concurrent Technical Sessions

Session 29 - Sand Key Room
Biomass & Biomass Cofiring II
Les Marshall
Ontario Power Generation, Canada

Session 30 - Gulf Room
Novel Design for Advanced Unit Operations
Dave Lyons, National Energy Technology Laboratory, U.S. Department of Energy

Session 31 - Palm Room
Upgrading Natural Gas
Evan Granite, National Energy Technology Laboratory, U.S. Department of Energy

Session 32 - Bay Room
Fluidized Bed Units
Fredrik Lind, Chalmers University, Sweden

11:30 a.m. – Lunch in the Island Ballroom – Presentation of the Best Student Paper Award and Roundtable Wrap-up Discussion – *Bring your ideas and suggestions for next year's conference.*

Friday, June 21st

6:30 a.m. Continental Breakfast in Lobby 2 for Polk Power Plant and Covanta Tour Participants

7:00 a.m. – Departure of Polk and Covanta Tours

7:30 a.m. – Conference Committee Chairs Meeting

THE CLEARWATER CLEAN ENERGY CONFERENCE

SUNDAY – June 16, 2019

Short Courses – To provide our attendees the latest in technological advances, we've invited industry experts to offer two-hour Short Courses intended to give an overview or specific details on topics of greatest interest to the industry. This year we are pleased to offer:

9:00 – 11:00 a.m. – **Fundamental Experiments and Modeling for Direct-Fired Supercritical CO_2 Combustion**
Prof. Subith Vasu, Center for Advanced Turbomachinery and Energy Research (CATER), University of Central Florida

This short course will present fundamentals and review of recent efforts in the development and validation of a combustion chemical kinetic mechanism for sCO_2 oxy-methane/syngas combustion that can be used for computational fluid dynamic code (CFD) simulations in sCO_2 oxy-combustion development. Typical gas-phase combustion models for fuels (methane, syngas, etc.) have been validated for gas turbine conditions – pressures below 40 atm and in fuel/air combustion - and cannot be extended to the operating conditions of sCO_2 combustors such as, those used in Allam cycle. Recent sCO_2 models are created by incorporating real gas and solvent effects on combustion process using quantum chemical and molecular dynamic investigations. Validation is carried out using unique experiments conducted in CO_2 diluted methane/syngas mixtures and for pressures up to 300 bar. Acquiring experimental data is critical in the development of a sCO_2 detailed kinetic mechanism as there was previously none available for methane at very high pressures near 300 bar (for Allam cycle) and for CO_2 diluted methane mixtures even at normal pressures. Challenges with coupling the mechanism to combustion CFD codes will be discussed. Such codes enable us to study a variety of topics regarding direct-fired sCO_2 oxy-methane/syngas combustors and will be highly valuable and accurate tool for computer design optimization of next generation sCO_2 combustors.

11:15 a.m. – 1:15 p.m. – **Combustion Tuning: Why and How**
Alan Paschedag, Covanta, Inc., and J.J. Letcavits, American Electric Power

The process of combustion tuning is on the surface very simple. However, without an understanding of what makes combustion tick and what preparations must be made in advance, the results will not be ideal. A tour through combustion principles and what settings, adjustments, pre-planning, and fuel sourcing can do to optimize burner tuning.

1:30 p.m. – 3:30 p.m. – **Catalysts and Sorbents for Pollution Control**
Evan Granite, National Energy Technology Laboratory, U.S. Department of Energy

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.

3:45 p.m. – 5:45 p.m. – **1:30 p.m. – 3:30 p.m. – Combustion Fundamentals**
Prof. Ashwani K, Gupta, University of Maryland

This Short Course will cover fundamental aspects of combustion, including fuels and their fundamental properties, stoichiometric balances, adiabatic flame temperature calculations, flame stability and pollutants formation and mitigation. No prior knowledge on the subject will be assumed so that this tutorial will be very fitting to students and users of combustion devices in industry.

3:00 p.m. – Exhibit Center Setup in the Island Ballroom

MONDAY – June 17, 2019	
8:30 a.m.	**Continental Breakfast in the Exhibit Center – Exhibit Center**
9:00 a.m.	**Morning Keynote Address & Panel**

	Keynote Speaker: *Dr. Randall W. Gentry, Chief Research Officer and Deputy Director, Science & Technology, Strategic Plans & Programs National Energy Technology Laboratory, U.S. Department of Energy* Panel**: Commercialization of R&D Technologies** *Chair: Dr. Massood Ramezan, KeyLogic* • *Dr. Randy Gentry, Chief Research Officer and Deputy Director, Science & Technology, National Energy Technology Laboratory, U.S. Department of Energy* • *Dr. Girish Srinivas, TDA Research Inc., **USA*** • *Dr. James C. Fisher, Somerset Coal, **USA*** • *Josh Stanislowski, Energy & Environmental Research Center, University of North Dakota, **USA*** • *William W. Follett, Program Manager, GTI (Gas Technology Institute)*
11:30 a.m.	**Lunch in the Exhibit Center**
12:45 p.m.	**Afternoon Keynote Address & Panel** **Keynote Speaker**: *Robert Bessette, Council of Industrial Boil Operators* **Panel: Impact of Renewables on Grid Stabilization** *Chair: Dr. Ronald Breault, National Energy Technology Laboratory, U.S. Department of Energy* • *Robert Hovsapian, Idaho National Laboratory, U.S. Department of Energy* • *Tom Tarka, National Energy Technology Laboratory, U.S. Department of Energy* • *Andrew Maxson, Electric Power Research Institute* • *Rick Kephart, Emerson* • *Martin Gascon, Intertek* • *Brian Vitalis, Babcock Power Inc.* • *Gregg Augspurger, Duke Energy*
3:15 p.m. **Break in the Exhibit Center**	

3:45 p.m.	**Four Concurrent Technical Sessions**			
	Session 1 **Palm Room** **CO_2 Capture, Storage & Reuse I** *Dave Hopkinson, National Energy Technology Laboratory, U.S. Department of Energy, and Victor Kusuma, Battelle*	**Session 2** **Gulf Room** **Grid Stability** *Dr. Ronald Breault National Energy Technology Laboratory, U.S. Department of Energy*	**Session 3** **Palm Room** **Oxy-Combustion I** *Prof. Terry Wall, University of Newcastle, Australia & Klas Andersson, Chalmers University, Sweden*	**Session 4** **Beach Room** **Coal Upgrading for Value Added Products** *Gerardine Botte, Ohio University*
3:45 p.m.	**108. Pilot Testing of Amine-Based Solvent at a Low-Rank Coal-Fired Power System** *Jason D. Laumb, John P. Kay, David J. Dunham, Bruce C. Folkedahl, University of North Dakota, Energy & Environmental Research Center; Tim Thomas, Mike Fowler, and Osamu Miyamoto, Mitsubishi Heavy Industries America Inc.* ***USA****; and Keisuke Iwakura, Tatsuya Tsujiuchi, Takashi Kamijo, Mitsubishi Heavy Industries, Ltd.,* ***JAPAN***	**97. Leveraging National Laboratory Assets to Address Stability Challenges due to Declining Grid Inertia Using Geographically Distributed Electrical-Thermal Co-Emulation** *R. Hovsapian, M. Panwar, J. D. Osorio, M. Mohanpurkar, Idaho National Laboratory; and D. Maloney, National Energy Technology Laboratory, U.S. Department of Energy,* ***USA***	34. **Investigation on Combustion Characteristics of 0.1MWth Pressurized Oxy-fuel Combustion System Using Gaseous Fuel** *Donghee Kim (Department of Mechanical Engineering, Pohang University of Science and Technology), Hyungjun Ahn, Won Yang, and Youngjae Lee, Thermochemical Energy System, Korea Institute of Industrial Technology,* ***KOREA***	33. **Z-path Moving Bed Pyrolysis for Low-Rank Coal Upgrading** *Qi Zhou, Yu Zhang, Xiaoyan Bai, Xianfeng Pei, Yang Zhang, Yan Wang, Beijing Research Institute of Coal Chemistry, China Coal Research Institute, State Key Laboratory of Coal Mining and Clean Utilization, National Energy Technology and Equipment Laboratory of Coal Utilization and Emission Control,* ***CHINA***
4:05 p.m.	**119. Status of Technology Development at the National Carbon Capture Center** *Doug McCarty, NCCC Process and Design Engineering Manager, Southern Company,* ***USA***	**124. Addressing Challenges of Flexible Operations through Controls and Automation Research** *Steven Seachman and Susan Maley, Electric Power Research Institute and Don Parker, Provecta Process Automation,* ***USA***	**36. Analytical Study of Pressurized Oxy-combustion Power Plant for Efficiency Increase and Heat Recovery** *Geun Yeong Park, Yong Woon Lee, Won Yang, Korea Institute of Industrial Technology, and Chemical and Biomolecular Engineering, Yonsei*	**106. U.S. Commercial Service – Exports of Coal and Coal Related Products – A Detailed "How To"** *William S. Lawton, U.S. Export Assistance Center, U.S. Commercial Service, International Trade Administration, U.S. Department of Commerce,* ***USA***

			*University, **KOREA***	
4:25 p.m.	**120. Automated Lab-Scale Membrane Testing at the National Carbon Capture Center: An Update** *Victor A Kusuma, Sameh Elsaidi, Ali K Sekizkardes, Lingxiang Zhu, and David Hopkinson, National Energy Technology Laboratory, U.S. Department of Energy, **USA***	**147. Duke Energy Flexible Operations Project** *Gregg Augspurger and Stephen Dean, Duke Energy, **USA***	**75. Advancing Pressurized Oxy-Coal Combustion for Power Generation: BYU Program Update** *Andrew Fry, Brigham Young University, USA*	**40. Preparing Metallurgical Coal for Use in the Manufacture of Carbon Fibres** *Rohan Stanger, Quang Anh Tran, John Lucas, Minoo Naebe, Graeme Jamison, and Terry Wall, Department of Chemical Engineering, University of Newcastle, **AUSTRALIA switch 46***
4:45p.m.	**123. Pilot scale Testing of Four Physical Solvents for Precombustion CO_2 Capture** *Nicholas Siefert, Michael Swanson, Joshua Stanislowski, Wei Shi, Robert Thompson, and David Hopkinson, National Energy Technology Laboratory, U.S. Department of Energy, **USA***	**150. Boiler & AQCS Load Cycling and Low Load Operation** *Brian Vitalis, Jason Lee, and Kevin Toupin, Riley Power Inc. (a Babcock Power Inc. Company), **USA***	**73. Integrated SO_x and NO_x Removal from Flue Gas with Simultaneous Moisture Latent Heat Recovery in Pressurized Oxy-Combustion Processes** *Piyush Verma, David Stokie, Benjamin Kumfer, Young-shin Jun, Gregory Yablonsky, Richard L. Axelbaum, Washington University in St. Louis, **USA***	**90. Production of Mesophase Pitch from Coal for Carbon Fiber Production** *Joshua Malzahn, Ignacio Preciado, Ding Wang, and Eric Eddings, Department of Chemical Engineering, University of Utah; and Matt Weisenberger, Center for Applied Energy Research, University of Kentucky, **USA***
5:05 p.m.	**107. Developing Tandem Catalysts for CO_2 Hydrogenation to Olefins** *Marc D. Porosoff, University of Rochester, **USA***	**126. Grid Impacts of Intermittent Resources at Scale** *Peter Balash, Ken Kern, John Brewer, National Energy Technology Laboratory, U.S. Department of Energy, **USA** **(Tom Tarka – presenting)***	**144. Sub-micron Ash Aerosol Formation in Oxy-coal Combustion at Atmospheric and Elevated Pressures** *Andrew Chiodo, Reaction Engineering International; and Jost O. L. Wendt, Yueming Wang and Xiaolong Li, University of Utah, **USA***	**110. Preparation of Activated Carbon Nanofibers by Degradative Solvent Extraction Product from Low-rank Coal and the Utilization for Supercapacitors** *Weixiang Qian, Chao Wu, Xu Zhang, Xianqing Zhu, Guangqian Luo, Huan Liu, Hongyun Hu, Hong Yao, Xian Li (Key Laboratory of Coal Clean Conversion and Chemical Process*

				Autonomous Region, College of Chemistry and Chemical Engineering, Xinjiang University), State Key Laboratory of Coal Combustion, School of Energy and Power Engineering, Huazhong University of Science and Technology, ***CHINA***
5:30 p.m. Beach Party – Weather Permitting: Poolside (or in the Exhibit Center)				

TUESDAY Morning – June 18, 2019				
7:30 a.m. **Continental Breakfast in the Exhibit Center**				
8:00 a.m. **Four Concurrent Technical Sessions**				
	Session 5 **Sand Key Room** **Advances in Analytical and Testing Techniques** *Dave Osborne* *Somerset Coal, Australia*	**Session 6** **Modeling** *Dr. Edmundo Vasquez* *Clean Energy Technologies*	**Session 7** **Palm Room** **Data Analytics and Advanced Control Strategies I** *Larry Shadle, National Energy Technology Laboratory, U.S. Department of Energy*	**Session 8** **Bay Room** **Gasification for Power & Chemicals I** *Dr. Massood Ramezan, KeyLogic and Kunlei Liu, University of Kentucky*
8:00 a.m.	**41. Understanding Coal Thermoplasticity Using High Range Molecular Spectrometry** *Rohan Stanger, Quang Anh Tran, John Lucas, and Terry Wall, Department of Chemical Engineering, University of Newcastle,* ***AUSTRALIA***	**113. Overview of DOE's Institute for the Design of Advanced Energy Systems** *D.C. Miller and A. Burgard, National Energy Technology Laboratory, U.S. Department of Energy; J. Siirola, Sandia National Laboratory; D. Agarwal, Lawrence Berkeley National Laboratory; L. Biegler, Carnegie Mellon University; and D. Bhattacharyya, West Virginia University,* ***USA***	**9. Optimizing Homogenization to Reduce Negative Environmental Impact of Coal Processing** *Michael P. Cipold (Karlsruhe Institute of Technology and J&C Bachmann GmbH), Dr. Pradyumn K. Shukla, Karlsruhe Institute of Technology; Dr. Claus C. Bachmann, J&C Bachmann GmbH,* ***GERMANY***	**26. Economic Viability and Optimal Scheduling of Polygeneration Plants in Germany** *Sebastian Miehling Alexander Buttler, Hartmut Spliethoff (Bavarian Center for Applied Energy Research), Institute for Energy Systems, Technical University of Munich,* ***GERMANY*****
8:20 a.m.	**42. Development of a Low Cost Optical Method for Inline Washability Monitoring of Fine Coal** *Rohan Stanger, Quang Anh Tran, Terry Wall, Dave Osbourne, Peter Stepien, Clint Bruin, Department of Chemical Engineering, University of Newcastle,*	**114. Advanced Modeling and Optimization to Support the Existing Fleet** *M. Zamarripa, T. Burgard, and J. Eslick, National Energy Technology Laboratory, U.S. Department of Energy; D. Bhattacharyya, West Virginia University; and B. Nicholson, and J. Siirola, Sandia National*	**50. Development of Real Time System Identification to Characterize Changes in a Gas Turbine during Transient Operations** *Lawrence Shadle, and David Tucker, National Energy Technology Laboratory, U.S. Department of Energy; and Kenneth M. Bryden, Paolo*	**14. Field Test of a Poison Resistant Sour Water Gas Shift Catalyst** *Girish Srinivas, Steve Schwab, Brian B. Gebhard, and Steven C. Gebhard, P.E., TDA Research Inc.,* ***USA***

	AUSTRALIA	*Laboratory,* ***USA***	*Pezzini, and Harry Bonilla, Ames Laboratory, Iowa State University,* ***USA***	
8:40 a.m.	**135. Robust Online Temperature Estimation of a Membrane-Wall Gasifier** *Jianliang Xu, Guangsuo Yu, Haifeng Liu, Key Laboratory of Coal Gasification and Energy Chemical Engineering of Ministry of Education, East China University of Science and Technology, and Shanghai Engineering Research Center of Coal Gasification, East China University of Science and Technology,* ***CHINA***	**115. Design and Optimization of Coal Plants of the Future** *J. Ghouse, C. Okoli, and M. Zamarripa, National Energy Technology Laboratory, U.S. Department of Energy; C. Laird and J. Siirola, Sandia National Laboratory; I. Grossmann, and L. Biegler, Carnegie Mellon University; and D. Bhattacharyya, West Virginia University,* ***USA***	**51. Dynamic Real-time Optimization of a Coal Fired Power Plant Using an Artificial Neural Network Model** *Kody Powell, University of Utah; and Seyed Mostafa Safdarnejad,* ***USA***	**7. Dry Solids Pump - Full-scale Testing at 500 psi and Techno-Economic Evaluation when Installed in a Quench Gasifier** *Timothy Saunders and Joseph Caravella, Gas Technology Institute; Greg Weber, Energy & Environmental Research Center, University of North Dakota,* ***USA****; and Christopher Higman, Higman Consulting,* ***UNITED KINGDOM***
9:00 a.m.	**17. The Influence of Alkali, Chlorine and Sulfur on Aerosol Formation** *Thomas Allgurén, Dan Gall, Klas Andersson, Department of Space Earth & Environment, Chalmers University of Technology,* ***SWEDEN****; and Yueming Wang, Xiaolong Li, Jost O. L. Went, Department of Chemical Engineering, University of Utah,* ***USA***	**134. Computation Accelerated Design of Advanced Materials for Novel Energy Applications** *Yifei Mo, Department of Materials Science and Engineering, University of Maryland,* ***USA***	**52. Testing of Hybrid Renewable Energy System Load Cycling in a Recuperated Gas Turbine** *Taylor Meyer, Daniel J. Maloney, and David A. Tucker, National Energy Technology Laboratory, U.S. Department of Energy; and Kenneth M. Bryden and Harry Bonilla, Ames Laboratory, Iowa State University,* ***USA***	**45. Progress on Opposed Multi-Burner (OMB) Coal-Water Slurry Gasification Technology and Its Industrial Applications** *Guangsuo Yu, Qinghua Guo, Yan Gong, Jianliang Xu, Yifei Wang, Xueli Chen and Fuchen Wang, East China University of Science and Technology,* ***CHINA***
9:20 a.m.	**149. Laser Induced Breakdown Spectroscopy (LIBS): A Potential Technology for Online Process Monitoring of Rare Earth Element (REE) Recovery**	**145. Modeling of the Coal Particle Behavior in an Ultra-Supercritical Boiler with Large Eddy Simulation** *Haoshu Shen, Yuxin Wu, Hai Zhang, Yang Zhang, Guangxi*	**53. Development of a Reinforcement Learning-Based Control Strategy for Load Following in Supercritical Pulverized Coal (SCPC) Power Plants** *Elijah Hedrick, Katherine*	44. **Effect of High Temperature Process on the Morphology Structure Evolution of Coal Char Particles under N_2 or CO_2 Atmosphere** *QinghuaGuo, ZhiqingZhang,*

	Jinesh Jain, Daniel Hartzler, Chet Bhatt, and Dustin McIntyre, National Energy Technology Laboratory, U.S. Department of Energy, ***USA***	*Yue, Key Laboratory for Thermal Science and Power Engineering of Ministry Education, Department of Energy and Power Engineering, Tsinghua University,* ***CHINA*********	*Reynolds, Parikshit Sarda, Stephen E. Zitney, and Benjamin Omell, and Debangsu Bhattacharyya, West Virginia University,* ***USA***	*Yan Gong, Guangsuo Yu, Yifei Wang, and Fuchen Wang, East China University of Science and Technology,* ***CHINA***
9:40 a.m.	**104. Optimal Operation of a Gas-fired CHP Plant on the Energy Market** *Janusz Lichota, Wrocław University of Technology,* ***POLAND***	**59. Effect of Scale on CFB Riser Dynamics** *Ronald Breault and Justin Weber, National Energy Technology Laboratory, U.S. Department of Energy; and Steve Rowan and Jingsi Yang, ORISE,* ***USA***	**54. Condition Based Monitoring and Predicting Ash Behavior in Coal Fired Boilers - II - Coal Properties Optimization** *Shuchita Patwardhan, David Stadem, Matt Fuka, and Steve Benson, Microbeam,* ***USA***	**39. Investigations on Crystallisation Processes of Three Oxidic Gasifier Slag Systems** *Jan Peter Schupsky, and Michael Müller, Institute of Energy and Climate Research – IEK 2, Forschungszentrum Jülich GmbH,* ***GERMANY***
10:00 a.m. Break in the Exhibit Center				

** Participant in the Best Student Paper Award

10:30 a.m. – Plenary Presentation: The Legacy of Prof. Janos M. Beer, Massachusetts Institute of Technology
Chair: *Prof. Ashwani Gupta, University of Maryland,* ***USA***
- *Prof.-Dr.-Ing. Klaus R. G. Hein,* ***Germany***
- *Prof. Hai Zhang, Department of Thermal Engineering, Tsinghua University,* ***China***
- *Angelos Kokkinos, U.S. Department of Energy,* ***USA***
- *Prof. Terry Wall, University of Newcastle,* ***Australia***

On December 8, 2018, one of the most distinguished leaders in the industry and in our conference passed away peacefully. Prof. Beer was instrumental in keeping our conference in the forefront of energy issues and in guiding us in the best way to proceed and the topics that we needed to cover. Prof. Beer's life had him participating in the major events in world history: he fought the Nazis (As a brave young man, he worked extensively with the Swedish humanitarian Raoul Wallenberg in November and December of 1944 that protected many Hungarian Jews from being deported to the Auschwitz-Birkenau death camp). He studied the violin at the famous Franz Liszt Academy of Music. After the war instead of pursuing a career in music, he studied engineering at the Technical University of Budapest. While there he became a world class rower. He was a Hungarian Freedom Fighter, and he and Marta had to flee Hungary in 1956. He first worked as an engineer at Babcock & Wilcox in U.K. where Prof. Meredith Thring of Sheffield University noticed him and convinced him to come to Sheffield. From there his career thrived. We plan to review his work and hear from colleagues and students from all over the world.

TUESDAY Afternoon – June 18, 2019				
12:10 p.m.	**Lunch – Exhibit Center**			
1:30 p.m.	**Plenary Session Panel**			
Waste To Energy **Chair:** *Dr. Ashwani Gupta, University of Maryland* • *Alan Paschedag, Covanta* • *Dr. Marco Castaldi, The City College of New York* • *Dr. Hang Seok Choi and Dr. Yong-Chil Seo, Yonsei University,* ***Korea*** • *Dr. Timothy G. Townsend, University of Florida* • *Dr. Halina Pawlak-Kruczek Wroclaw University of Technology,* ***Poland*** • *Pramodh Nijhawan, Industrial Accessories Company* • *Prof. Yuxin Wu, Department of Thermal Engineering, Tsinghua University,* ***China***				
3:30 p.m. **Four Concurrent Technical Sessions**				
4:00 p.m.	**Session 9** **Sand Key Room** **Radiation** *Brad Adams* *Brigham Young University*	**Session 10** **Gulf Room** **CO_2 Capture, Storage & Reuse II** *Dave Hopkinson, National Energy Technology Laboratory, U.S. Department of Energy, and Victor Kusuma, Battelle*	**Session 11** **Palm Room** **Advanced Cycles for Power Generation** *Horst Hack* *Electric Power Research Institute*	**Session 12** **Bay Room** **Data Analytics and Advanced Control Strategies II** *Dr. Ronald Breault, National Energy Technology Laboratory, U.S. Department of Energy*
4:00 p.m.	**23. Characterizing Flame Stability and Radiative Heat Transfer in Oxy-Coal Flames** *Gautham Krishnamoorthy, Department of Chemical Engineering, University of North Dakota,* ***USA***	**15. CO_2 as a Geological Working Fluid: Enhancing Oil Recovery from Unconventional Resources** *Jared P. Ciferno, Technology Manager, Onshore Oil & Gas, U.S. Department of Energy, National Energy Technology Laboratory (NETL*), **USA**	**55. Advanced Ultra-supercritical (AUSC) Component Testing** *Horst Hack, Electric Power Research Institute,* ***USA***	**117. Dynamic Model-Based Digital Twin Technology for Flexible Power Plant Operations and Control** *Stephen E. Zitney, National Energy Technology Laboratory, U.S. Department of Energy, and Debangsu Bhattacharyya, Department of Chemical and Biomedical Engineering, West Virginia University,* ***USA***
4:20 p.m.	**77. Radiation Calculations**	**25. Developing a High**	**56. Evaluation of Steam**	**129. Early Detection of**

	with a Dimensionally Adaptive Mesh *Bradley R. Adams, and Todd A. Williams, Dept. of Mechanical Engineering, Brigham Young University,* ***USA***	**Fidelity Computational Fluid Dynamics Model for CO_2 Separation by Adsorption on 13X Zeolite** *Subhodeep Banerjee, Rupendranath Panday, Greggory Breault, Cheng Li, William A. Rogers, National Energy Technology Laboratory, U.S. Department of Energy,* ***USA***	**Cycle Upgrades to Improve the Competitiveness of U.S. Coal Power Plants** *Horst Hack, Electric Power Research Institute, Inc.,* ***USA***	**Vertical Pit Pump Failure Using Advanced Pattern Recognition Modeling and Condition Monitoring Techniques** *Kelly Whittenberg, Black and Veatch and Jeremy Cole, Wisconsin Public Service,* ***USA***
4:40 p.m.	**78. A Comparison of Heat Transfer Measurements between Pulverized-coal and 85% coal/15% Biomass Co-firing Combustion in a 1.5 MW Pilot-scale Furnace** *Teri Draper, Kaitlyn Scheib, Eric Eddings, and Terry Ring, Department of Chemical Engineering, University of Utah; Stan Harding, Michal Hradisky, Marc Backman, and Jennifer Spinti, Institute for Clean and Secure Energy, University of Utah; Andrew Fry, Department of Chemical Engineering, Brigham Young University,* ***USA****; Adrian Gunnarsson, and Klas Andersson, Department of Space, Earth and Environment, Energy Technology, Chalmers University,* ***SWEDEN***	**57. CCUS Research and Technology Demonstration Projects Program Update** *Andrew Hlasko, U.S. Department of Energy,* ***USA***	**96. Hydrogen Enrichment for a Solid Oxide Fuel Cell/Gas Turbine (SOFC/GT) Hybrid Power Generation System Using Mechanical Gas Separation** *John VanOsdol, Dave Tucker, and Larry Shadle, National Energy Technology Laboratory, U.S. Department of Energy,* ***USA***	**125. Predicting Power Plant Equipment Life Using Machine Learning** *Martin Gascon, Nikhil Kumar and Rana Ghosh, Intertek* ***USA***
5:00 p.m.	**158. Radiative Heat Transfer Modeling in**	**91. Effect of Temperature on the Geological**	**128. Evaluating AUSC New Build and Retrofit Options**	**143. Process Failure Detection via Recurrence**

	Pressurized Oxy-fuel Combustion Systems *Pan Du, Zhiwei Yang, and Richard L. Axelbaum, Department of Energy, Environmental & Chemical Engineering, Consortium for Clean Coal Utilization, Washington University in St. Louis,* ***USA***	**Sequestration of CO_2 in a Layered Carbonate Formation** *R. Kumar, S. W. Campbell, Department of Chemical and Biomedical Engineering, and J. A. Cunningham, Department of Civil and Environmental Engineering, University of South Florida,* ***USA****	**for Existing Coal Plants** *Travis Shultz, Walther Shelton, National Energy Technology Laboratory, U.S. Department of Energy; Eric Lewis, and Dale Keairns, Deloitte Consulting; Mark Woods, Richard Newby, and Charles White, Key Logic; Marc Turner, David Gray and John Plunkett (Retired), Leidos,* ***USA***	**Quantification Analysis** *Steven L. Rowan, ORISE,* ***USA****, Ronald W. Breault, National Energy Technology Laboratory; and Narasimhan Soundarrajan, REM Engineering Services LLC,* ***USA***
5:20 p.m.	**159. Heat Transfer Modelling of Industrial Rotary Kilns for Iron Ore Pelletizing** *Adrian Gunnarson and Klas Andersson, Chalmers University,* ***SWEDEN****; and Bradley Adams, Brigham Young University,* ***USA***	**109. Integration of a Full Scale Carbon Capture System with a 470 MW Lignite Fired Power Plant** *Josh Stanislowski, University of North Dakota, Energy & Environmental Research Center,* ***USA***	**133. Thermodynamic Analysis of A Novel Solar Hybrid System Incorporating Methane steam Reforming and A Recuperative Direct-fired Supercritical Carbon Dioxide Cycle** *Tuantuan Xin, Cheng Xu, Shaokui Li, Wenyi Liu, Heng Chen and Yongping Yang, National Thermal Power Engineering and Technology Research Center, North China Electric Power University,* ***CHINA****	**157. Applied Artificial Intelligence for Energy** *Ben Bishop, Siemens,* **USA**

** Participant in the Best Student Paper Award

WEDNESDAY MORNING – June 19, 2019				
7:30 a.m. **Continental Breakfast in the Exhibit Center**				
8:00 a.m. **Four Concurrent Technical Sessions**				
	Session 13 **Sand Key Room** **Recovery of Rare Earth Elements** *Prof. Eric Eddings* *University of Utah*	**Session 14** **Gulf Room** **Biomass & Biomass Cofiring I** *Les Marshall, Ontario Power Generation, Canada*	**Session 15** **Palm Room** **Chemical Looping I** *JoAnn Lighty* *Boise State University*	**Session 16** **Bay Room** **Combustion & Gasification I** *Ashwani Gupta, University of Maryland and Weihong Yang, KTH Royal Institute of Technology, Sweden*
8:00 a.m.	**61. Electrochemical Extraction of Rare Earth Metals from Coal and Coal By-Products** *Behnaz Jafari, Alamgir M. Haque, Xiang Lyu, and Gerardine G. Botte, Center for Electrochemical Engineering Research, Department of Chemical and Biomolecular Engineering, Russ College of Engineering and Technology, Ohio University,* ***USA***	**170. Effect of Acid Leaching on Ash Removal of Biomass and Its Production Property During Pyrolysis** *Weina Liu, The Clean Air and Energy Efficiency Laboratory of Shenwu,* ***CHINA****; and Emma Li, The Harker School,* ***USA***	**13. Application of 50 kWth Coal-Fueled Chemical Looping Combustion System using Multi-Functional Bauxite Oxygen Carriers** *Liang Kong, Zhen Fan, Jonathan Pelgen, Heather S. Nikolic, and Kunlei Liu (Department of Mechanical Engineering), Center for Applied Energy Research, University of Kentucky,* ***USA***	**28. Determination of the Intrinsic Gasification Kinetics of Bituminous Coal including Product Inhibition and Char Deactivation under Entrained Flow Conditions** *Tobias Netter, Andreas Geißler, Prof. H. Spliethoff (Bavarian Center for Applied Energy Research), Institute for Energy Systems, Technical University of Munich,* ***GERMANY*****
8:20 a.m.	**112. Determination and Recovery of Rare Earths from Coal Combustion By-Products** *Evan Granite, Elliot Roth, National Energy Technology Laboratory, U.S. Department of Energy; and Ken Ludwig, Electric Power Research Institute,* ***USA***	**18. NO Formation during Co-Combustion of Coal with Two Thermally Treated Biomasses** *Thomas Allgurén, Rikard Edland, Klas Andersson, Fredrik Normann, Department of Space Earth & Environment, Chalmers University of Technology,* ***SWEDEN****; Andrew Fry, Department of Chemical*	**37. An Overview of Microstructural Changes Occurring in a NETL Developed Cu/Fe Spinel Oxygen Carrier During Chemical Looping Redox Cycling Using a Real Time CSLM Technique** *Anna Nakano, Jinichiro Nakano (DOE NETL/Leidos Research Support Team), and*	**29. A Reduced Order Model for Simulating Entrained Flow Gasifiers and Its Extended Utilization for Pre- and Post-Processing** *M. Hartwich and B. Meyer, Energy Process Engineering and Thermal Waste Treatment, TU Bergakademie Freiberg; and A. Richter, CIC Virtuhcon, TU Bergakademie*

		Engineering, Brigham Young University, ***USA***	*James Bennett, U.S. Department of Energy National Energy Technology Laboratory,* ***USA***	*Freiber,* ***GERMANY***
8:40 a.m.	**161. Rare Earth Elements and Critical Materials Recovery from Coal-Based Resources** *Mary Anne Alvin, REE Technology Manager, National Energy Technology Laboratory, U.S. Department of Energy,* ***USA***	**35. Development of Measuring Method of Grindability by Mixing Ratio with Coal and Biomass** *YongWoon Lee, and Won Yang, Thermochemical Energy System R&D Group, Korea Institute of Industrial Technology,* ***KOREA***	**58. Effects of Fuel Type and Temperature on the Attrition of Hematite Ore for Chemical Looping** *Nathan Galinsky (Oak Ridge Institute for Science and Education), Samuel Bayham, and Ronald Breault, National Energy Technology Laboratory,* ***USA***	**22. Characteristic Comparison of CO_2-assisted Co-gasification and Co-pyrolysis Using Waste Tire and Pine Bark Mixture** *Zhiwei Wang, K. G. Burra, A. K. Gupta, The Combustion Laboratory, Department of Mechanical Engineering, University of Maryland,* ***USA***
9:00 a.m.	**155. Rare Earth Elements from Coal and Related Materials: An Overview of NETL's R&D Approach and Portfolio** *Tom Tarka, National Energy Technology Laboratory,* **USA**	**71. Moisture Uptake and Mechanical Stability of Upgraded Biomass for Use in Pulverized Coal Co-firing** *Cristina Jaramillo and Eric Eddings, Department of Chemical Engineering, University of Utah,* ***USA***	**24. Chemical Looping Combustion: An Oxygen Carrier Production Cost Study** *Robert Stevens, U.S. Department of Energy, National Energy Technology Laboratory; Richard Newby, KeyLogic Systems, Inc.; and Dale Keairns, Deloitte Consulting, LLP,* ***USA***	**47. Innovative Fluidized Bed Technologies in Coal to Chemical Processes** *Mao Ye, Tao Zhang, Jinling Zhang, Jibin Zhou, Jing Wang, and Zhongmin Liu, National Engineering Laboratory for MTO, Dalian Institute of Chemical Physics, Chinese Academy of Sciences,* ***CHINA***
9:20 a.m.	**156. Effect of Ca on Extractability of Rare Earth Minerals from Fly Ash** *Ward Burgess, Megan Macala, Catherine Spencer, Bret Howard, Murphy Keller, and Evan Granite, National Energy Technology Laboratory, U.S. Department of Energy,* ***USA***	**74. Comparison of Combustion Performance and Fouling Behavior While Firing a 15 wt% Blend of Prepared Woody Biomass with Coal and Pure Coal in a 1.5 MW Pilot-scale Furnace** *Andrew Fry, Brigham Young University,* ***USA***	**16. Prediction of Performance of a Pilot-Scale Dual Fluidized Bed System for Chemical Looping with Oxygen Uncoupling** *Zachary Reinking, and Kevin J. Whitty, Department of Chemical Engineering, University of Utah; Hong-Shig Shim, Reaction Engineering International; and JoAnn S.*	**80. Praxair Oxygen Transport Membranes for Economical Syngas Production for Chemical Synthesis Applications** *Dr. Lawrence E. Bool, Praxair, Inc.,* ***USA***

			Lighty, College of Mechanical Biomedical Engineering, Boise State University, ***USA***	
9:40 a.m.	**169. Investigation of Rare Earth Element Extraction from North Dakota Coal-Related Feedstocks** *Ryder Shallbetter, Engineer, Institute for Energy Studies, University of North Dakota,* ***USA***	**86. Valorization of Coal and Biomass Co-firing Fly Ash for CO_2 Capture Application** *Prof. Chuanwen Zhao, Dr. Yafei Guo, Dr. Jian Sun, Prof. Ping Lu, Jiangsu Provincial Key Laboratory of Materials Cycling and Pollution Control; School of Energy and Mechanical Engineering, Nanjing Normal University, Bancang Street, Nanjing, Jiangsu,* ***CHINA***	**79. Design and Implementation of a Solid Fuel Fluidized Bed Reactor for Chemical Looping Combustion Studies** *Michael Bobek (Oak Ridge Institute for Science and Education), Samuel Bayham, Ronald Breault, Nattional Energy Technology Laboratory,* ***USA***	**167. Mineral Matter Transformations during Gasification of Petcoke-biomass Blends** *Shubhadeep Banik and Sarma V. Pisupati, John and Willie Leone Family Department of Energy and Mineral Engineering, and EMS Energy Institute, The Pennsylvania State University,* ***USA***
10:00 a.m. – Break in the Exhibit Center				

** Participant in the Best Student Paper Award

WEDNESDAY MORNING – June 19, 2019				
10:30 a.m. – Four Concurrent Technical Sessions				
	Session 17 **Sand Key Room** **Energy From Waste** *Alan Paschedag, Covanta, and Prof. Hang Seok Choi, Yonsei University, Korea*	**Session 18** **Gulf Room** **Combustion Emissions** *Dr. Edmundo Vasquez, Clean Energy Technologies and Byron Burrows, TECO*	**Session 19** **Palm Room** **Chemical Looping II** *Robert Stevens, National Energy Technology Laboratory, U.S. Department of Energy* *Andrew Tong, Ohio State*	**Session 20** **Beach Room** **PC Fired Units** *J.J. Letcavits, AEP*
10:30 a.m.	**8. Conversion of Waste from Gasification Facilities, Refineries, and Steelmaking Plants to H_2 and/or CO** *Jinichiro Nakano, Anna Nakano (DOE NETL/Leidos Research Support Team), and James Bennett, U.S. Department of Energy National Energy Technology Laboratory,* ***USA***	**21. Impact of Flowfield on Pollutants Emission from a Swirl Assisted Distributed Combustor** *Joseph S. Feser, Serhat Karyeyen (Gazi University Department of Energy Systems Engineering, Ankara,* ***TURKEY****) and Ashwani K. Gupta, University of Maryland Department of Mechanical Engineering,* ***USA***	**27. Sustainable Conversion of Carbon Dioxide and Shale Gas to Green Chemicals via Chemical Looping** *Prof. Luke M. Neal, and Professor Fanxing Li, NC State University,* ***USA***	**6. Single Solution That Reduces Power Plants Heat Rates, Emissions, and Operating Costs** *A. Kravets, A. Favale, J. Barba and D. Grace, Veritask Energy Systems, Inc.,* ***USA***
10:50 a.m.	**111. Cofiring of RDF with Coal, Slurry and Biomass in Modern, Flexible and Sustainable CHP on an Example of Fortum Zabrze Project – 203 Mwth CFB with CFB Scrubber** *Michael Gadnor, Sumitomi SHI FW Energiaa Polska,* ***POLAND***	**85. Selenium Migration Characteristics in the Wet Flue Gas Desulfurization Slurry: A Lab-Scale Study** *Renjie Zou, Guangqian Luo, Haoyu Zhang, Mingyu Yu, Yongda Huang), Hongyun Hu, Xian Li, and Hong Yao, State key Laboratory of Coal Combustion, School of Energy and Power Engineering, Huazhong University of Science and Technology,* ***CHINA***	**94. 250 kWt Pilot Testing in Support of a 10 MWe Coal-Direct Chemical Looping Demonstration Feasibility Study** *Thomas J. Flynn, Luis G. Velazquez-Vargas, and Jinhua Bao, The Babcock & Wilcox Company,* ***USA***	**65. Continuous Boiler CO Monitoring for Combustion Optimization and Boiler Efficiency Improvement** *Dave Earley, EES Combustion Technologies and Services, Inc.,* ***USA***
11:10 a.m.	**121. Novel Installation for the Recovery of the**	**136. Techno-Economic Analysis of FGD**	**166. Oxy-PFBC and SCO_2 Cycle Technology Status**	**66. Using Coal Additives for a Fuel Flexibility**

	Agricultural Water from the Digestate *Halina P. Kruczek, Wrocław University of Technology,* ***POLAND***	**Wastewater Treatment Process Options at Existing Plants** *Marc Turner, Leidos; Jessica VanWagoner, KeyLogic; and Mitch Mueller, Danny Rellergert, and Mike Preston, Black & Veatch; Eric Grol, Department of Energy, National Energy Technology Laboratory,* ***USA***	**and Test Results** *William W. Follett, Program Manager, GTI (Gas Technology Institute),* ***USA***	**Program: Getting an Edge in Today's Competitive Market** *Dave Earley and Mark Pastore, EES Combustion Technologies and Services, Inc.,* ***USA***
11:30 a.m.	**122. Energy From Waste: The Path to Power** *Alan Paschedag, Manager, Process Engineering, Covanta,* ***USA***	***69.*** **Treating Effluent Streams at Coal Power Plants Using Membranes** *Nicholas Siefert, Timothy Bartholomew, Jake Weidmann, Sara Osipi, and Meagan Mauter, National Energy Technology Laboratory, U.S. Department of Energy,* ***USA***	**168. Development of a Spout Bed Reactor for Chemical-Looping-Combustion** *Johannes George van der Watt and Junior Nasah, University of North Dakota, Institute for Energy Studies, Gautham Krishnamoorthy, University of North Dakota, Department of Chemical Engineering; and Teagan Nelson and Dr. Srivats Srinivasachar, Envergex LLC,* ***USA***	**105. Consideration of Combustion-related Issues Faced in the Retrofit of an Existing Pulverized Coal Fired Boiler Utilizing Oxy-coal Technology** *Kevin Davis, Brydger Van Otten, and Andrew Chiodo Reaction Engineering International; and Steven Krimsky, Jupiter Oxygen Corporation,* ***USA***

WEDNESDAY AFTERNOON – June 19, 2019

11:50 p.m. – Themed Lunch in the Exhibit Center

Advanced Cycles for Power Generation, *Horst Hack, Electric Power Research Institute*

sCO$_2$, *Josh Stanislowski, Energy & Environmental Research Center, University of North Dakota*

Energy From Waste, *Alan Paschedag, Covanta*

Biomass, *Les Marshall, Ontario Power Generation*

Hybrid (Fossil & Renewable) Power Systems, *Dr. Massood Ramezan, Senior Program Director, KeyLogic*

Emission Controls: Current Status, *Dr. Edmundo Vasquez, Clean Energy Technologies*

Low NO$_x$ Burners, *J.J. Letcavits, AEP*

1:30 p.m. Two Concurrent Panels –

Panel: Treating and Recovering Value from Mineral Residues
Chair: *Dave Osborne, Somerset Coal,* ***Australia***
- *William Lawton, U.S. Department of Commerce,* ***USA***
- *Michael O'Brien, Team Leader, Enhanced Coal Processing, Mining and Processing Technologies/Coal Mining Program, Queensland Centre for Advanced Technologies (QCAT), CSIRO,* ***Australia***
- *Tom Tarka, National Energy Technology Laboratory, U.S. Department of Energy,* ***USA***

Panel: Emissions: The Current Status
Chair: *Dr. Edmundo Vasquez, Clean Energy Technologies*
- *Profs. Hai Zhang and Yuxin Wu, Department of Thermal Engineering, Tsinghua University,* ***China***
- *Prof. Jörg Maier, University Stuttgart,* ***GERMANY***
- *Suzette Puski, Babcock Power,* ***USA***
- *Jason Laumb, Energy & Environmental Research Center, University of North Dakota,* ***USA***

3:30 p.m. – Break in the Exhibit Center

4:00 p.m. – Four Concurrent Technical Sessions

	Session 21 **Sand Key Room** **Oxy-Combustion II** *Prof. Terry Wall, University of Newcastle, Australia and Klas Andersson, Chalmers*	**Session 22** **Gulf Room** **Supercritical CO$_2$** *Suhyeon Park, University of Central Florida and Josh Stanislowski, UNDEERC*	**Session 23** **Palm Room** **Fuels Production** *Dushyant Shekhawat, National Energy Technology Laboratory, U.S. Department*	**Session 24** **Bay Room** **Combustion & Gasification II** *J.J. Letcavits, AEP & Alan Paschedag, Covanta*

	University, Sweden		*of Energy*	
4:00 p.m.	**87. Characteristics of Pressurized Oxy-Coal Combustion in a 100 kW_{th}, 15 bar Combustor** *Zhiwei Yang, Dishant Khatri, Tianxiang Li, and Richard. L, Axelbaum, Department of Energy, Environmental & Chemical Engineering, Washington University in St. Louis,* ***USA***	**68. Experimental Ignition Studies of Supercritical CO_2 Oxy-Fuel Mixtures** *Suhyeon Park, Gihun Kim, Anthony Terracciano, Samuel Barak, Subith Vasu, Center for Advanced Turbomachinery and Energy Research (CATER), University of Central Florida,* ***USA***	**4. Pyrolysis of Hydrothermal Carboni-zation - Treated Pulp and Paper Mill Sludge Through TGA and Py-GC/MS** *Shule Wang, Henry Persson, Pär Jönsson, and Weihong Yang, Royal Institute of Technology, School of Industrial Engineering and Management, Department of Materials Science and Engineering, Group of Energy and Furnace Technology;* ***SWEDEN****	**148. Vortexing Circulating Fluid Beds as a Novel Comp Gasifier** *Justin Weber and Dr. Ronald Breault, National Energy Technology Laboratory, U.S. Department of Energy; and Michael Bobek, Oak Ridge Institute for Science and Education,* ***USA***
4:20 p.m.	**138. Design, Construction, and Assessment of Dry Coal Feeding in a High Pressure Oxy-coal System** *Andrew Chiodo and Kevin Davis, Reaction Engineering International; and Kevin Whitty, Jost O. L. Wendt, and Xiaolong Li, University of Utah,* ***USA***	**82. Design of a Coal-Based Allam Cycle Large Pilot Plant** *Josh Stanislowski, Energy & Environmental Research Center, University of North Dakota,* ***USA***	**10. Energy Efficient Synthesis of Methanol from Biodiesel Waste Glycerol: Introducing a New Sustainable Reaction Process** *Shalini Kandasamy, Department of Chemical Engineering, Monash University,* ***AUSTRALIA****	**19. On the Nitrogen Chemistry in Jet and Swirled Pilot-Scale PF Flames** *Rikard Edland, Thomas Allgurén, Klas Andersson, Fredrik Normann, Jost O. L. Went (Department of Chemical Engineering, University of Utah), Department of Space Earth & Environment, Chalmers University of Technology,* ***SWEDEN;*** *Andrew Fry, Department of Chemical Engineering, Brigham Young University,* ***USA***
4:40 p.m.	**139. Modeling and Bench-Scale Testing of a High Pressure Coal Feed System for Oxy-combustion** *Brad Adams, Jacob Tuia,*	**89. Measurement of Convective Heat Transfer Coefficients with Supercritical CO_2 Using the Wilson Plot Technique**	**67. High Solids Anaerobic Digestion of Water Hyacinth, Banana Waste and Moringa Biomass for Enhanced Methane**	**20. Influence of Process Conditions on Fast Pyrolysis of Waste Tire in a Conical Spouted Bed Reactor** *Hoon Chae Park, Byeong Kyu*

	Taylor Schroedter, and Andrew Fry, Brigham Young University, ***USA***	*Jim Black, Doug Straub, Joe Yip, and Matthew Searle, National Energy Technology Laboratory, U.S. Department of Energy; Ed Robey, Leidos; and Sridharan Ramesh, and Arnab Roy, West Virginia University Research Corporation,* ***USA***	**Production** *R. Z. Gaur, P. Bittencourt, X. Yang, E. Lee, S. J. Ergas, Department of Civil & Environmental Engineering, University of South Florida,* ***USA***	*Lee, Hang Seok Choi, Department of Environmental Engineering, Yonsei University,* ***REPUBLIC OF KOREA***
5:00 p.m.	**95. Ash Formation under High Pressure Oxy-combustion Systems** *Dishant Khatri, Zhiwei Yang, Tainxiang Li, Richard Axebaum, Washington University in St. Louis,* ***USA***	**83. Supercritical CO_2 Power Cycle Roadmap for Fossil Applications** *Andrew Maxson, Electric Power Research Institute; and David Thimsen, Thimsen Consultants,* ***USA***	**101. Microwave-assisted Coal Conversion to Fuels and Chemicals** *Dushyant Shekhawat, Mark W. Smith, Christina Wildfire, Victor Abdelsayed, and Candice Ellison, National Energy Technology Laboratory, U.S. Department of Energy,* ***USA***	**63. Investigation of Gaseous Potassium Adsorption Process and Sodium-Potassium Competitive Adsorption by Modified Kaolinite during the Combustion of Biomass** *Xiuju Zhang, Huan Liu, Haoxuan Xing, Geyi Wang, Haiyan Li, Xian Li, and Hong Yao, State Key Laboratory of Coal Combustion, School of Energy and Power Engineering, Huazhong University of Science and Technology,* ***CHINA***
5:20 p.m.	**146. Full Scale Experiments in Oxy-fired Aluminum Recovery Smelters to Tackle the Challenge with Batch Process Dynamics** *Thomas Allgurén, Department of Space Earth & Environment, Chalmers University of Technology,* ***SWEDEN***	**118. Dynamic Modeling and Control of a 10 MWe Supercritical CO_2 Recompression Closed Brayton Cycle** *Stephen E. Zitney and Eric A. Liese, National Energy Technology Laboratory, U.S. Department of Energy,* ***USA***	**12. Torrefaction of Agricultural Residues: Effect of Temperature, Residence Time and Biomass Composition on Process Products Properties** *Katarzyna Jagodzińska, Marek Pronobis, and Edyta Kudlek, Silesian University of Technology, Institute of Power Engineering and Turbomachinery; Michał*	**70. Integration of Algal Biosolid Processing with Coal in Gasified Spout-Bed** *John P Dooher, Adelphi University/Dooher Institute of Physics and Energy, Garden City, Devan Cole and Joseph Cilio, Department of Physics, Adelphi University,* ***USA***

			Czerep and Mateusz Wnukowski, Wroclaw University of Science and Technology, Institute of Heat Engineering and Fluid Mechanics, ***POLAND****; and Weihong Yang, KTH Royal Institute of Technology, Department of Material Sciences and Engineering,* ***SWEDEN****	
5:45 p.m. – Conference Committee Meeting – Sand Key Room				

** Participant in the Best Student Paper Award

THURSDAY Morning – June 20, 2019				
8:00 a.m. – Four Concurrent Sessions				
8:00 a.m.	**Session 25** **Sand Key Room** **Advanced Coal Beneficiation** *Dave Osborne, Somerset Coal, Australia*	**Session 26** **Gulf Room** **Data Analytics and Advanced Control Strategies III** *Dr. Ronald Breault, National Energy Technology Laboratory, U.S. Department of Energy*	**Session 27** **Palm Room** **Alternative Fuels for Gas Turbines** *Prof. Ashwani Gupta, University of Maryland*	**Session 28** **Bay Room** **Gasification for Power & Chemicals II** *Dr. Massood Ramezan, KeyLogic and Kunlei Liu, University of Kentucky*
8:00 a.m.	**72. Coal Beneficiation Program Overview – Expanding the U.S. Coal Value Chain: An Overview of the U.S. DOE Coal Beneficiation Program** *John Rockey, Perry Bissell, Justin Strock, and Anthony Zinn, National Energy Technology Laboratory, U.S. Department of Energy,* ***USA***	**127. Machine Learning and Data Analytics Applications for Enhancing Operator and Control System** *Rick Kephart, Emerson,* ***USA***	**98. Effect of Low Aromatic HEFA Fuel on Effect of Gas Turbine Vibration and Instability** *Charith Wijesinghe, Bhupendra Khandelwal and Yuxiao Ling, Low Carbon Combustion Centre, The University of Sheffield,* ***UNITED KINGDOM***	**142. Sustainable Utilization of the Sewage Sludge Using Combined Drying, Torrefaction and Gasification Technologies** *Halina P. Kruczek, Michal Czerep, Michal Ostrycharczyk, Mateusz Wnukowski Marcin Baranowski, Mateusz Kowal, Krystian Krochmalny and Lukasz Niedzwiecki, Wrocław University of Science and Technology, Faculty of Mechanical and Power Engineering, Department of Boilers, Combustion and Energy Processes,* ***POLAND***
8:20 a.m.	**162. Mobile Coal Segregation Unit at Great River Energy** *Ye Yao and Tom Oakland, Great River Energy,* ***USA***	**151. Considerations for Enhancing Asset Performance Management with Machine Learning – A Pragmatic View of Predictive and Prescriptive Maintenance** *Ryan Conger, ASPEN,* ***USA***	**171. Laminar Flame Speed Measurements of Alternative Liquid Fuels** *Gihun Kim, Bader Almansour, Suhyeon Park, Anthony C. Terracciano, and Subith Vasu, Center for Advanced Turbomachinery and Energy Research, University of Central*	**48. New Advances in Air Separation for Fossil Energy Plants** *Dave Lyons, Gasification Systems, National Energy Technology Laboratory, U.S. Department of Energy,* ***USA***

			*Florida, **USA***	
8:40 a.m.	**154. Use of the Szego Mill for Clean Energy: From Coal Beneficiation to Fuel Alcohol** *Olev Trass, Department of Chemical Engineering and Applied Chemistry, University of Toronto, Toronto, Ontario, **CANADA***	**163. Using Data Clustering to Identify Plant Leakage** *Harry Bonilla and Kenneth Bryden, Ames Laboratory, Iowa State University; and Larry Shadle, National Energy Technology Laboratory, U.S. Department of Energy, **USA***	**100. Assessment of Condensable PM Measured by Legislative Methods US EPA 5B/202 Wet Impingers and US EPA 5I/202 Dry Impingers When Used for Ultra-low PM Level Produced by Gas Turbine Engine** *Ihab Ahmed, Bob Pearce, Roger Brown, Bhupendra Khandelwal, Low Carbon Combustion Centre, The University of Sheffield, **UNITED KINGDOM***	**5. Study on Coal Ash/Slag Transformation and Elemental Migration in a Staged-OMB Gasifier** *Zhongjie Shen, Andrew Placido, Zachary Moore, and Kunlei Liu, University of Kentucky Center for Applied Energy Research, **USA***
9:00 a.m.	**165. Thermodynamic Evaluation of Bed Agglomeration Potential in Advanced Chemical Looping Combustion of Solid Fuels** *James Kennedy, Aditi Khadilkar, and Sarma Pisupati, The Pennsylvania State University; and Dr. Ronald Breault, National Energy Technology Laboratory, U.S. Department of Energy, **USA***	**130. Remote Monitoring & Diagnostic Successes at Merom Generating Station** *Mike Merwald, Black & Veatch, and Gary Burris, Merom Generating Station, **USA***	**99. An Investigation on the Effect of Varying Fuel Sources Used in Jet Engines on Particulate Matter** *Marcus N Kauffmann, Ihab Ahmed, James Cronly, Bhupendra Khandelwal, Low Carbon Combustion Centre, The University of Sheffield, **UNITED KINGDOM***	**141. Gasification of Torrefied Sewage Sludge with the Addition of Calcium Oxide** *Halina P. Kruczek,, Mateusz Wnukowski, Lukasz Niedzwiecki, Mateusz Kowal, Krystian Krochmalny and, Wrocław University of Science and Technology, Faculty of Mechanical and Power Engineering, Department of Boilers, Combustion and Energy Processes, **POLAND***
9:20 a.m.	**TBA**	**164. Using Machine Learning Tools to Predict Compressor Surge and Stall** *Harry Bonilla, Tina Akinyi, Laurel Barnet, Sam Hipple, and Kenneth Bryden, Ames Laboratory, Iowa State University; Jessica DeBoom, Iowa State University; and*	**TBA**	**81. Hot Oxygen Technology for Tar and Methane Reforming from Syngas Streams** *Dr. Lawrence E. Larry Bool, Praxair, Inc., **USA***

		Larry Shadle, National Energy Technology Laboratory, U.S. Department of Energy, ***USA***		

THURSDAY Morning – June 20, 2019				
9:40 a.m. – Break in the Island Ballroom				
10:10 a.m.	**Four Concurrent Technical Sessions**			
	Session 29 **Sand Key Room** **Biomass & Biomass Cofiring II** *Les Marshall, Ontario Power Generation, Canada*	**Session 30** **Gulf Room** **Novel Design for Advanced Unit Operations** *Dave Lyons, National Energy Technology Laboratory, U.S. Department of Energy*	**Session 31** **Palm Room** **Upgrading Natural Gas** *Evan Granite, National Energy Technology Laboratory, U.S. Department of Energy*	**Session 32** **Bay Room** **Fluidized Bed Units** *Fredrik Lind, Chalmers University, Sweden*
10:10 a.m.	**88. Parametric Study of Hydrothermal Treatment of Biomass to Produce Biofuels** *Ankit Mathanker, Deepak Pudasainee, Rajender Gupta, Department of Chemical & Materials Engineering, and Amit Kumar (Department of Mechanical Engineering), University of Alberta,* ***CANADA***** **49. An Overview of Novel Reactor Development** *Dave Lyons, National Energy Technology Laboratory, U.S. Department of Energy,* ***USA***	**1. Brief Review of Catalytic Oxidative Coupling of Methane to Ethane and Ethene** *Evan J. Granite, National Energy Technology Laboratory, U.S. Department of Energy,* ***USA***	**30. Investigating the Leaching Capacity of Potassium from Rock Ilmenite Used as a Bed Material in Fluidized Bed Boiler When Acidic, Neutral and Alkaline Conditions Are Applied** *Ewa Krymarys, Angelica Gyllén, Fredrik Lind, Magnus Rydén, Department of Space, Earth and Environment and Pavleta Knutsson, Department of Chemistry and Chemical Engineering, Chalmers University of Technology,* ***SWEDEN***** **93. Numerical Investigation of Pre-mixed and Non-premixed Wood Volatile Injection in an Industrial Biochar Plant** *Hassan Khodaei , Chris Olson (Innovative Reduction Strategies Inc. (IRSI), and Petr Nikrityuk, Department of Chemical and Materials Engineering, Donadeo*
10:30 a.m.	**153. Process Intensified Distillation using a Microwick Technology to Facilitate Modular Processing** *Ward TeGrotenhuis, Danny Bottenus, Paul Humble, and Mike Powell, Pacific Northwest National Laboratory,* ***USA***	**43. Dehydroaromatization of Ethane Using Microwave Catalytic Reactor** *John Hu, Department of Chemical & Biomedical Engineering, Center for Innovation in Gas Research & Utilization, West Virginia University,* ***USA***	**32. Sulfur Interactions with Rock Ilmenite during Combustion of Biomass in a 12MW$_{th}$ CFB Boiler** *Mariane Vigoureux (Department of Chemistry and Chemical Engineering) Frederik Lind, and Pavleta Knutsson, Department of Space, Earth and*

	Innovation Centre for Engineering University of Alberta, ***CANADA***			*Environment, Chalmers University of Technology,* ***SWEDEN***
10:50 a.m.	**140. Integrated Thermo-Catalytic Reforming of Forest and Agricultural Residues** *Manjot Gill, and Rajender Gupta, Department of Chemical & Materials Engineering; and Vinoj Kurian, Madhumita Patel, and Amit Kumar, Department of Mechanical Engineering, University of Alberta,* ***CANADA***	**160. Material and Construction Considerations in the Development of Novel Coal Reactors** *James Bennett, David Maurice, and Jinichiro Nakano (Leidos Research Support Team), National Energy Technology Laboratory, U.S. Department of Energy,* ***USA***	**46. Refractory Failure in Entrained-Flow Gasifier: Investigation of Partitioned Erosion Characteristics in an Industrial Opposed Multi-Burner Gasifier** *Yan Gong, QinghuaGuo, Huiwen Zhu, and Guangsuo Yu, East China University of Science and Technology,* ***CHINA***	**38. Distribution of O_2 and CO in the Cross Section of a Circulating Fluidized Bed Furnace during Operating with Inert and Oxygen Active Bed Materials** *Fredrik Lind (Department of Space, Earth and Environment) and Pavleta Knutson (Department of Environmental Inorganic Chemistry), Chalmers University of Technology,* ***SWEDEN***
11:10 a.m.	**152. Project ARBAHEAT – Taking Coal Plant Repowering One Step Further** *Stephan Janbroers, Simon Leiser, Pedro Abelha, Jan Pels, Mariusz Cieplik and Jaap Kiel, TNO,* ***THE NETHERLANDS***	**60. Experimental Investigation on Fountain Characteristics in a Rectangular Spouted Bed Based on Image Processing** *Ronald Breault and Justin Weber, National Energy Technology Laboratory, U.S. Department of Energy; and Steve Rowan and Jingsi Yang, ORISE,* ***USA***	**92. Upgrading of Natural Gas Liquids via Chemical Looping Oxidative Dehydrogenation (ODH)** *Luke M. Neal, Vasudev Haribal, and Fanxing Li, NC State University,* ***USA***	**103. Minimizing NO_x Emissions from a Fluidized Bed Boiler** *Janusz Lichota, Wrocław University of Technology,* ***POLAND***
11:30 a.m.	**Lunch in the Island Ballroom – Presentation of the Best Student Paper Award and Roundtable Wrap-up Discussion –** Bring your ideas and suggestions for next year's conference.			

** Participant in the Best Student Paper Award

FRIDAY MORNING – June 21, 2019
6:30 a.m. Continental Breakfast in Lobby 2 for Polk Power Plant and Covanta Tour Participants
7:00 a.m. – Departure of Polk Power Plant and Covanta Tours – For those taking the Polk tour, we swing by the airport after the tour for those who have afternoon flights.

7:30 a.m. – Conference Committee Chairs Meeting

The 44th International Technical Conference on Clean Energy

The Clearwater Clean Energy Conference

June 16 to 21, 2019

Clearwater, Florida, USA

THE CLEARWATER CLEAN ENERGY CONFERENCE HIGHLIGHTS

Endorsing Organizations:

- **American Institute of Chemical Engineers**
- **American Public Power Association**
- **CANMET Natural Resources, Canada**
- **China Coal Research Institute**
  Ministry of Coal, People's Republic of China
- **Edison Electric Institute**
- **Export Assistance Center, U.S. Commercial Service**
- **International Energy Agency: Coal Research**
- **Japan Coal Energy Center (JCOAL)**
- **National Mining Association**
- **National Rural Electric Cooperative Association**
- **Ohio Coal Development Office**
- **U. S. Geological Survey**

MISSION STATEMENT – Increased demand – coupled with energy security issues, 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 21st century.

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

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. We seek papers from all countries world-wide.

The Panels, Short Courses and Technical Sessions **offer information on all of the major topics of the day.**

Technical Sessions

The conference presents topics of the greatest interest to the industry in 32 technical sessions.

Panels

To provide our attendees with the most comprehensive and up-to-date information from the world's energy leaders, we offer panel presentations covering an overview of emerging, evolving, and innovative technologies, fuels, policy and/or equipment in the power generation industry. In addition, we will honor the life and legacy of the late Prof. Janos M. Beer.

Short Courses

On Sunday, June 16th, we offer Short Courses on a wide variety of topics important to the energy community. **Participation is optional; is included in the registration fee; and open to all conference registrants.**

The Exhibit Center

where we showcase 24 booths providing opportunities to highlight accomplishments and achievements. We also offer tables for Information Display. Those signing up for this are included in the write-ups and could include an ad in the Official Program. Signed up so far:

- EES Combustion Technologies and Services, Inc.
- KeyLogic Systems Inc.
- The Pennsylvania State University
- Reaction Engineering International

The **Clearwater Clean Energy Conference** offers participants about 150 technical presentations in four days. Buffet style luncheons in the Exhibit Center (an area dedicated for the use of attendees all day), refreshment breaks and a fabulous beach reception offer numerous networking opportunities.

BACKGROUND

At the direction of the Conference Committee, it was decided to broaden the scope of the conference to include some new and exciting technologies currently on the horizon. Industry professionals representing nearly all the major players in the electric utility industry were in Clearwater, Florida, USA for the **43rd Clearwater Clean Energy Conference.**

This conference has earned a reputation for excellence as one of the premiere conferences on coal technologies as it grows in size and scope since its inception in 1975.

- University of Kentucky
- U.S. Department of Energy

Best Student Paper Award – Over the years the conference has benefitted from the many excellent papers given by students. To give these exceptional students well-deserved recognition, the Conference Committee now presents the **Clearwater Clean Energy Conference Best Student Paper Award.** All full time students are eligible for participation.

Journal Publication – This year we plan again on the publication of a special issue of ASME Journal of Energy Resources Technology (JERT), in July 2020. This will be similar to what we've done in the past. Prospective authors should plan for their paper submission for journal publication. This is being done under the guidance of Ashwani K. Gupta, Distinguished University Professor, University of Maryland, Department of Mechanical Engineering; E-mail: akgupta@umd.edu To submit go to the ASME JERT website and Select Special issue "2019 Clearwater Clean Energy" and then upload the paper. The paper will undergo a review and if accepted will be published in the Special issue of JERT in July 2020.

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.

- **Advanced Cycles for Power Generation**, *Horst Hack, Electric Power Research Institute*
- **Supercritical CO_2,** *Josh Stanislowski, Energy & Environmental Research Center, University of North Dakota*
- **Energy From Waste,** *Alan Paschedag, Covanta*
- **Hybrid (Fossil & Renewable) Power Systems,** *Massood Ramezan, KeyLogic*

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 and use code: **CL1143**. The hotel offers the conference $193/night for Single or Double accommodations. You may also email: group.reservations@sheratonsandkey.com

• **Low NO_x Burners,** *J.J. Letcavits, AEP*

Field Trips – Friday, June 21, 2019

Covanta Pasco, Inc. – Energy-from-Waste Facility

The Pasco County Solid Waste Resource Recovery Facility in Spring Hill, FL, operating as Covanta Pasco, Inc., began commercial operation in May 1991, serving the residents of Pasco County. The facility processes up to 1,050 tons per day of municipal solid waste, generating 31.2 megawatts of renewable energy that is sold to Duke Energy. The facility uses secondary sewer treatment effluent from a nearby wastewater treatment plant for part of its process water make-up.

Polk Power Plant Field Trip:

Tampa Electric Company planned, engineered, built, and operates the Polk Power Plant Unit #1 Integrated Gasification Combined Cycle (IGCC) Power Plant. The project was partially funded under the Department of Energy's Clean Coal Technology Program pursuant to a Round III award.

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Sheraton Sand Key, Clearwater, Florida, USA

www.ClearwaterCleanEnergyConference.com

for complete conference details

44th International Technical Conference on Clean Energy

June 16 to 21, 2019
Sheraton Sand Key
Clearwater, Florida, USA

$795 Now to April 15th

$895 April 16th to May 1st

$995 May 2nd to the conference.

$395 Full Time Students to May 1st –

$495 May 2nd to Conference

REGISTRATION FORM -- **(Return with payment) –** *or call with credit card information to avoid filling out the form*

Name_____

First Name for Badge_____

Title_____

Company_____

Address_____

City_____State_____Zip_____

Country_____

Phone_____

Mobile_____

Email_____

Registration Fee: $_____ –

☐ Spouse's Fee: $150.00

Spouse's Name_____

☐ Polk Power Plant Tour: $150.00
☐ Covanta/Hillsborough Tour: $150.00

GRAND TOTAL:
$_____

*The registration fee covers one **Proceedings**, all conference events (Sunday through Thursday), the Exhibit Center, 4 luncheons, evening events, all breaks, all Continental breakfasts, and all conference materials.*

CTA reserves the right to modify the Conference Program at any time

Method of Payment; Check One:

☐ **Check enclosed** *(payable to CTA; remit to Post Office Box 1130, Louisa, VA 23093)*; **or call 540-603- 2022 or 240-751-0900 with the information below or email to barbarasak@aol.com**

☐ ☐**VISA No.**

_____

☐☐ **MasterCard No.**

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☐ ☐ **American Express No.**

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☐☐ **Discover No.**

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Card Expiration Date:

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Signature:_____

Spouses Registration *With so much to see and do in the Clearwater area; we don't plan specific activities for spouses. However, the $150 fee covers the Welcome Party, four luncheons, beach party, Continental breakfasts and all refreshment breaks.* ***Keep in mind, the on-site spouse's registration is $175.***

Student Registration *To encourage participation by full-time students currently enrolled in a college or university, the Conference Committee is offering a registration fee of $395 to May 1st; $495 after that date.*

The Clearwater Clean Energy Conference

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www.ClearwaterCleanEnergyConference.com