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Tutorials*

TUESDAY, DECEMBER 7 6:30-8:00 PM

TUT1: The Rechargeable Battery Market: Value Chain and Main Trends 2020-2030 (Live Virtual Instructor)*

Instructor:*Michael Sanders, Senior Advisor, Energy, Avicenne Energy*

This tutorial will present the 10-year automotive market forecasts from Avicenne and other analysts (micro|Hybrid|P-HEV|EV). Other coverage will include car makers' strategies and advanced energy storage (advanced lead acid|supercap|NiMH|LIB). *This instructor will be presenting virtually and will be able to interact live with on-site and virtual attendees.

TUT2: Improving the Energy Density of Batteries with Silicon-Based Anodes (On-Site Instructor)*

Instructor:*Dee Strand, PhD, CSO, R&D, Wildcat Discovery Technologies, Inc.*

This short course will present key challenges in use of silicon-based anodes as well as progress in implementation of silicon and what can we expect in the future. *This instructor will be presenting this tutorial in-person.

TUT3: Battery Safety and Abuse Tolerance Validation (On-Site Instructor)*

Instructor:*Shmuel De-Leon, CEO, Shmuel De-Leon Energy Ltd.*

This tutorial focuses on portable, stationary and automotive battery safety along the battery cycle life (acceptance, testing, assembly, use, transportation and disposal). The training is to provide attendees with the knowledge needed to safely handle the batteries in their organization and to support reduction in safety events. *This instructor will be presenting virtually and will be able to interact live with on-site and virtual attendees.

THURSDAY, DECEMBER 9 7:15-8:45 AM

TUT4: Materials for Next-Generation Batteries (Live Virtual Instructor)*

Instructor:*George Crabtree, PhD, Director, Joint Center for Energy Storage Research (JCESR), Argonne National Laboratory*

This tutorial will cover the materials and performance challenges for next-generation batteries for electric vehicles and the electricity grid. The needs and use cases for storage in these two applications will be analyzed, and the possibilities of advanced lithium-ion, lithium-sulfur, and multivalent batteries for vehicles will be presented. *This instructor will be presenting virtually and will be able to interact live with on-site and virtual attendees.

TUT6: Battery Data Science for Automotive Applications (Both On-Site & Live Virtual Instructors)*

Instructors:*Tal Sholklapper, CEO & Co-Founder, Voltaiq, Inc.*

Christianna N. Lininger, PhD, Application Engineer, Voltaiq, Inc.

Austin Sendek, PhD, Founder/CEO, Aionics, Inc.; Visiting Scholar, Stanford University

From the manufacturing floor to on-board vehicle diagnostics, each battery represents a potentially valuable stream of data. This tutorial will focus on a broad survey of "data science" tools that can help make these data streams useful. Themes covered include overview of machine learning opportunities, data management, exploration and key features, and machine learning examples — materials discovery and cycle life prediction. *The instructors will be presenting both on-site and virtually and will be able to interact live with on-site and virtual attendees.

TUT7: Advances in Solid-State Batteries (Live Virtual Instructor)*

Instructor:*Venkataraman Thangadurai, PhD, Professor and Associate Head (Graduate), Chemistry, University of Calgary*

This tutorial will cover the latest advances in solid-state batteries and their commercial applications. *This instructor will be presenting virtually and will be able to interact live with on-site and virtual attendees.

"It's a great conference; it has a super-high bandwidth. You can learn a lot about what's going on in the industry today."

– Mark Verbrugge, PhD General Motors

** All Access or separate registration required for Tutorials*

TUESDAY, DECEMBER 7

7:30 am Registration and Morning Coffee

SILICON ANODES

8:50 Organizer's Remarks
Victoria Mosolgo, Associate Conference Producer, Production, Cambridge EnerTech

8:55 Chairperson's Remarks
Martin Winter, PhD, Director & Professor, Electrochemical Energy Technology, University of Muenster

9:00 Lithium-Silicon Anodes to Unlock the Future of Electrified Transportation
Rick Costantino, PhD, Co-Founder & CTO, Group14 Technologies

9:20 Silicon-Carbon Anodes to Unlock the Future of Electrified Transportation
Ashok Lahiri, CTO, ENOVIX Corp.
Enovix is the leader in advanced silicon-anode lithium-ion battery development and production. This presentation will describe the company's 3D cell architecture which enables the use of an anode that is 100% active silicon anode and mitigates the traditional problems experienced with silicon in lithium-ion batteries: volume expansion, formation lithium loss, and break-up of silicon during cycling leading to poor cycle life.

9:40 Advanced Anode Technology to Enable Longer Range, Ultra-Fast Charge, and Flying Cars
James Cushing, GM, ESS, Applied Materials
Ubiquitous adoption of electric vehicles continues to be limited by issues such as range anxiety, long charge times, and cost. Today, attempts to improve one hurts the other (e.g.; larger packs improve range but increase cost). In this talk, we explore the use of new anode materials (silicon and lithium metal) to change the game-increasing range, shrinking charge times, and ultimately increasing power density enough to enable flying cars.

10:00 MODERATED Q&A: Session Wrap-Up
Moderator: Martin Winter, PhD, Director & Professor, Electrochemical Energy Technology, University of Muenster
Panelists:Rick Costantino, PhD, Co-Founder & CTO, Group14 Technologies
Ashok Lahiri, CTO, ENOVIX Corp.
James Cushing, GM, ESS, Applied Materials

10:15 Coffee Break

SOLID-STATE BATTERIES

10:35 Chairperson's Remarks
Martin Winter, PhD, Director & Professor, Electrochemical Energy Technology, University of Muenster

10:40 One Platform, Endless Performance Capabilities: Sulfide Solid-State and the Enablement of Multiple Next-Generation Electrodes
Josh Buettner-Garrett, CTO, Solid Power
Sulfide solid electrolytes are a tool to enable a variety of next-generation electrodes such as high-content silicon anodes and conversion-type cathodes. By expanding what is possible in cell and pack design, sulfide solid-state will suit a wide range of application requirements in the future. In this presentation, Solid Power will outline what's possible, and what has been accomplished so far, using the company's solid-state platform.

11:00 Lithium-Metal Anode Battery Development at QuantumScape
Tim Holme, PhD, CTO, QuantumScape Battery Corporation
QuantumScape, founded in 2010 with a mission to revolutionize energy storage, is developing a solid-state battery with a lithium-metal anode to enable long-range, faster charging, low-cost electric vehicles. The company is driven by the huge opportunity to transform the automotive industry and enable a sustainable future. This talk will highlight recent developments in solid-state batteries as well as the challenges in commercializing a new battery technology.

11:20 Large-Format, Commercially-Relevant, and Practical Solid-State Battery for EV
Factorial
Alex Yu, Co-Founder and President, R&D, Factorial, Inc.
The field of batteries today is consistently filled with claims that over-promise and under-delivery. Factorial Energy is taking a different approach. Instead of making claims by comparing apples with oranges, we want to provide down-to-earth solid-state-batteries for EV customers that can be practically commercialized in the near, medium and long terms.

11:40 MODERATED Q&A: Session Wrap-Up
Moderator: Martin Winter, PhD, Director & Professor, Electrochemical Energy Technology, University of Muenster
Panelists:Josh Buettner-Garrett, CTO, Solid Power
Tim Holme, PhD, CTO, QuantumScape Battery Corporation
Alex Yu, Co-Founder and President, R&D, Factorial, Inc.

11:55 Networking Lunch, *Sponsored By* **USABC**

LITHIUM METAL ANODES

12:55 pm Chairperson's Remarks
Martin Winter, PhD, Director & Professor, Electrochemical Energy Technology, University of Muenster

1:00 All Solid-State Batteries – Chemistry, Electrochemistry and Mechanical Concerns
Ying Shirley Meng, Professor, NanoEngineering & Director, Sustainable Power & Energy Center, University of California, San Diego
All-solid-state batteries with lithium metal anode offer the possibility of safe high-energy rechargeable batteries. In this talk, I will show how innovative characterization for all-solid-state batteries can be designed to probe buried interphases, and offer new insights to accelerate the innovation of novel energy storage materials and architectures.

1:20 High-Throughput Investigation of Low-Cost Cathode Active Materials
Dee Strand, PhD, CSO, R&D, Wildcat Discovery Technologies, Inc.
The move toward global electromobility for automotive applications requires both sustainable and low-cost materials. This challenging initiative requires the optimization of material combinations to meet increased energy and power specifications, but also lower the overall cost of the battery. In this presentation, we will present how the successful use of high-throughput screening methods to develop and optimized electrode designs to improve EV battery key performance indicators.

1:40 Talk Title to be Announced
Yang Shao-Horn, PhD, WM Keck Professor of Energy, Mechanical Engineering, Massachusetts Institute of Technology

2:00 MODERATED Q&A: Session Wrap-Up
Moderator: Martin Winter, PhD, Director & Professor, Electrochemical Energy Technology, University of Muenster
Panelists:Ying Shirley Meng, Professor, NanoEngineering & Director, Sustainable Power & Energy Center, University of California, San Diego
Dee Strand, PhD, CSO, R&D, Wildcat Discovery Technologies, Inc.
Yang Shao-Horn, PhD, WM Keck Professor of Energy, Mechanical Engineering, Massachusetts Institute of Technology

2:15 Refreshment Break

2:35 Chairperson's Remarks

Venkat Srinivasan, Director, Center for Collaborative Energy Storage Science, Argonne National Laboratory

2:40 The Development of Ultra-Thin Highly Conductive Glass Separators for Next-Generation Batteries

Steven Visco, PhD, CEO & CTO, PolyPlus Battery

PolyPlus Battery Company is developing next-generation lithium metal batteries based on continuous sheets of high conductivity sulfide glass separators and lithium metal anodes. PolyPlus has a proprietary draw tower installed in its Berkeley facility and has produced sulfide glass sheets as thin as 15 microns. The approach is inherently scalable and is expected to reach cost parity with polymeric separators with high volume manufacturing.

3:00 Active Cathode Materials for Next-Generation Li-Ion Batteries

Rohan Gokhale, PhD, Applied Technology Manager, Umicore Rechargeable Battery Materials

3:20 Grain Engineering in Polycrystalline High Nickel Cathode Materials

Kenan Sahin, PhD, President, CAMX Power

CAMX will highlight its latest global patents on grain boundary enrichment and present pathways to lower cobalt, improve temperature performance, reduce impedance growth, mitigate cracking, and expand SOC operation.

3:40 MODERATED Q&A: Session Wrap-Up

Moderator: Venkat Srinivasan, Director, Center for Collaborative Energy Storage Science, Argonne National Laboratory

Panelists:Steven Visco, PhD, CEO & CTO, PolyPlus Battery

Rohan Gokhale, PhD, Applied Technology Manager, Umicore Rechargeable Battery Materials

Kenan Sahin, PhD, President, CAMX Power

3:55 Chairperson's Remarks

Venkat Srinivasan, Director, Center for Collaborative Energy Storage Science, Argonne National Laboratory

4:00 Batteries for Decarbonization of Transportation and Grid: Present Status and R&D Needs

Venkat Srinivasan, Director, Center for Collaborative Energy Storage Science, Argonne National Laboratory

Batteries are an enabling technology to ensure deep decarbonization. Today's lithium-ion (Li-ion) batteries have demonstrated enormous potential. However, the energy density, cost, recharge time, lifetime, and safety of these batteries do not satisfy the requirements for complete electrification. The talk will describe the present status of battery technology vis-a-vis the targets, the R&D approaches, the challenges with different materials and chemistry changes, and the impact if the R&D is successful.

4:20 Automotive Solutions for High-Energy Electrodes

Kurt Kelty, Vice President, Automotive, Sila Nanotechnologies, Inc.

My talk will introduce an innovative drop-in-replacement nanocomposite silicon-based anode powder that completely replaces graphite and offers around 5 times higher gravimetric capacity and enables 20% higher energy density (Wh/L) today over state-of-the-art lithium-ion to power portable electronics and electric vehicles.

4:40 MODERATED Q&A: Session Wrap-Up

Moderator: Venkat Srinivasan, Director, Center for Collaborative Energy Storage Science, Argonne National Laboratory

Panelists:Kurt Kelty, Vice President, Automotive, Sila Nanotechnologies, Inc.

5:15 Grand Opening Networking Reception in the Exhibit Hall with Poster Viewing, *Sponsored by* **Clarios**

6:30 Evening Tutorials*

Seven tutorials will take place at AABC across Tuesday and Thursday. The tutorials are designed to be instructional, interactive and provide in-depth information on a specific topic. Tutorial themes include introductions for those new to the field as well as explanations on more technical aspects than time allows during our partnering forum, symposia and main conference programs. Instructors are drawn from industry and academia alike, many of whom are recognized in their fields or have teaching experience.

**Tutorials included in All Access Pricing or separate registration required. See Tutorial page for details.*

8:00 Close of Day

WEDNESDAY, DECEMBER 8

8:30 am Registration and Morning Coffee

8:55 Chairperson's Remarks

Martin Winter, PhD, Director & Professor, Electrochemical Energy Technology, University of Muenster

9:00 Recent Developments on High-Energy Density Li-Ion and Post Li-Ion Batteries at CEA-LITEN

Sebastien Martinet, PhD, Battery Senior Scientist, Electrochemical Storage, CEA Liten

The presentation will make an update on CEA-LITEN developments on high energy density batteries for xEV applications. Last results relative to new oxyfluoride and sulfide rocksalt positive materials will be discussed. Then, our recent achievements on the improvement of lithium metal electrode cyclability will be detailed, combining modelling and experimental approaches. High-energy density cells based on some major innovations will be presented.

9:20 Challenges and Prospects for Tailored Design of Nickel-Rich Layered Cathodes for High-Energy Lithium-Ion Batteries

Aurora Gomez Martin, PhD, PostDoc Researcher, MEET, University of Muenster

This presentation will focus on the challenges and approaches for the development of high-nickel, low-cobalt layered oxide cathodes for high-energy LIBs via a continuous Couette-Taylor-Flow-Reactor. Besides cathode chemistry, tailored particle engineering of layered cathode materials during the co-precipitation also allows for an optimum energy output while cycle life and thermal stability aspects can be improved via elemental substitution, concentration gradient, or surface modifications strategies.

9:40 Silicon-Dominant Anodes and NMC Cathodes Produced with an NMP-Free PVDF-Free Process for High Energy Li-Ion Batteries

Nicolò Brambilla, Chief Technology Officer, Nanoramic Laboratories

Nanoramic developed a proprietary battery technology, Neocarbonix, that enables Tier-I battery companies and automotive OEMs to achieve next-gen battery performance using existing equipment and manufacturing processes. Neocarbonix enables PVDF-free cathode electrodes manufactured with an NMP-free coating process, enabling environmentally friendly, lower cost, high-power and energy-dense batteries compatible with any cathode chemistry. Neocarbonix is also an enabler of Si-dominant anodes, using a water-based coating process and inexpensive forms of Si.

10:00 MODERATED Q&A: Session Wrap-Up

Moderator: Martin Winter, PhD, Director & Professor, Electrochemical Energy Technology, University of Muenster

Panelists:Sebastien Martinet, PhD, Battery Senior Scientist, Electrochemical Storage, CEA Liten

Aurora Gomez Martin, PhD, PostDoc Researcher, MEET, University of Muenster

Nicolò Brambilla, Chief Technology Officer, Nanoramic Laboratories

10:15 Coffee Break in the Exhibit Hall with Poster Viewing, Vianode

10:45 Close of Symposium

Battery Engineering for Automotive Applications

Building Better Batteries

TUESDAY, DECEMBER 7

7:30 am Registration and Morning Coffee

BATTERY STATE ESTIMATION

8:50 Organizer's Remarks

Bridget Kotelly, Conference Producer, Production, Cambridge EnerTech

8:55 A Case Study of Efficient Cell-Level Lithium-Ion Battery Pack State of Power Estimation Using Dual Time-Scale Filtering

Marcelo Araujo-Xavier, PhD, Research Engineer, Research and Advanced Engineering, Ford Motor Co.

9:00 A Case Study of Efficient Cell-Level Lithium-Ion Battery Pack State of Power Estimation Using Dual Time-Scale Filtering

Marcelo Araujo-Xavier, PhD, Research Engineer, Research and Advanced Engineering, Ford Motor Co.

This work demonstrates a bottom-up approach for SOP estimation where information from individual cells are used in the SOP calculation rather than pack-level only.

9:20 Assessing Robustness of a Model-Based Lithium-Ion Battery Pack State Estimation over Life: A Case Study Using Battery Life Test Data

Gabrielle Vuylsteke, Research Engineer, Research & Advanced Engineering, Ford Motor Co.

This work presents a case study evaluating the reliability of a model-based battery state estimation framework, where we tested the algorithm on pack-level data from beginning, middle, and end of battery life.

9:40 Advanced Embedded Sensors in Batteries

Rohit Bhagat, PhD, Professor, Centre Director for Centre for E-Mobility and Clean Growth Research, Coventry University UK

Battery management systems rely on accurate state-of-charge estimation which rely on robust parameterisation of batteries, usually done during the preproduction stage. The parameterisation of batteries and subsequent validation can take a long time. Here we present our work on developing embedded sensors into automotive battery cells, allowing measurement of electrode potentials and internal temperature.

10:00 MODERATED Q&A: Session Wrap-Up

Moderator: Marcelo Araujo-Xavier, PhD, Research Engineer, Research and Advanced Engineering, Ford Motor Co.
Panelists:Gabrielle Vuylsteke, Research Engineer, Research & Advanced Engineering, Ford Motor Co.
Rohit Bhagat, PhD, Professor, Centre Director for Centre for E-Mobility and Clean Growth Research, Coventry University UK

10:15 Coffee Break

CELL TESTING

10:35 Chairperson's Remarks

Bapiraju Surampudi, Institute Engineer, Electric Powertrain, Southwest Research Institute

10:40 Analysis of the Mechanical Behaviour of Aged Li-Ion Batteries in Different Loading Conditions

Gregor Gstrein, PhD, Project Senior Scientist, Graz University of Technology

The mechanical response of electrochemically aged Li-ion cells was analyzed for different loading conditions and compared with fresh cells. The goal of this study was to understand the effect of degradation mechanisms in quasi-static but also dynamic loading conditions. It was found, that the change in the cell structure due to aging (e.g.; formation of SEI, reduction of electrolyte, material cracking) significantly influences the mechanical response of the cells.

11:00 Performance of Immersion Cooling for Lithium-Ion Modules

Bapiraju Surampudi, Institute Engineer, Electric Powertrain, Southwest Research Institute

An NMC 811 21700 cell module is subjected to immersion cooling during fast charging and nail penetration testing. The results are compared to baseline without immersion cooling and benefits and shortcomings are analyzed.

11:20 Importance of Reliable Circuit Protection as a Safety Measure in Automotive Applications

Shilong Wang, MBA, Sales Director – Asia, Sales, AEM Components

As Electric Vehicles (EV) continue to play a larger role in the future of the automotive industry, circuit protection is becoming more and more vital. This presentation highlights some concerns associated with the conventional fuses and explains why AEM fuse technology offers performance and safety for system critical EV applications.

11:40 MODERATED Q&A: Session Wrap-Up

Moderator: Bapiraju Surampudi, Institute Engineer, Electric Powertrain, Southwest Research Institute
Panelists:Gregor Gstrein, PhD, Project Senior Scientist, Graz University of Technology
Shilong Wang, MBA, Sales Director – Asia, Sales, AEM Components

11:55 Networking Lunch, *Sponsored By* **USABC**

SAFETY

12:55 pm Chairperson's Remarks

Judith Jeevarajan, PhD, Vice President, Research, Electrochemical Safety Research Institute (ESRI), Underwriters Laboratories, Inc.

1:00 Mitigation of Thermal Runaway for Li-Ion Cells Transported for Automotive Applications

Judith Jeevarajan, PhD, Vice President, Research, Electrochemical Safety Research Institute (ESRI), Underwriters Laboratories, Inc.

The Battery Safety Science Research team at Underwriters Laboratories has carried out research using different materials and designs to reduce or eliminate thermal runaway propagation in lithium-ion cells and modules. The presentation will cover research findings on methods and designs to mitigate thermal runaway in shipping containers that transport cells and batteries for automotive applications. Mitigation methods in modules with electrically interconnected cells will also be presented.

1:20 Multi-Functional Venting Units Reducing the Risk of Battery Fires Caused by Thermal Runaway

Michael Harenbrock, Principal Expert, Engineering Electric Mobility, MANN+HUMMEL GmbH

To protect passengers from the negative impact of thermal runaways, standards like GB 38031-2020 are introduced. One way to comply with these is to prevent hot particles, created by cell explosion, from being ejected to the environment, so they cannot ignite flammable gas/air mixtures outside the pack. Adding hot particle filter functionality to venting units as shown in the presentation is an innovative solution addressing these new requirements.

1:40 Battery Safety Analytics

Conner Fear, Graduate Research Assistant, Mechanical Engineering, Purdue University

Widespread adoption of electric vehicles is predicated upon safe operation of lithium-ion batteries under operational extremes. In this regard, it is imperative to understand the implications of underlying thermo-electrochemical interactions in the resulting thermal safety scenarios. This talk will center on thermal safety analytics in Li-ion cells which includes mechanism-driven modeling at scales and high-resolution experimental data from materials to cell-level thermal stability signatures.

2:00 MODERATED Q&A: Session Wrap-Up

Moderator: Judith Jeevarajan, PhD, Vice President, Research, Electrochemical Safety Research Institute (ESRI), Underwriters Laboratories, Inc.
Panelists:Michael Harenbrock, Principal Expert, Engineering Electric Mobility, MANN+HUMMEL GmbH
Conner Fear, Graduate Research Assistant, Mechanical Engineering, Purdue University

2:15 Refreshment Break

CELL ENGINEERING

2:35 Chairperson's Remarks

Michael Schoenleber, Co-Founder & CTO, Batemo GmbH

2:40 Prismatic, Pouch or Cylindric? A Cell Format Comparison

Michael Schoenleber, Co-Founder & CTO, Batemo GmbH

The race for the best cell format is open: From cylindric to pouch to prismatic approaches, all formats are currently out on the automotive battery market. In our talk we will shed light on the pros and cons of different formats and share insights we gained by opening and physically modelling a large variety of the cells, which are currently on the market.

3:00 New Challenges for the Development of Premium Automotive Battery Cells

Benno Leuthner, Custom Cells Itzehoe GmbH

In high volume cell production, the parameters differ from premium cell production. Premium cell production requires high development speed, market access, technology knowledge, hands-on mentality and courage to try new technologies and bring them into series production. New materials require state-of-the-art production processes and environments in series development. To achieve outstanding performance values in the battery cell, new concepts must be engineered to series maturity in materials and production processes.

3:20 Resolving the Challenge – Efficient Upscaling of Anode Raw Material Processing into Volume Kiln Production ONEJOON

Peter Vervoort, Vice President, Global Technology, ONEJOON GmbH

Heat processing of new battery materials in industrial quantities can be challenging. ONEJOON´s unique approach provides a large contribution to grant a fast upscale at low risk. With it´s test center and extensive simulation expertise, ONEJOON helps to define the parameters needed for the definition of a production concept. It can choose from a wide range of proven kiln systems to establish the most capable kiln line.

3:40 MODERATED Q&A: Session Wrap-Up

Moderator: Michael Schoenleber, Co-Founder & CTO, Batemo GmbH
Panelists:Benno Leuthner, Custom Cells Itzehoe GmbH
Peter Vervoort, Vice President, Global Technology, ONEJOON GmbH

BATTERY MANAGEMENT SYSTEMS

3:55 Chairperson's Remarks

Wenzel Prochazka, Senior Product Manager, Battery Systems, AVL List GmbH

4:00 Battery State Estimates over a Wide Operating Window Using Nonlinear Kalman Filters and Physics-Based Reduced-Order Model

Gregory L. Plett, PhD, Professor, Electrical & Computer Engineering, University of Colorado, Colorado Springs

This talk will show how to apply nonlinear Kalman filters efficiently to a family of ROMs so that the filter's state estimates are valid over a wide battery-pack temperature and SOC operating.

4:20 Physics-Based Reduced-Order Model Comparison with Application to Lithium-Ion Battery Management and Control

Scott Trimboli, PhD, Associate Professor, Electrical & Computer Engineering, University of Colorado, Colorado Springs

Accurate and reliable electric vehicle battery management is crucial for safe and effective operation, especially in light of today's high-performance systems. Physics-based models enable advanced control actions based on dynamic electrochemical measures but are prohibitively complex for embedded architectures. This work compares several reduced model forms to assess their accuracy, computational complexity, and amenability for use in advanced control algorithms.

4:40 Glimpses into BEV Batteries on the Market – AVL Series Battery Benchmarking

Wenzel Prochazka, Senior Product Manager, Battery Systems, AVL List GmbH

AVL's series battery benchmarking program provides a database for objective comparison in technical attributes, as well as in engineering methodology, for BEV battery market competitors for clear-system, target definition of high-performing, reliable, and safe batteries. Two hundred-seventy different criteria are evaluated through AVL benchmarking metrics displayed in 8 high-level attributes. The found integrated system performance values are pointed out to support current and future development programs.

5:00 MODERATED Q&A: Session Wrap-Up

Moderator: Wenzel Prochazka, Senior Product Manager, Battery Systems, AVL List GmbH
Panelists:Gregory L. Plett, PhD, Professor, Electrical & Computer Engineering, University of Colorado, Colorado Springs
Scott Trimboli, PhD, Associate Professor, Electrical & Computer Engineering, University of Colorado, Colorado Springs

5:15 Grand Opening of the Exhibit Hall with Poster Viewing CLARIOS

6:30 Evening Tutorials*

Seven tutorials will take place at AABC across Tuesday and Thursday. The tutorials are designed to be instructional, interactive and provide in-depth information on a specific topic. Tutorial themes include introductions for those new to the field as well as explanations on more technical aspects than time allows during our partnering forum, symposia and main conference programs. Instructors are drawn from industry and academia alike, many of whom are recognized in their fields or have teaching experience.

Tutorials included in All Access Pricing or separate registration required. See Tutorial page for details.

8:00 Close of Day

WEDNESDAY, DECEMBER 8

8:30 am Registration and Morning Coffee

ANALYZING THERMAL RUNAWAY

8:40 The Battery Failure Databank: Insights from an Open-Access Database of Thermal Runaway Data from Lithium-Ion Batteries

Donal P. Finegan, PhD, Staff Scientist Batteries, Electrified Transport, National Renewable Energy Laboratory

The Battery Failure Databank contains robust, high-quality data from hundreds of abuse tests spanning numerous commercial-cell designs and abuse testing conditions.

9:00 Distributed Heat Load Approach to Thermal Runaway Simulation

William Q. Walker, PhD, Research Scientist I, Underwriters Laboratories, Inc.

Here we demonstrate a distributed heat load approach as an alternative and less computationally expensive analysis technique for thermal runaway and cell-to-cell propagation. Previous testing was conducted to evaluate materials selection and state-of-charge impacts for transportation boxes containing Li-ion cells. A conduction and radiation driven thermal model using a distributed heat load approach for thermal runaway heating was developed and the results of which are presented here.

9:20 Battery Relevant Cell Side Wall Rupture Characterization

Eric C. Darcy, PhD, Battery Technical Discipline Lead, Power Systems, NASA Johnson Space Center

We've experienced that driving high energy density cylindrical cells into thermal runaway (TR) while unsupported structurally under reports the risk of side wall ruptures while in battery designs. Controlling this risk is critical for achieving passively TR propagation resistant battery designs. We're undertaking a large, statistically significant design, assembly, and test effort to characterize this risk in 3 different battery designs.

9:40 Design Considerations and Material Selection When No Two Battery Packs are Alike Parker LORD

Will Aldridge, Senior Chemical Engineer, Parker LORD

While almost every OEM is working on new platforms, there is little standardization in the design of battery packs. From different cell chemistries and form factors to different performance requirements, no two designs are the same. Thermal management solutions also vary widely, in particular the thermal interface materials used in battery packs.

10:00 MODERATED Q&A: Session Wrap-Up

Moderator: Eric C. Darcy, PhD, Battery Technical Discipline Lead, Power Systems, NASA Johnson Space Center
Panelists:Donal P. Finegan, PhD, Staff Scientist Batteries, Electrified Transport, National Renewable Energy Laboratory
William Q. Walker, PhD, Research Scientist I, Underwriters Laboratories, Inc.
Will Aldridge, Senior Chemical Engineer, Parker LORD

10:15 Coffee Break in the Exhibit Hall with Poster Viewing, Vianode

10:45 Close of Symposium

EV Technology for Specialty Transportation

High-Energy Battery Development for Light to Heavy Duty Applications

TUESDAY, DECEMBER 7

7:30 am Registration and Morning Coffee

MARKET EXPANSION

8:55 Chairperson's Remarks
Craig Wohlers, Executive Director, Conferences, Cambridge Enertech

9:00 Why the U.S. Needs to Make Electric Vehicle Battery Manufacturing a National Priority
John Boesel, President & CEO, CALSTART Inc.
Learning from the OPEC experience, the United States needs to be taking strong steps now to ensure that it develops a strong and robust domestic electric vehicle (EV) battery manufacturing industry. This presentation will outline specifics steps and actions that the U.S. should be advancing to accelerate the growth of the EV battery supply chain and industry in North America.

9:20 Beyond Li-Ion – High Energy & Power Cells Market Review
Shmuel De-Leon, CEO, Shmuel De-Leon Energy Ltd.
The li-ion battery industry production is growing fast due to high demand, especially from the automotive and grid storage segments. Aligned with production capacity growth, there are large investments in R&D development for the next battery generations behind the ordinary li-ion battery technology. Our presentation will discuss the battery technologies that have a good chances for breakthrough and will review the main startups developing that technology.

9:40 Market Evaluation, Technology Overview and Use Cases for a Combination of Heavy Duty BEV, Charging Infrastructure and Vehicle to Grid Applications
Simon Buderath, Strategy & Technology Consulting, P3 USA
The presentation will provide a market overview that will focus on technology and use cases for for a combination of heavy duty BEV, charging infrastructure and vehicle to grid applications.

10:00 MODERATED Q&A: Session Wrap-Up
Moderator: Kevin Konecky, Director, Battery Institute, Vinfast
Panelists:John Boesel, President & CEO, CALSTART Inc.
Shmuel De-Leon, CEO, Shmuel De-Leon Energy Ltd.
Simon Buderath, Strategy & Technology Consulting, P3 USA

10:15 Coffee Break

HEAVY-DUTY ELECTRIC VEHICLE MARKET

10:35 Chairperson's Remarks
Craig Wohlers, Executive Director, Conferences, Cambridge Enertech

10:40 California Leads the Heavy-Duty Sector Transition to Zero-Emission
Leslie Goodbody, Engineer, California Air Resources Board
This talk will focus on California's near-term and long-term goals for heavy-duty and off-road vehicles and equipment, and the regulatory and incentive programs designed to help us achieve them.

11:00 Heavy-Duty Electrification in Action and Next Steps
Frank Falcone, Chief Engineer, Vehicle Testing, Calibration, and Validation, Meritor
This presentation provides a review of class 8 work in our local ports and beyond through the various grants that started at TransPower. In addition, we will discuss battery performance over the last 10 years to lay the ground work to explore how different levels of improvement can achieve different applications.

11:20 Zero Emission Battery Electric Drayage Truck in Southern California: Volvo LIGHTS Project
Seungbum Ha, PhD, Lead, Fuel Cell & Stationary, South Coast AQMD
Volvo LIGHTS (Low Impact Green Heavy Transport Solutions) is part of California Climate Investments, a statewide initiative to work reducing greenhouse gas emissions, strengthening the economy and improving public health and the environment—particularly in disadvantaged communities. Over a three-year project period, Volvo LIGHTS will demonstrate the ability for heavy-duty, battery electric trucks and equipment to reliably move freight between two major ports and warehouses with zero emissions.

11:40 MODERATED Q&A: Session Wrap-Up
Moderator: Kevin Konecky, Director, Battery Institute, Vinfast
Panelists:Leslie Goodbody, Engineer, California Air Resources Board
Frank Falcone, Chief Engineer, Vehicle Testing, Calibration, and Validation, Meritor
Seungbum Ha, PhD, Lead, Fuel Cell & Stationary, South Coast AQMD

11:55 Networking Lunch, *Sponsored By* **USABC**

HEAVY-DUTY ELECTRIC VEHICLE MARKET

12:55 pm Chairperson's Remarks
Leslie Goodbody, Engineer, California Air Resources Board

1:00 Toyota's Project Portal FCEV Heavy-Duty Truck Update
Scott Friedman, Senior Engineer, R&D Product Development Office, Toyota Motor North America
Toyota will provide an update on how adapting technology in tandem with more efficient batteries will transform the freight industry as Toyota transitions into a zero emission mobility company.

1:20 Hyundai's Programs for North America Including ZEV Trucks
Jerome Gregeois, Director Commercial Vehicles Development, HOD Powertrain Performance & Driveability, Hyundai-Kia America Technical Center
This presentation will focus on Hyundai's ZEV trucks and it's North America focus on fuel cell class 8 applications. In addition, battery applications in Korea will be reviewed.

1:40 E-Mobility & Battery Development for Heavy-Duty Military Applications
Wsewolod Rusow, Subject Matter Expert, Doctrine & Concept Development, NATO Energy Security Center of Excellence
The defense sector recognizes outstanding progress in EV domain and confirms its advantages for a wide spectrum of military applications. Many NATO initiatives are trying to integrate the performance of electromobility into operational concepts.

2:00 MODERATED Q&A: Session Wrap-Up
Moderator: Leslie Goodbody, Engineer, California Air Resources Board
Panelists:Scott Friedman, Senior Engineer, R&D Product Development Office, Toyota Motor North America
Jerome Gregeois, Director Commercial Vehicles Development, HOD Powertrain Performance & Driveability, Hyundai-Kia America Technical Center
Wsewolod Rusow, Subject Matter Expert, Doctrine & Concept Development, NATO Energy Security Center of Excellence

2:15 Refreshment Break

VEHICLE TO GRID

2:35 Chairperson's Remarks
Frank Falcone, Chief Engineer, Vehicle Testing, Calibration, and Validation, Meritor

2:40 Technical and Financial Analysis of Electric School Bus Batteries Used for Vehicle-to-Grid (V2G) Applications
Russell Vare, Director, Automotive Partnerships, Nuvve Corporation
Due to the size of their batteries and driving schedules, electric school buses

are the perfect application for Vehicle-to-Grid (V2G) technology. The first results from early V2G school bus deployments are now available. This session reviews the technical variance of an AC implementation on bidirectional onboard chargers versus a DC implementation with fast charging stations, as well as the economic results from each configuration.

3:00 Vehicle-Grid Integration (VGI) for Medium and Heavy-Duty Electric Vehicles
Rajit Gadh, PhD, Professor, Mechanical & Aerospace Engineering, University of California Los Angeles

3:20 Present & Future: Advancements in V2G-Ready Product Line-Ups
Peter Tuckerman
This presentation will examine what is coming up next and why the industry is growing and changing so rapidly. In addition, the environmental, social, and economic impacts of this growing/changing industry will be presented.

3:40 MODERATED Q&A: Session Wrap-Up
Moderator: Frank Falcone, Chief Engineer, Vehicle Testing, Calibration, and Validation, Meritor
Panelists:Russell Vare, Director, Automotive Partnerships, Nuvve Corporation
Rajit Gadh, PhD, Professor, Mechanical & Aerospace Engineering, University of California Los Angeles
Peter Tuckerman

3:55 Chairperson's Remarks
Frank Falcone, Chief Engineer, Vehicle Testing, Calibration, and Validation, Meritor

4:00 San Diego Gas & Electric's Utilization of Electric School Bus Batteries for Vehicle-to-Gid (V2G) Pilot
Joe Bielawski, Project Manager, San Diego Gas & Electric
San Diego Gas & Electric (SDG&E) is working on a vehicle-to-grid (V2G) pilot to understand how SDG&E can utilize electric vehicles (EVs) as a distributed energy resource (DER) to improve SDG&E's load factor, reduce greenhouse gas (GHG) emissions and reduce local air pollution.

INNOVATION IN SPECIALTY APPLICATIONS

4:20 MegaWatt Wireless Charging Systems Drive the Need for Compatible Battery Chemistries in Heavy Duty Vehicle Applications
Michael P. Masquelier, CEO & CTO, WAVE Wireless Advanced Vehicle Electrification
With commercial deployments at 250kW for public transit enabling over 6 million miles, a recent 500kW demonstration for a Class-8 drayage truck, and a 1MW wireless charger in development for regional haul Class-8 trucks, it's time to revisit the battery pack specifications (chemistry, C-rate, cost) needed to support this extreme fast charge.

4:40 New Testing and Applications of High Energy Density Supercapacitors
Andrew F. Burke, PhD, Research Engineer, University of California Davis
There have been significant improvements in the energy density of supercapacitors in recent years. Several of these high energy density devices from Skeleton Technologies and Aowei China Have tested. Carbon/carbon cells exhibited energy density about 10 Wh/kg and hybrid lithium supercapacitors had energy densities up to 70Wh/kg. Applications of these new cells in various hybrid and electric vehicles have been assessed via vehicle simulations.

5:00 MODERATED Q&A: Session Wrap-Up
Moderator: Frank Falcone, Chief Engineer, Vehicle Testing, Calibration, and Validation, Meritor
Panelists:Joe Bielawski, Project Manager, San Diego Gas & Electric
Michael P. Masquelier, CEO & CTO, WAVE Wireless Advanced Vehicle Electrification
Andrew F. Burke, PhD, Research Engineer, University of California Davis

5:15 Grand Opening Networking Reception in the Exhibit Hall with Poster Viewing, *Sponsored by* **Clarios**

6:30 Evening Tutorials*
Seven tutorials will take place at AABC. The tutorials are designed to be instructional, interactive and provide in-depth information on a specific topic. Tutorial themes include introductions for those new to the field as well as explanations on more technical aspects than time allows during our partnering forum, symposia and main conference programs. Instructors are drawn from industry and academic alike, many of whom are recognized in their fields or have teaching experience.
**Tutorials included in All Access Pricing or separate registration required. See Tutorial page for details.*

8:00 Close of Day

WEDNESDAY, DECEMBER 8

8:30 am Registration and Morning Coffee

BATTERY SAFETY AND NAVIGATING REGULATORY REQUIREMENTS

8:55 Chairperson's Remarks
Ryan Hart, Air Resources Engineer, California Air Resources Board

9:00 Status of NTSB Recommendations on Responder Safety in EV Battery Fires
Thomas Barth, PhD, Senior Accident Investigator & Biomechanics Engineer, Office of Highway Safety, National Transportation Safety Board
The NTSB conducted investigations of EV fire events and issued a report with safety recommendations to NHTSA, vehicle manufacturers, and responder associations in January of 2021. This presentation reviews the progress and issues raised in that report. The evolution and status of emergency response guides for vehicles with high voltage Li-ion batteries is discussed.

9:20 Cylindrical Lithium Ion Battery Market Review 2021
Shmuel De-Leon, CEO, Shmuel De-Leon Energy Ltd.

HEAVY-DUTY ELECTRIC VEHICLE MARKET

9:40 Prioritizing School Buses in Medium and Heavy Duty Electrification
Stephanie Ly, PhD, Senior Manager, Fleet Electrification & Charging, Electric School Bus Initiative, World Resources Institute
This presentation will discuss the electric school bus market and how it fits into the medium- and heavy-duty sector. Specific opportunities to leverage the existing supply chain from battery suppliers to OEMs and dealerships have yet to be achieved. The session will link policy, incentives, and industry processes to outline next steps to electrify U.S. school buses.

10:00 MODERATED Q&A: Session Wrap-Up
Moderator: Ryan Hart, Air Resources Engineer, California Air Resources Board
Panelists:Thomas Barth, PhD, Senior Accident Investigator & Biomechanics Engineer, Office of Highway Safety, National Transportation Safety Board
Shmuel De-Leon, CEO, Shmuel De-Leon Energy Ltd.
Stephanie Ly, PhD, Senior Manager, Fleet Electrification & Charging, Electric School Bus Initiative, World Resources Institute

10:15 Coffee Break in the Exhibit Hall with Poster Viewing, *Sponsored by* **Vianode Elkem**

10:45 Close of Symposium

Battery Intelligence for Automotive Applications

How Smart Analysis of Your Battery Data Can Drive On-Time New Vehicle Launches, Optimal Performance, and Increased Margins

TUESDAY, DECEMBER 7

7:30 am Registration and Morning Coffee

INTRODUCTION TO ENTERPRISE BATTERY INTELLIGENCE (EBI)

8:50 Organizer's Remarks

Mary Ann Brown, Executive Director, Conferences, Cambridge EnerTech

INDUSTRY PERSPECTIVES

8:55 Chairperson's Remarks

Austin Sendek, PhD, Founder/CEO, Aionics, Inc.; Visiting Scholar, Stanford University

9:00 Introduction to Enterprise Battery Intelligence (EBI)

Tal Sholklapper, CEO & Co-Founder, Voltaiq, Inc.

While the industry is familiar with the battery and its battery management system (BMS), very few are aware of the critical need for a missing third layer, the Enterprise Battery Intelligence (EBI) system. The EBI is needed to unlock the significant advances in battery yield, energy density, and lifetime that the industry is calling for.

9:20 "Knees" in Lithium-Ion Battery Lifetime

Peter Attia, PhD, Department of Materials Science, Stanford University

One of the most challenging aspects of improving lithium-ion battery lifetime is the presence of "knees", or the sudden loss of capacity, power, or energy with cycling. Here, I summarize the work of an international collaboration to classify observed and proposed knee mechanisms from the literature. We find that some mechanisms can be predicted from electrochemical signals, while others cannot. This work informs strategies for battery lifetime prediction.

9:40 A Holistic Systems Approach for Lithium Metal Battery Development

Richard Wang, CEO & Founder, Cuberg

Successful commercial innovation in battery technology is uniquely difficult because of interrelated and coupled challenges stemming from the atomic scale all the way through GWh-level manufacturing. Cuberg, as part of Northvolt, has pioneered a vertically integrated approach towards battery innovation that combines excellence in simulation, data science, high-throughput testing, cell design, process development, supply chain, and customer distribution to deliver the world's first lithium metal battery at commercial scale.

10:00 MODERATED Q&A: Session Wrap-Up

Moderator: Austin Sendek, PhD, Founder/CEO, Aionics, Inc.; Visiting Scholar, Stanford University

Panelists:Tal Sholklapper, CEO & Co-Founder, Voltaiq, Inc.

Peter Attia, PhD, Department of Materials Science, Stanford University

Richard Wang, CEO & Founder, Cuberg

10:15 Coffee Break

10:35 Chairperson's Remarks

Tal Sholklapper, CEO & Co-Founder, Voltaiq, Inc.

10:40 Industry 4.0 Software Architecture and Data Collection During Cell Production

Bob Zollo, Solution Architect for Battery Testing, Keysight Technologies

This presentation covers software and data collection for cell formation, aging, and grading on production lines. A tuned solution for formation lines can be based on Industry 4.0 technologies, thus providing a system with flexibility and agility that securely manages processes, data collection, and storage. This data is an important battery intelligence data source to track cell provenance and history from cell development, manufacturing and batteries deployed in the field.

11:00 AI/ML Life Prediction in Use-Cases Having Complex Roles and Variable EOL Definitions

Susan Babinec, Program Lead, Stationary Storage, Argonne Collaborative Center for Energy Storage Science (ACCESS), Argonne National Laboratory

AI/ML cycle life prediction is emerging as *the* broadly transformational capability; initial focus has been on urgent transportation needs. Argonne's expanded scope includes diverse stationary markets, where useful life extends beyond 80% capacity and use-protocols are complex and changeable (e.g., stacking or role changes during asset life) and requires alternative research strategies. This talk compares results with various ML approaches and with the use of both experimental and synthetic data.

11:20 How to Improve Battery Performance, Lifetime and Safety Using Integrated Photonics Sensing

Paul van Wijk, Vice President, Sales, PhotonFirst

Growing numbers of electric propulsion for advanced performance (auto) motive applications drive the need for battery condition and health monitoring of temperature, voltage and current in and outside the pack as well as active cell balancing. PhotonFirst develops fiber optic sensing systems based on photonic integrated circuits (PICs) enabling low cost, robust, low weight and scalable solutions. Paul van Wijk will share how the company unlocks this technology for your application.

11:40 MODERATED Q&A: Session Wrap-Up

Moderator: Tal Sholklapper, CEO & Co-Founder, Voltaiq, Inc.

Panelists:Bob Zollo, Solution Architect for Battery Testing, Keysight Technologies

Susan Babinec, Program Lead, Stationary Storage, Argonne Collaborative Center for Energy Storage Science (ACCESS), Argonne National Laboratory

Paul van Wijk, Vice President, Sales, PhotonFirst

11:55 Networking Lunch, *Sponsored By* **USABC**

START-UP PERSPECTIVES

12:55 pm Chairperson's Remarks

Eli Leland, PhD, CTO and Co-Founder, Voltaiq, Inc.

1:00 Introduction to Battery Machine Learning

Christianna N. Lininger, PhD, Application Engineer, Voltaiq, Inc.

The field of battery development and manufacturing is full of opportunities for the application of machine learning. Machine learning techniques have accelerated materials discovery at the fundamental atomic scale, and have also impacted the commercial and manufacturing scale, accelerating failure predictions. In this talk, we will be covering some case studies of impactful machine learning applications in the battery field, spanning these time, length, and cost dimensions.

1:20 Predictive Battery Analytics: A Major Driver for Unlocking Value in the Battery Lifecycle – Examples from the Electric Bus & Automotive Industry

Stephan Rohr, Founder & Co-CEO, TWAICE

Battery Analytics gives customers control over batteries along the lifecycle: development, for optimized battery design; in-life, for optimized fleet management including maintenance, and in second life scenarios: reselling or repurposing in new use cases. Drawing on customer success stories, we will present arguments for deploying battery analytics in electric vehicle fleets. This holistic approach to lifecycle management enables lower costs, improved quality and a sustainable contribution to renewable energy.

1:40 Accelerating Battery Materials Discovery with Physics-Based Machine Learning

Austin Sendek, PhD, Founder/CEO, Aionics, Inc.; Visiting Scholar, Stanford University

New machine learning (ML) approaches offer a route to accelerated materials discovery by training predictive models on existing experimental data and then using these models to screen databases of candidate materials. In this talk, we present our research in using ML to accelerate electrode and electrolyte discovery, discuss best practices for the application of ML to materials design, and highlight the Aionics materials design software platform.

2:00 MODERATED Q&A: Session Wrap-Up

Moderator: Eli Leland, PhD, CTO and Co-Founder, Voltaiq, Inc.

Panelists:Christianna N. Lininger, PhD, Application Engineer, Voltaiq, Inc.

Stephan Rohr, Founder & Co-CEO, TWAICE

Austin Sendek, PhD, Founder/CEO, Aionics, Inc.; Visiting Scholar, Stanford University

2:15 Refreshment Break

2:35 Chairperson's Remarks

Christianna N. Lininger, PhD, Application Engineer, Voltaiq, Inc.

2:40 Charging Algorithms – Powered by Machine Learning – Can Ultra-Fast Charge Today's Lithium-Ion Batteries with Minimal Degradation

Kostyantyn Khomutov, Co-Founder and Chief Executive Officer, GBatteries

GBatteries will present an innovative and compelling way to charge unaltered Li-ion batteries, powered by machine learning. One which reduces irreversible chemical reactions and allows for ultra-fast charging.

3:00 Early Warning Prognostics and Prevention of Thermal Runaway

Niles Fleischer, CEO, ALGOLiON Ltd.

Lithium battery fires are becoming more common. ALGOLiON developed a software solution for the EV and other markets that provides the earliest detection of lithium battery fire hazards, warning of explosions days in advance instead of the seconds available now. AlgoShield provides a better ROI on your battery, and protects your products, the people who use them and your bottom line by lowering warranty costs and exposure to liabilities.

3:20 CellCheck Battery Intelligence

Thyag Sadasiwan, Marketing, KULR Technology

KULR will showcase its latest technology, CellCheck. CellCheck senses and analyzes a battery's full life history, and adverse incidents including electrical, physical, and environmental events which impact battery health. CellCheck is able to accurately predict battery health and safety throughout its lifecycle, delivering immediate assessments regarding hazards and risks, degradation of reliability and safety resulting from daily real-world use or abuse of energy dense batteries.

3:40 MODERATED Q&A: Session Wrap-Up

Moderator: Christianna N. Lininger, PhD, Application Engineer, Voltaiq, Inc.

Panelists:Kostyantyn Khomutov, Co-Founder and Chief Executive Officer, GBatteries

Niles Fleischer, CEO, ALGOLiON Ltd.

Thyag Sadasiwan, Marketing, KULR Technology

ACADEMIC PERSPECTIVES

3:55 Chairperson's Remarks

Christianna N. Lininger, PhD, Application Engineer, Voltaiq, Inc.

4:00 Multi-Task Learning for One-Shot Prediction of Battery Capacity and Power Degradation

Weihan Li, Research Associate & Team Lead for Battery Data and Machine Learning, ISEA, RWTH Aachen University

We introduce a data-driven prognostics framework to predict both capacity and power fade simultaneously with multi-task learning. The model is able to predict the degradation trajectory of both capacity and internal resistance together with knee-points and end-of-life points accurately with as little as 100 cycles. Compared with single-task learning models, the model shows a significant prediction accuracy improvement and reduces 50% of the total computational cost.

4:20 Learn Inter-Cycle Features for Battery Life Prognostics and Planning

Anna G. Stefanopoulou, William Clay Ford Professor of Technology, Professor Mechanical Engineering, Professor of Electrical and Computer Engineering, University of Michigan

We show an adaptive inter-cycle extrapolation algorithm that allows us to simulate the entire lifetime of the battery in seconds for a real-time decision. The accelerated simulation allows us also to iteratively tune (learn) degradation parameters to match experimental observations of capacity fade, loss of lithium inventory, and individual electrode capacities (features) from both cycling and calendar aging.

4:40 Machine Learning and Robotic Experimentation to Accelerate Battery Materials Innovation

Venkat Viswanathan, Assistant Professor, Mechanical Engineering, Carnegie Mellon University

In this talk, I will cover the use of machine learning and robotic experimentation to optimize battery electrolytes, both aqueous and non-aqueous. I'll demonstrate fully autonomous electrolyte discovery with no-human intervention and provide a landscape for the future of autonomous experimentation in batteries.

5:00 MODERATED Q&A: Session Wrap-Up

Moderator: Christianna N. Lininger, PhD, Application Engineer, Voltaiq, Inc.

Panelists:Weihan Li, Research Associate & Team Lead for Battery Data and Machine Learning, ISEA, RWTH Aachen University

Anna G. Stefanopoulou, William Clay Ford Professor of Technology, Professor Mechanical Engineering, Professor of Electrical and Computer Engineering, University of Michigan

Venkat Viswanathan, Assistant Professor, Mechanical Engineering, Carnegie Mellon University

5:15 Grand Opening Networking Reception in the Exhibit Hall with Poster Viewing, *Sponsored by* **Clarios**

6:30 Evening Tutorials*

Seven tutorials will take place at AABC across Tuesday and Thursday. The tutorials are designed to be instructional, interactive and provide in-depth information on a specific topic. Tutorial themes include introductions for those new to the field as well as explanations on more technical aspects than time allows during our partnering forum, symposia and main conference programs. Instructors are drawn from industry and academia alike, many of whom are recognized in their fields or have teaching experience.

**Tutorials included in All Access Pricing or separate registration required. See Tutorial page for details.*

8:00 Close of Day

WEDNESDAY, DECEMBER 8

8:30 am Registration and Morning Coffee

ACADEMIC PERSPECTIVES

8:55 Chairperson's Remarks
Tal Sholklapper, CEO & Co-Founder, Voltaiq, Inc.

9:00 Model-Based Battery Management Systems for Lithium-Ion Batteries
Venkat R. Subramanian, PhD, Ernest Dashiell Cockrell Chair Engineering & Professor, Mechanical & Materials Science Engineering, University of Texas Austin

Using model-based control strategies, we have developed optimal charging protocols to minimize the capacity fade due to SEI-layer formation, lithium-plating, and intercalation-induced stresses, while controlling internal temperatures inside the batteries. In collaboration with NREL, we have shown increase in cycle-life by more than 100%. We will present further results for faster charging and improved battery life on 2.2kWh battery modules.

9:20 Big Data for Li-Ion Battery Diagnosis and Prognosis
Matthieu Dubarry, PhD, Assistant Researcher, Battery Testing & Evaluation & Modeling, University of Hawaii

Battery diagnosis and prognosis algorithms are critical to increase penetration of electrochemical storage systems. Current data-driven models are often limited by the non-representativity of the training data available. This work will showcase how synthetic big data training datasets can be used for transfer learning to solve this issue. This approach offers the benefits of the broad applicability to various cell chemistries, designs, and operating modes, as well as high fidelity.

9:40 CO-PRESENTATION: Lithium-Ion Battery Degradation: What You Need to Know and How to Model and Diagnose It
Yatish Patel, PhD, Research Associate Mechanics of Materials, Mechanical Engineering, Imperial College, London
Gregory J. Offer, PhD, Professor in Electrochemical Engineering, Imperial College London

This presentation will focus on developing novel diagnostic and state estimation techniques which uniquely take advantage of the temperature of the cell and not just voltage and current. The latest work uses knowledge of the entropic behavior of the individual electrodes, to extract loss of lithium inventory (LLI), loss of active material (LAM) or stoichiometric drift, under realistic real-world operating conditions.

10:00 MODERATED Q&A: Session Wrap-Up
Moderator: Tal Sholklapper, CEO & Co-Founder, Voltaiq, Inc.
Panelists:Venkat R. Subramanian, PhD, Ernest Dashiell Cockrell Chair Engineering & Professor, Mechanical & Materials Science Engineering, University of Texas Austin
Matthieu Dubarry, PhD, Assistant Researcher, Battery Testing & Evaluation & Modeling, University of Hawaii
Yatish Patel, PhD, Research Associate Mechanics of Materials, Mechanical Engineering, Imperial College, London
Gregory J. Offer, PhD, Professor in Electrochemical Engineering, Imperial College London

10:15 Coffee Break in the Exhibit Hall with Poster Viewing, Vianode
Sponsored by **Vianode Elkem**

10:45 Close of Symposium

WEDNESDAY, DECEMBER 8

PLENARY KEYNOTE SESSION

10:45 am Organizer's Remarks
Craig Wohlers, Executive Director, Conferences, Cambridge EnerTech

10:55 Start-Up Award Winner Presentation

11:05 Panel Discussion: Beyond the Car – The Role of Batteries in the Low-Carbon Eco-System Required to Support EV Adoption
Moderator: Craig Rigby, Vice President, Technology, Clarios
This expert panel will discuss how these critical stationary applications will evolve, in part to support enabling electric vehicle adoption, as well as how different technologies tailor-made for these emerging requirements can provide disruptive value propositions in terms of performance, safety, and cost.
Panelists:Peter Lamp, PhD, Head, Research Battery Technology, BMW Group
Susan Babinec, Program Lead, Stationary Storage, Argonne Collaborative Center for Energy Storage Science (ACCESS), Argonne National Laboratory
Haresh Kamath, Director, DER and Energy Storage, Electric Power Research Institute
Celina Mikolajczak, Chief Manufacturing Officer, QuantumScape
Colin Wessells, PhD, CEO, Natron Energy

12:15 pm Networking Lunch, *Sponsored by* **Keysight**

1:15 Dessert Break in the Exhibit Hall with Poster Viewing

xEV MARKET EXPANSION

2:05 Organizer's Remarks
Crag Wohlers, Executive Director, Conferences, Cambridge EnerTech

2:10 How Ultium Will Power GM's All-Electric Future
Andrew Oury, Engineering Technical Leader, Battery Packs, General Motors
General Motors believes in an all-electric future with zero crashes, zero emissions, and zero congestion. GM plans to launch 30 new all-electric vehicles by 2025, leveraging the innovative Ultium Platform, GM's next-generation BEV architecture. Mr. Oury will discuss key technical features of the Ultium Platform and how its flexibility can power electric vehicles across wide-ranging segments, from performance vehicles to mid-size SUVs and the world's first all-electric super-truck.

2:30 Beyond Propulsion: Additional Vehicle Features Becoming the Norm for Electrified Vehicles
Kevin Vander Laan, Supervisor, Battery Cell & Systems, Ford Motor Co.
Electrified vehicles represent a broad range of vehicle types and customers (retail and commercial), electrified vehicles support many additional customer features made possible through electrification. Consequently, the battery is expected to support these customer features – all of which add to the usage of the high-voltage battery. This presentation will further explain these different features and their impact on the battery using examples from various types of electrified vehicles.

2:50 MODERATED Q&A: Session Wrap-Up
Moderator: Brian Barnett, PhD, President, Battery Perspectives
Panelists:Andrew Oury, Engineering Technical Leader, Battery Packs, General Motors
Kevin Vander Laan, Supervisor, Battery Cell & Systems, Ford Motor Co.

3:05 Refreshment Break in the Exhibit Hall with Poster Viewing

4:15 How to Make a Large-Scale Battery Cell Factory Cost Competitive
Lukas Mauler, Leading Manager New Powertrain Technologies, Porsche Consulting
Dramatic capacity increases and increasing cost pressure are the main challenges for cell manufacturers to be successful on the global market. To succeed in this market environment, a progressive industrialization strategy as well as an intelligent cost reduction strategy are required.

BATTERIES FOR xEVs

4:35 Next-Generation Engineered Lithium-Metal Batteries for xEV Applications
Jeffrey Britt, PhD, COO, Sion Power Corporation
Sion Power has focused efforts on the development of Licerion-EV, a cell design geared explicitly towards meeting and exceeding automotive requirements for next-generation cell technology. Licerion-EV has gone beyond the lab and into commercial-sized cells focusing on automotive industry requirements for the next-generation electric vehicles.

4:55 How to Launch an EV – Demystifying EV Pack Development From Cell Selection to Vehicle Integration
Nicole Schauser, PhD, Applications Engineer, Customer Success, Voltaiq
Launching a new EV is a high-stakes game, where any problems encountered during development can jeopardize ship dates. We'll walk through each stage of EV pack development and highlight how an integrated Battery Intelligence platform can drive an on-time launch, while ensuring quality and traceability throughout the vehicle lifecycle.

5:15 MODERATED Q&A: Session Wrap-Up
Moderator: Brian Barnett, PhD, President, Battery Perspectives
Panelists:Lukas Mauler, Leading Manager New Powertrain Technologies, Porsche Consulting
Jeffrey Britt, PhD, COO, Sion Power Corporation
Nicole Schauser, PhD, Applications Engineer, Customer Success, Voltaiq

5:30 Networking Reception in the Exhibit Hall with Poster Viewing, *Sponsored by* **Toyota**

6:30 Close of Day

THURSDAY, DECEMBER 9

6:45 am Registration and Morning Coffee

7:15 Morning Tutorials*
Seven tutorials will take place at AABC. The tutorials are designed to be instructional, interactive and provide in-depth information on a specific topic. Tutorial themes include introductions for those new to the field as well as explanations on more technical aspects than time allows during our partnering forum, symposia and main conference programs. Instructors are drawn from industry and academic alike, many of whom are recognized in their fields or have teaching experience.
**Tutorials included in All Access Pricing or separate registration required. See Tutorial Page for details.*

8:45 Session Break-Transition to Conference Programs

xEV MARKET EXPANSION

9:00 Organizer's Remarks
Victoria Mosolgo, Assoc Conference Producer, Production, Cambridge EnerTech

9:05 Chairperson's Remarks
Kevin Konecky, Director, Battery Institute, Vinfast

9:10 Introduction of Honda's VGI Programs
Kiyotaka Kawashima, PhD, EV & Energy Business Lead, American Honda Motor Co., Inc.
Honda had conducted a number of VGI research programs in the past. We are shifting gears to launch commercial energy services globally. In this presentation, we would like to update the audience following Honda's VGI pilot and commercial

programs.

BATTERIES FOR xEVs

9:30 12V Batteries: Delivering Safety, Security and Enhanced Reliability in Electric Vehicles

Eric Michielutti, Director for Lithium Ion Product and Technology, Clarios

The emergence of electric vehicles has intensified the demands of the low-voltage power net and redefined the role of the 12V battery. Enhanced levels of vehicle autonomy have driven the 12V battery to become a critical safety component providing redundancy and drive support. This talk will explore the shifting requirements of 12V batteries in xEV and autonomous platforms and the future of low voltage battery technology.

9:50 Enevate: Fast Charge, Fast-track to Sustainability

Benjamin Park, PhD, Founder and CTO, Enevate Corporation

Enevate is a battery technology company supplying breakthrough technologies to the battery industry. Its pure silicon-dominant Li-ion cells designed with its own electrolyte and cell designs allow for unique properties including extreme fast charge while increasing high energy density, wide temperature operation, safety, and potential for reduced cost. Technical developments, cell operation and design principles, and sustainability updates will be given.

10:10 MODERATED Q&A: Session Wrap-Up

Moderator: Kevin Konecky, Director, Battery Institute, Vinfast

Panelists:Eric Michielutti, Director for Lithium Ion Product and Technology, Clarios

Kiyotaka Kawashima, PhD, EV & Energy Business Lead, American Honda Motor Co., Inc.

Benjamin Park, PhD, Founder and CTO, Enevate Corporation

10:25 Coffee Break in the Exhibit Hall with Poster Viewing

FAST-CHARGING

11:25 Chairperson's Remarks

Brian McCarthy, PhD, Senior Scientist, EC Power

11:30 Fast Charging of Lithium-Ion Batteries at All Temperatures

Brian McCarthy, PhD, Senior Scientist, EC Power

Range anxiety is a key reason that consumers are reluctant to embrace electric vehicles (EVs). However, none of today's EVs allow fast charging in cold or even cool temperatures due to the risk of lithium plating, the formation of metallic lithium that drastically reduces battery life and even results in safety hazards. Here, we present an approach that enables 15-minute fast charging of Li-ion batteries in any temperatures (-50 °C).

11:50 P3 Charging Index

Simon Buderath, Strategy & Technology Consulting, P3 USA

12:10 pm Software Intelligence for Safer Electric Vehicle (EV) Batteries

Nadim Maluf, CEO, Qnovo

Qnovo intelligent battery management software delivers an exceptional experience to next-generation electric vehicles that do not require battery compromises. Improved safety, all-weather superfast charging, longer driving range, extended warranty, predictive maintenance, and predictive analytics come standard. In this presentation, we share lessons learned to scale adaptive charging solutions to large form-factor multi-cell packs used in EVs.

12:30 Moderated Q&A: Session Wrap-Up

Moderator: Brian McCarthy, PhD, Senior Scientist, EC Power

Panelists:Simon Buderath, Strategy & Technology Consulting, P3 USA

Nadim Maluf, CEO, Qnovo

12:45 Networking Lunch

1:45 Dessert Break in the Exhibit Hall with Poster Viewing

LIFE & RELIABILITY

2:30 Chairperson's Remarks

Oliver Gross, MASc, SME Energy Storage and Conversion, Advanced Propulsion Technology, Stellantis

2:35 Squeezing the Balloon – Exploring the Constraints on Engineering Future Traction Batteries

Oliver Gross, MASc, SME Energy Storage and Conversion, Advanced Propulsion Technology, Stellantis

In the past decade, the automotive industry has seen traction battery energy density nearly triple and cost per kWh drop by 90%. It would be comforting to believe that such trends will continue, but there are certain limitations becoming evident to the development of future batteries. We explore what progress remains practically available to traction batteries and contrast potential future developmental pathways, when the vehicle and customer are prioritized.

2:55 BYD Battery Roadmap

Samuel Kang, Head of Total Solutions, BYD America

3:15 Solid State Battery Technology Breakthrough, Commercialization, and Highlights of ProLogium

Lisa Hsu, Director, Marketing Division, ProLogium Technology

As EV demand growing, the industry is seeking the next generation battery and solid state battery is considered the most promising one due to high safety, high energy density and low cost advantages. In this talk, ProLogium will highlight its enabling solid state battery technology progress, competitiveness with peers and the omni solution for commercializing EV application.

3:35 MODERATED Q&A: Session Wrap-Up

Moderator: Oliver Gross, MASc, SME Energy Storage and Conversion, Advanced Propulsion Technology, Stellantis

Panelists:Samuel Kang, Head of Total Solutions, BYD America

Lisa Hsu, Director, Marketing Division, ProLogium Technology

3:50 Refreshment Break Exhibit Hall - Last Chance for Poster Viewing

INFRASTRUCTURE

4:10 Chairperson's Remarks

Gil Tal, PhD, Director, Plug In Hybrid & Electric Vehicle PH & EV Research, University of California Davis

4:15 Cost-Effective Integration of Second-Life EV Batteries with Solar PV Systems for Commercial Buildings

Chris Chunting Mi, PhD, Professor & Chair, Electrical & Computer Engineering, San Diego State University

The aim of this study is to validate that using second-life EV batteries in BESS for PV and storage systems for commercial buildings will reduce the overall cost over serviceable life compared to using new batteries. To achieve this, we are conducting thorough multi-scale analysis and modeling of the second-life EV battery aging process and building degradation models, accordingly developing optimized energy management strategy considering PV and load profiles.

4:35 Demand Drivers for Charging Infrastructure –- On Our Way from 10% to 100% Market Share

Gil Tal, PhD, Director, Plug In Hybrid & Electric Vehicle PH & EV Research, University of California Davis

4:55 Transportation Electrification, Charging Infrastructure

Jordan Smith, Engineering Manager, Advanced Technology, Southern California Edison

5:15 Moderated Q&A: Session Wrap-Up

Moderator: Gil Tal, PhD, Director, Plug In Hybrid & Electric Vehicle PH & EV Research, University of California Davis

Panelists:Chris Chunting Mi, PhD, Professor & Chair, Electrical & Computer Engineering, San Diego State University

Jordan Smith, Engineering Manager, Advanced Technology, Southern California Edison

5:30 Close of Conference

Global Battery Raw Materials

Balancing Supply, Demand & Costs for Battery Component Materials

WEDNESDAY, DECEMBER 8

PLENARY KEYNOTE SESSION

10:45 am Organizer's Remarks
Craig Wohlers, Executive Director, Conferences, Cambridge EnerTech

10:55 Start-Up Award Winner Presentation

11:05 Panel Discussion: Beyond the Car – The Role of Batteries in the Low-Carbon Eco-System Required to Support EV Adoption

Moderator: Craig Rigby, Vice President, Technology, Clarios
This expert panel will discuss how these critical stationary applications will evolve, in part to support enabling electric vehicle adoption, as well as how different technologies tailor-made for these emerging requirements can provide disruptive value propositions in terms of performance, safety, and cost.
Panelists:Peter Lamp, PhD, Head, Research Battery Technology, BMW Group
Susan Babinec, Program Lead, Stationary Storage, Argonne Collaborative Center for Energy Storage Science (ACCESS), Argonne National Laboratory
Colin Wessells, PhD, CEO, Natron Energy
Celina Mikolajczak, Chief Manufacturing Officer, QuantumScape
Haresh Kamath, Director, DER and Energy Storage, Electric Power Research Institute

12:15 pm Networking Lunch, *Sponsored by* **Keysight**

1:15 Dessert Break in the Exhibit Hall with Poster Viewing

GLOBAL MARKET DEMAND FOR BATTERY MATERIALS

2:00 Organizer's Remarks
Victoria Mosolgo, Assoc Conference Producer, Production, Cambridge EnerTech

2:05 Chairperson's Remarks
Shmuel De-Leon, CEO, Shmuel De-Leon Energy Ltd.

2:10 Supply Chain Security in the Lithium-Ion Economy
Albert Li, Analyst, China, Benchmark Mineral Intelligence
An overview of the supply chain dynamics at the center of lithium ion economy, from critical raw materials and chemical components through to their battery cells and EV, ESS, and portable applications.

2:30 Battery Metals Price Recoveries – Where Will Momentum Head?
Alice Yu, Senior Research Analyst, Metals and Mining Research, S&P Global Market Intelligence
Positive fundamentals drove lithium and cobalt price rallies at the start of 2021. Do the price increases reflect the start of a new cycle, or are these just temporary reversals? This presentation will assess battery metals performances in 2021 and provide our price projections, taking into account PEV sales, battery mix, metals demand, project financing, and supply cost.

2:50 Green Growth in North America: Technology and Inflation in a Post-Pandemic Economy
Chris Berry, Founder & President, House Mountain Partners
This presentation will attempt to offer a realistic view of how supply chains can be regionalized, what the obvious and hidden costs are, and who will win and who will lose both economically and geopolitically as the global economy electrifies and digitizes.

3:10 MODERATED Q&A: Session Wrap-Up
Moderator: Shmuel De-Leon, CEO, Shmuel De-Leon Energy Ltd.
Panelists:Albert Li, Analyst, China, Benchmark Mineral Intelligence
Alice Yu, Senior Research Analyst, Metals and Mining Research, S&P Global Market Intelligence
Chris Berry, Founder & President, House Mountain Partners

3:25 Refreshment Break in the Exhibit Hall with Poster Viewing

GLOBAL MARKET DEMAND FOR BATTERY MATERIALS

4:30 Chairperson's Remarks
Shmuel De-Leon, CEO, Shmuel De-Leon Energy Ltd.

BATTERY RAW MATERIALS SUPPLY

4:35 North American Battery Materials - Risks and Opportunities
Trent Mell, President & CEO, Electra Battery Materials Corporation
Is cobalt destined to be the choke point of the EV supply chain? Roughly 70% of cobalt supply is mined in the DRC and most of that mine feed finds its way to China for refining. China controls a majority of refined cobalt market, including almost 80% of the cobalt sulfate chemical required for lithium-ion batteries. What opportunities exist to diversify mine supply and refining away from these two countries?

4:55 Replacing Pitch Coating on SPG
Daniel Higgs, PhD, Director of Product Marketing, Forge Nano
When batteries are stored or used, unwanted reactions occur inside leading to degradation of performance. Many of these unwanted reactions, such as transition metal dissolution, lithium inventory loss, and solid electrolyte interphase (SEI) growth, can be slowed by coatings the cathode and anode powders before the battery is made. This talk will present an alternative to pitch coating on SPG anode powders.

5:15 MODERATED Q&A: Session Wrap-Up
Moderator: Shmuel De-Leon, CEO, Shmuel De-Leon Energy Ltd.
Panelists:Trent Mell, President & CEO, Electra Battery Materials Corporation
Daniel Higgs, PhD, Director of Product Marketing, Forge Nano

5:30 Networking Reception in the Exhibit Hall with Poster Viewing, *Sponsored by* **Toyota**

6:30 Close of Day

THURSDAY, DECEMBER 9

6:45 am Registration and Morning Coffee

7:15 Morning Tutorials*
Seven tutorials will take place at AABC. The tutorials are designed to be instructional, interactive and provide in-depth information on a specific topic. Tutorial themes include introductions for those new to the field as well as explanations on more technical aspects than time allows during our partnering forum, symposia and main conference programs. Instructors are drawn from industry and academic alike, many of whom are recognized in their fields or have teaching experience.
**Tutorials included in All Access Pricing or separate registration required. See Tutorial Page for details.*

8:45 Session Break-Transition to Conference Programs

GLOBAL MARKET DEMAND FOR BATTERY MATERIALS

9:00 Organizer's Remarks
Craig Wohlers, Executive Director, Conferences, Cambridge EnerTech

9:05 Chairperson's Remarks
Daniel Higgs, PhD, Director Business Development, Forge Nano

9:10 Impact of the xEV Market Growth on Lithium-Ion Batteries and Raw Materials Supply 2020-2030
Michael Sanders, Senior Advisor, Energy, Avicenne Energy
Today less than 1% of the automotive market is Electric Vehicle. With this very small market share, xEV already consume more than 60% of the total Li-ion battery production, more than 40% of the cobalt production, and more than 50% of the lithium production. With conservative xEV forecasts (5 million EV sold per year in 2025), the impact on the lithium-ion battery market and supply chain will be huge.

BATTERY RAW MATERIALS SUPPLY

9:30 Vulcan Energy – A Local and Zero Carbon Source of Lithium
Vincent Ledoux-Pedailles, Vice President, Vulcan Energy
Vulcan Energy is aiming to become the first Zero Carbon Lithium producer in the world. There is currently no lithium production in Europe, more than 80% is coming from China, which is a supply chain risk. It is also an environmental risk as current production processes are carbon heavy, use harsh chemicals, and consume a lot water. Vulcan will address Europe's need for local and sustainably produced lithium.

9:50 Thermal Management Solutions - Proposal from Japan Made Insulation Materials Quality -
Saki Hamada, Sales staff, Business Development, AWA PAPER & TECHNOLOGICAL COMPANY, Inc.
Electric Vehicles are becoming more widespread due to worldwide environmental concerns. In particular, batteries, which are an important component in EV, are being developed by each company to enable safe and long-distance cruising. We have developed a heat insulating material for lithium-ion batteries as one of the safety measures. This presentation will introduce a heat insulating material that can withstand high temperatures and is durable even for long-term use.

10:10 MODERATED Q&A: Session Wrap-Up
Moderator: Daniel Higgs, PhD, Director Business Development, Forge Nano
Panelists:Michael Sanders, Senior Advisor, Energy, Avicenne Energy
Vincent Ledoux-Pedailles, Vice President, Vulcan Energy

10:25 Coffee Break in the Exhibit Hall with Poster Viewing

11:25 Chairperson's Remarks
Daniel Higgs, PhD, Director Business Development, Forge Nano

11:30 Sustainable Response to the Challenges of Growing Nickel Demand
Denis Sharypin, Head, Market Research, MMC Norilsk Nickel
The transport electrification, wider use of renewable energy and expansion of energy storage push nickel demand higher. This presentation will focus on nickel demand projections by industry and potential additional supply sources, including an update on Indonesian projects and possible constraints with the NPI to nickel sulphate conversion plans. The nickel incentive price required to bring additional metal units to the market will be also examined.

11:50 Graphite: Carbon for a Decarbonizing World
Gavin Montgomery, Director Battery Raw Materials, Metals & Mining, Wood Mackenzie Ltd.
We will present on the challenges and implications of scaling up both synthetic and natural graphite to meet the demand from electrification. Will look at market fundamentals, project pipelines, ESG challenges and costs for OEMs.

12:10 pm The Nickel Supply Chain Challenge
Alex Laugharne, Principal Consultant, Consulting, CRU International
In this talk, CRU Principal Consultant Alex Laugharne will set out how rapidly growing nickel supply concentration in Indonesia and China conflicts sharply with Western battery sector consumers' strategic, security of supply, and ESG goals. This talk will describe what can be done by stakeholders across the industry to address these increasingly critical issues.

12:30 MODERATED Q&A: Session Wrap-Up
Moderator: Daniel Higgs, PhD, Director Business Development, Forge Nano
Panelists:Denis Sharypin, Head, Market Research, MMC Norilsk Nickel
Gavin Montgomery, Director Battery Raw Materials, Metals & Mining, Wood Mackenzie Ltd.
Alex Laugharne, Principal Consultant, Consulting, CRU International

12:45 Networking Lunch

1:45 Dessert Break in the Exhibit Hall with Poster Viewing

BATTERY RAW MATERIALS SUPPLY

2:30 Chairperson's Remarks
Alex Laugharne, Principal Consultant, Consulting, CRU International

2:35 Euro Manganese - Battery-Grade Manganese Products in the Heart of Europe, Made by Recycling Waste
Marco Romero, Mr., CEO, Euro Manganese Inc.
Euro Manganese stands to become the only primary producer of high purity manganese in the European Union, as the region works to establish a strong and sustainable local battery supply chain to serve its fast-growing EV industry. The Chvaletice Project is designed to meet increasingly stringent EU regulations, which will require battery raw materials providers to address the full product life cycle, including carbon footprint and requirements for recycling and using recycled materials.

INNOVATIONS IN RECYCLING BATTERY MATERIALS

2:55 Cathode-Healing for Efficiency and Cost Savings in Manufacturing
Steve Sloop, PhD, President, OnTo Technology LLC
Efficiency is critical for competitive US manufacturing of lithium-ion batteries and eliminating the 5-10% cost on manufacturing due to scrap can help to double already razor thin margins. OnTo's environmentally friendly, innovative direct recycling technology can essentially eliminate this loss in manufacturing.

3:15 Decarbonizing Battery Material Supply Chains
Michael Tamlin, COO, Neometals Ltd.
Battery recycling creates generates raw materials for new battery manufacture with responsible sourcing and the circular economy borne in mind. Further, if done sustainably, recycling significantly reduces the CO2 footprint of electric vehicles. Neometals is part of the solution.

3:35 MODERATED Q&A: Session Wrap-Up
Moderator: Alex Laugharne, Principal Consultant, Consulting, CRU International
Panelists:Steve Sloop, PhD, President, OnTo Technology LLC
Michael Tamlin, COO, Neometals Ltd.
Marco Romero, Mr., CEO, Euro Manganese Inc.

3:50 Refreshment Break Exhibit Hall - Last Chance for Poster Viewing

INNOVATIONS IN RECYCLING BATTERY MATERIALS

4:10 Chairperson's Remarks
Steve Sloop, PhD, President, OnTo Technology LLC

4:15 ReCell Center's Update on Lithium-Ion Battery Recycling Research
Bryant J. Polzin, Process Engineer & Deputy Director, ReCell Center, Argonne National Laboratory
As the ReCell Center moves into its third year, it continues to invent new technologies and refine existing recycling processes. The Center is focused on scaling up its technologies and applying them to the processing of both manufacturing scrap and end-of-life batteries. The presentation will highlight the progress of the Center.

4:35 Creating the Circular Economy Around Lithium-Ion Batteries
Jean-Christophe Lambert, Director, Lithion Recycling
What are the current challenges of establishing a proper battery recycling industry? We wish to share our thoughts on what solutions can be put in place to bring recycling to scale and what needs to be developed technically and commercially to have a full close-loop on battery materials.

4:55 Volume Will Allow for Technological Advances in Material Recovery from Recycled Batteries
Shane Thompson, President, Heritage Battery Recycling
We are approaching a point where the volume of batteries will allow for the upgrading of historical black mass. HBR is investing in technologies (selective separation technology) that will recover material. This material will be more amenable to being put back into the battery supply chain. In this presentation, we will provide an overview of these technologies and timing with implementation.

5:15 MODERATED Q&A: Session Wrap-Up
Moderator: Steve Sloop, PhD, President, OnTo Technology LLC
Panelists:Bryant J. Polzin, Process Engineer & Deputy Director, ReCell Center, Argonne National Laboratory
Jean-Christophe Lambert, Director, Lithion Recycling
Shane Thompson, President, Heritage Battery Recycling

5:30 Close of Conference

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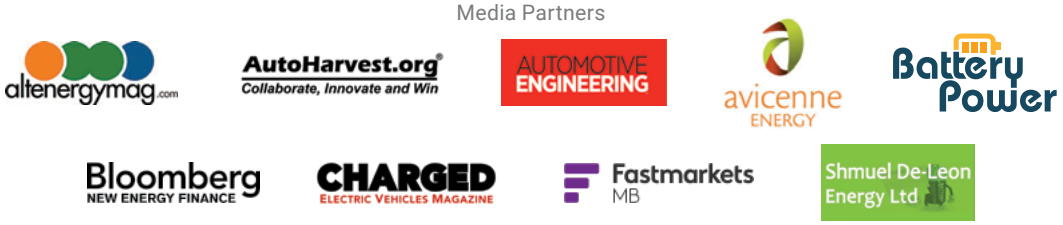

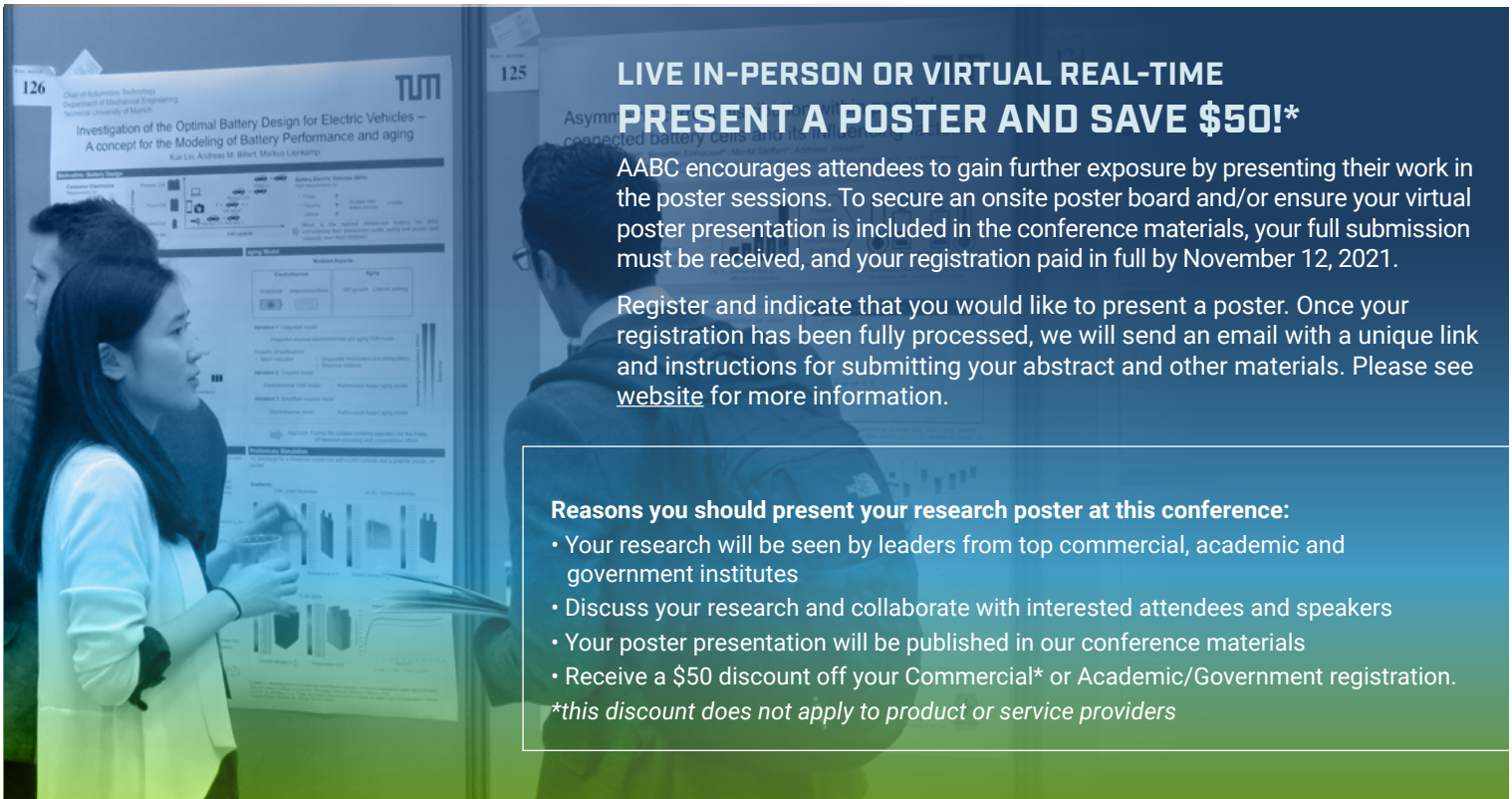

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Register and indicate that you would like to present a poster. Once your registration has been fully processed, we will send an email with a unique link and instructions for submitting your abstract and other materials. Please see website for more information.

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TUESDAY, DECEMBER 7

7:30 am Registration and Morning Coffee

STRATEGIC INVESTING FOR OPPORTUNITIES IN RENEWABLE ENERGY

8:50 Organizer's Remarks

Craig Wohlers, Executive Director, Conferences, Cambridge EnerTech

8:55 Chairperson's Remarks

Christopher Claxton, Principal, Volta Energy Technologies

9:00 Implications of Economy-Wide Decarbonization on the Battery Industry

James Frith, PhD, Senior Associate, Energy Storage, Bloomberg LP

Decarbonizing an economy, rather than just power or transport, changes the nature of the challenge ahead. The transition to a low-carbon economy, for instance, blurs the distinction between the transport and power sectors. Batteries underpin this transition and are of strategic importance to companies and countries alike across industries. In this session, we review energy transition investment and activity and highlight notable technology advancements and the implications for battery demand.

9:20 Battery Investing Sweet Spots

Sam Jaffe, Founder & Managing Director, Cairn Energy Research Advisors

This presentation will explore historical investing approaches to batteries that have failed and suggest a path forward for making battery investments pay off. Investing in companies that incrementally improve Li ion performance will always have a better chance at success than investing in a completely new battery architecture.

9:40 Venture Landscape in Battery, Energy Storage, and Related Technology

Jeffrey Chamberlain, PhD, CEO, Volta Energy Technologies

10:00 Session Break

START-UP INNOVATION SHOWCASE

10:20 Start-Up Pitch Session Chairperson & Judge Introductions

Christopher Claxton, Principal, Volta Energy Technologies

10:20 START-UP PITCH SESSIONS

We will be awarding 8 early-stage speaking slots to give presentations during the EnerTech Innovation and Investment Forum pitch sessions. Selected finalists will pitch to a group of judges consisting of venture capital firms and key industry executives. 1 finalist will be awarded a 10 minute presentation during the conference plenary keynote session.

The deadline has now passed. Feel free to submit a proposal to be considered for future pitch sessions.

Please CLICK HERE to submit a proposal

10:20 Pitch Session: JUDGES PANEL

Moderator: Christopher Claxton, Principal, Volta Energy Technologies

Panelists:Dong Su Kim, PhD, CEO, LG Technology Ventures

Jeffrey Chamberlain, PhD, CEO, Volta Energy Technologies

David Schroeder, PhD, CTO, Volta Energy Technologies

Frederick Stoa, Investment Manager, Equinor

Michael Falcon, Partner, In-Q-tel

Sungkwon Kang, PhD, Director, LG Technology Center of America

10:30 START-UP PITCH 1: An Easily Adoptable Anode Solution to Improve Battery Performance and Safety

Carol J Hirschmugl, PhD, Founder & CEO, COnovate

COnovate is a seed-stage company with a novel composite material developed by the co-founders at a University of Milwaukee laboratory. This new patented material has a unique set of beneficial properties as an anode material, including a larger interlayer structure that facilitates much faster lithium intercalation than graphite, and can be produced from a variety of carbon sources (including renewable feedstocks).

10:45 START-UP PITCH 2: TENIX Nanoadditives for Power-Boosted Cathodes

Paige Johnson, Founder & CEO, Ten-Nine Technologies LLC

New materials are required for lithium ion batteries to significantly advance in both performance and sustainability. While the auto industry has embraced silicon additives to enhance anode performance, no similar solutions for the cathode have existed...until now. Ten-Nine Technologies' proprietary nano-additives can up to double pulse power capability when blended with traditional cathode materials, including at low states of charge, and are nickel and cobalt-free.

11:00 START-UP PITCH 3: Low-Cost Roll-to-Roll Nanolayer Electrode Coatings for High-Energy, High-Safety EV Batteries

Jonathan Tan, Co Founder & CEO, Coreshell Technologies

Coreshell is unlocking the true capacity and economics of batteries to enable the timely deployment of electric vehicles and clean energy. Our founding team has a proven track record of commercializing world-leading nanolayer materials in polymer membranes, thin-film solar & electrochromic. We're now applying that expertise to create a low-cost liquid-deposition electrode-level coating that enables high-energy, low fire-risk, and significantly reduced cost/kWh batteries.

11:15 START-UP PITCH 4: Catalyzing the EV Transition with Breakthrough Battery Manufacturing Inspection & Intelligence

Andrew Hsieh, PhD, Co Founder & CEO, Feasible Inc

Battery production must scale with unprecedented speed, while decreasing cost by >40% and improving reliability. Our breakthrough inspection and intelligence platform enables customers to detect production issues upstream at their source, as opposed to days or weeks later. By providing in-process insights into production quality, we help customers speed up development of new batteries and processes, accelerate scale-up and yield ramp for new manufacturing operations, and increase productivity and profitability.

11:30 Session Break and Networking Session

LATE-STAGE INNOVATOR SHOWCASE

1:15 pm Chairperson's Remarks

Christopher Claxton, Principal, Volta Energy Technologies

1:20 Towards Commercial Adoption of Model Based Battery Management Systems - From Theory to Practice

Manan Pathak, PhD, Co Founder & CEO, BattGenie Inc

BattGenie's innovation is the development and deployment of physics-based fast solving electrochemical models which are computationally efficient and can run on low-cost microcontrollers. These models have been validated to increase cycle life over 100%, and reduce charging time by 40%. This talk will give an overview of BattGenie 's BMS algorithms.

1:40 Scaling New Technology for International Growth

Ajay Kochhar, President & CEO, Li Cycle Corp

This presentation will explore Li-Cycle's patented and commercial approach to lithium-ion (Li-ion) battery resource recovery and how it can be applied to multiple verticals and across diverse markets. Ajay Kochhar, our President and CEO, Co-Founder, and Executive Director will also detail the scalability of Li-Cycle's technology and how it plays a key role in our global expansion plans, and the opportunities and challenges of raising capital, particularly during the pandemic.

START-UP INNOVATOR SHOWCASE

2:00 START-UP PITCH SESSIONS

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2:00 Pitch Session: JUDGES PANEL

Moderator: Christopher Claxton, Principal, Volta Energy Technologies

Panelists:Dong Su Kim, PhD, CEO, LG Technology Ventures

Jeffrey Chamberlain, PhD, CEO, Volta Energy Technologies

David Schroeder, PhD, CTO, Volta Energy Technologies

Frederick Stoa, Investment Manager, Equinor

Michael Falcon, Partner, In-Q-tel

Sungkwon Kang, PhD, Director, LG Technology Center of America

2:00 START-UP PITCH 5: High-Energy-Density Vehicle Battery with Drop-in Lithium Anode Enabled

XiaoLiang Leon Wang, PhD, Founder, R&D, Automat Solutions

A novel class of high-energy-density batteries will be developed by dropping lithium metal anode into conventional lithium-ion battery, enabled by an advanced liquid electrolyte. The development process employs a closed-loop machine learning and high-throughput robotic experimentation workflow, which allows for an efficient search of the vast chemical and material space for possible electrolytes.

2:15 START-UP PITCH 6: In-Vehicle Battery Diagnostics to Enable the Circular Economy

Steven Chung, Co Founder & CFO, Engineering, ReJoule Inc

ReJoule's diagnostic system, based on electrochemical impedance spectroscopy, is a fast and non-invasive solution that can help maximize the value of every battery. We've tested our system on used battery modules and will be moving upstream to characterize battery packs in-vehicle.

2:30 START-UP PITCH 7: EnPower – Building Better Batteries

Annette Finsterbusch, President & CEO, Enpower Inc

EnPower, Inc. is a lithium-ion battery company building cells that solve the trade-off between energy and power. EnPower's patented multilayer electrodes enable high energy density cells to repeatedly fast charge without causing degradation or capacity fade in the batteries. The company operates an R&D line in Phoenix, AZ, and plans to expand U.S. production for e-mobility applications in 2022.

2:45 START-UP PITCH 8: Unlocking Low Cost Pure Micron Silicon

Surya Moganty, CTO, NOHMs Technologies Inc.

Silicon can hold about 10 times the number of lithium-ion as the existing material in lithium-ion batteries – graphite, and its use could lead to 20-40% higher energy density. Our patented anode architecture combined with proprietary electrolyte design produce an expansion-controlled pure micron sized silicon-based Li-ion battery with a long-life span. This talk will provide the performance of silicon anodes based on pure µm silicon.

3:00 Session Break and Networking Session

LATE-STAGE INNOVATOR SHOWCASE

4:00 Creating Lower Cost and Manufacturable Solid-State Battery

Freidoon Rastegar, CEO, Solid State Battery Inc.

SSB has developed a battery material does not use any volatile solvents in it is process. The specialized material eliminates the need for a large and lengthy dryer system found in standard lithium-ion battery manufacturing, substantially reducing capital needs.

4:20 Enovix 3D Silicon Lithium-Ion Battery: From Mobile Electronics to Electric Vehicles

Cameron Dales, GM & Chief Commercial Officer, Enovix

Enovix is the leader in advanced silicon-anode lithium-ion battery development and production. This presentation will describe the company's 3D cell architecture, its "drop-in" cell assembly process, its first 100% active silicon-anode lithium-ion battery production facility in Fremont, CA, and its go-to-market strategy, including commercial delivery to leading mobile electronic device OEMs in 2022. The presentation will conclude with an update on the company's EV battery development program.

4:40 High Energy Density with Ultrafast Charging in Lithium-Ion: Can It Be Done?

Fernando Gomez-Baquero, PhD, Director of Runway and Spinouts, Jacobs Technion-Cornell Institute

A decade of research in Li-ion batteries has brought good advancements in energy density, but less so in charging times. Most "fast charging" cells in the market in reality achieve around 2C and by an excessive charging current to the detriment of cell cycle life. In this talk, I will address the challenges in fast charging and the potential solutions to reduce the trade-off between energy and fast charging beyond 30C.

5:00 Announcement of the Winner of the 2021 AABC Start-Up Award

Christopher Claxton, Principal, Volta Energy Technologies

The start-up pitch winner will be presented their award during the plenary session on Thursday, December 9th and will do a 10 minute presentation during the plenary keynote session.

5:15 Grand Opening Networking Reception in the Exhibit Hall with Poster Viewing, *Sponsored by* **Clarios**

6:30 Evening Tutorials*

Seven tutorials will take place at AABC across Tuesday and Thursday. The tutorials are designed to be instructional, interactive and provide in-depth information on a specific topic. Tutorial themes include introductions for those new to the field as well as explanations on more technical aspects than time allows during our partnering forum, symposia and main conference programs. Instructors are drawn from industry and academia alike, many of whom are recognized in their fields or have teaching experience.

**Tutorials included in All Access Pricing or separate registration required. See Tutorial page for details.*

8:00 Close of Day

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Contact our Registration department at 781-972-5400 or Toll-free in the US 888-999-6288.

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Includes post-event recorded access only. Does not include access to live Q&A or networking.

POSTER SUBMISSION: Poster abstracts are due by November 12, 2021. Once your registration has been fully processed, we will send an email containing a unique link allowing you to submit your poster abstract and other materials. If you do not receive your link within 5 business days, please contact jring@cambridgeenertech.com.

** AABC reserves the right to publish your poster content in various marketing materials and products.*

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