Session Number (User created)	Session Title:	Total minutes of Instruction:	GBCI Topic Category (Pick one only)	Session Description (100 words):	Learning Objectives (Minimum of three)	Approved GBCI CE Hours	Is session LEED-specific?	Session meets LEED-specific requirements for the following LEED AP Specialties:
Seminar 1	*2011 Solar Decathlon: Lessons for Net Zero Residential Structures*	*90*	*Project systems and Energy impacts*	*Representative teams from the 20 international entries in the 2011 Solar Decathlon present the design, construction and performance of their high performance residential building entries. Students present their experience in the competition, their employment of computerized energy analysis and automation systems, integrated new solar (and other) technologies and techniques to maximize utilization of small living spaces while minimizing their impact on the environment. ASHRAE is one of the sponsors of the U.S. Department of Energy's 5th Solar Decathlon, which was first held in the fall of 2002 and then biennially in Washington, DC., beginning in 2005.*	*Describe how solar energy systems can be used to provide the energy needed for a small, efficient residential structure;* *Explain the importance of: (1) interdisciplinary design (2) energy modeling and (3) integrated energy systems for high performance buildings;* *List successfully used systems for a high performance (zero energy) residence;* *Explain how phase change materials (PCMs)and desiccants can be incorporated into a renewable energy system (RES) for a high performance structure;* *Describe the pitfalls (and solutions to those pitfalls) which presenters described in the construction and operation of their zero energy residential structures;* *Provide an overview on the benefits and practicality of using off-the-shelf systems for HVAC systems, controls, energy recovery, etc.*	**1.5**	**No**	**N/A**
Seminar 2	*Highly Energy Efficient Buildings, Part 1: Case Studies of Highly Energy Efficient Buildings in Various Countries: Impediments and Opportunities*	90	*Project systems and Energy impacts*	*In different parts of the world there are newly constructed buildings with very high levels of energy performance. These buildings have low needs of energy and use renewable sources, resulting not only in low energy consumption but also achieve high levels of thermal comfort, daylighting, and good acoustics. Embodied energy in building materials is considered in life cycle energy use. Case studies of new buildings in India and Latvia are presented along with the study of a building in Pakistan from over 400 years ago which could be cited as one of the first high efficiency buildings in history. It features an array of passive systems, including natural ventilation with venturi effects for air distribution, daylighting and reflective lighting as well as superb acoustics.*	*Define high performance building and know that such building includes also thermal comfort;* *Explain the exact definition of Zero Energy Building;* *Describe the first energy efficient public building in history;* *Describe the importance of life cycle building performance commissioning;* *Describe the passive measures which should be applied into a high performance building;* *Describe the thermal characteristics of efficient buildings, U factors, energy consumption indexes an get their own opinion are all of the same importance*	**1.5**	**No**	**N/A**

Session Number (User created)	Session Title:	Total minutes of Instruction:	GBCI Topic Category (Pick one only)	Session Description (100 words):	Learning Objectives (Minimum of three)	Approved GBCI CE Hours	Is session LEED-specific?	Session meets LEED-specific requirements for the following LEED AP Specialties:
Seminar 3	*Liquid Cooling Technologies to Enable High Density and Improve Energy Efficiency of Information Technology Data Center Facilities*	90	*Project systems and Energy impacts*	*Information Technology (IT) data centers consume a large amount of electricity in the U.S. and worldwide of which cooling use about one third. Thus, the thermal management and energy efficiency of data center systems is of growing importance. In addition to their energy related challenges, the heat flux of electronic devices and the volumetric heat density of servers and the racks that house them are also rapidly increasing for many applications. Technologies like liquid cooling that enhance energy efficiency and cooling performance of the electronic equipment and data centers will be critical to the future success of the IT industry.*	*Describe current challenges in data center cooling and energy efficiency;* *Describe rack-level liquid cooling technology innovations for data centers;* *Describe server-level liquid cooling technology innovations for data centers;* *Describe the cooling and energy benefits of rack and server level liquid cooling in data centers;* *Explain case study based energy and temperature information for data center liquid cooling;* *Understand the new guidelines for liquid cooling specifications for data centers through efforts by ASHRAE TC9.9 and High Performance Cooling Working Group (US National Labs).*	**1.5**	**No**	**N/A**
Seminar 4	*Water-Cooled VRF Systems: An Introduction*	90	*Project systems and Energy impacts*	*The session reviews the fundamentals of water-cooled variable refrigerant systems as utilized for comfort heating/cooling applications in buildings across North America. The seminar also evaluates the performance potential of the system from a comfort and energy efficiency perspective.*	*Describe the water-cooled VRF heat pump and heat recovery concept as applied to commercial buildings;* *Describe the application potential for both heat pump and heat recovery water-cooled VRF systems across a range of building types;* *Describe how to ensure optimal annual performance levels through effective system design strategies;* *Understand filed data on the annual operating performance of a water-cooled VRF heat recovery geothermal system.* *Describe basic design guidance on the implementation of water-cooled VRF systems in commercial buildings;* *Understand case study reference documentation and further reading publication listings on the application of water-cooled VRF systems.*	**1.5**	**No**	**N/A**

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Seminar 5	*What Is the Right Degree of Automation in Building Operations: A Debate and Discussion*	90	*Site*	*We depend on increasingly intelligent controls to work automatically -- from the simple night setback by a programmable thermostat to implementation of much more complex algorithms by a BAS. However, is there such a thing as too much automation? How does automation apply to building operations and maintenance tools to support high performance, sustainable buildings? Should all building operations and management practices be automated? Or, will some practices always require some level of human interaction? Perhaps there is a balance point? A debate and discussion of opposing views of automation practices versus the need for building operator intervention is presented.*	*Describe current trends and practice of building automation for building operations;* *Describe current trends and practices for human interaction with building automation systems during building operations and maintenance;* *Define supervisory control and situational awareness;* *Describe how recent experiences with monitoring-only systems gives the potential for operator use of supervisory systems;* *Understand what features are most used and desired in BAS operator interfaces;* *Describe why BAS are often reset and overridden by operators.*	**1.5**	**No**	**N/A**
Technical Paper Session1	*Estimating Potential Energy Savings in Central Energy Plants, Cooling Tower Fans and HPWH by Simulation Modeling*	90	*Project systems and Energy impacts*	*This session investigates the opportunity to look at potential energy savings in central plants by looking at two central chilled water sites using simulations to determine potential savings opportunities. In addition, HPWH modeling is examined to compare the existing modeling method to a laboratory study. In addition this session will also attempt to answer a question on cooling tower fans from the 2007 ASHRAE Applications Handbook.*	*Describe how heat pump water heaters (HPWHs) operate, including the strengths and shortfalls of the technology and the energy savings potential of HPWHs relative to electric resistance water heating;* *Explain why modeling HPWHs in an annual simulation is important;* *Name the regions of the country where HPWHs will be most beneficial, and explain why the performance of a HPWH depends on location;* *Define the purpose and thermodynamic and equipment requirements of a plant simulation model;* *Understand that cooling tower selection to minimize plant kW is a plant simulation problem;* *Understanding the use of system models to select a preferred implementation strategy for equipment replacement and changes to operating procedures.*	**1.5**	**No**	**N/A**

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Technical Paper Session 2	*Fundamentals and Applications*	90	*Project systems and Energy impacts*	*This session combines two topics relevant to HVAC&R Fundamentals and Applications:* *The first presentation covers correlation equations that can used to determine thermodynamic properties of ammonia water mixtures for analysis of adsorption system performance. The second presentation establishes the impact of short periods of high metabolic rates on thermal comfort.*	*Describe the effect of transient metabolic conditions on thermal comfort analysis; Describe the correction methods for the PMV calculation for thermal conditions that involve high metabolic activity;* *Identify the difference between transient and steady-state thermal environment;* *Describe some of the most important correlations used in the literature to obtain thermodynamic saturation properties of Ammonia water mixtures;* *Define new correlation equations in simple polynomial forms that are easy to use;* *Apply the new correlations for computing Ammonia water VLE thermodynamic properties and compare quantitatively between the properties determined using the new developed correlations and the corresponding ones reported in the literature;* *Define Ammonia-Water VLE thermodynamic properties*	**1.5**	**No**	**N/A**
Conference Paper Session 1	*Data Centers: Energy Recovery, Static Pressure Control and Hydrothermal Potential*	90	*Project systems and Energy impacts*	*Data Centers account for an ever increasing consumption of energy. With continued advances in server technology the requirements for power and cooling will increase, almost exponentially, over the next several years. Continuing to do things in the same fashion will no longer be an option.* *This session will explore three areas that offer significant increase in energy efficiency, if understood and properly used.* *First we'll discuss divorcing the control of the fans in CRAH or CRAC units from the control of the coil or coil and compressors. When done properly we can much closer match CRAH/CRAC cfm to server cfm. Secondly we will take an in depth look at several means of recovering the waste heat from servers. Different data centers offer different opportunities and the ability to match the correct technology determines the degree of savings and simplicity of control.* *Lastly we will explore the opportunities offered by utilizing hydrothermal energy. The possibility for a "net –zero" energy data center will be discussed and analyzed.*	*Describe the basic economizer strategies for data centers and their potential drawbacks;* *Describe an alternate methodology for controlling CFM vs. the coil load for precision cooling units;* *Explain how to avoid potential control problems with the alternate control methodology;* *Describe the basics for a hydro-thermal and net-zero data center;* *Describe traditional methods of control for cooling a data center and alternate methods for controlling fan speed of precision cooling units separately from room load;* *Explain how to access the potential for waste heat recovery in a data center and if an economic case can be made for doing it.*	**1.5**	**No**	**N/A**

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Conference Paper Session 2	*Heat Pump Optimization*	90	*Project systems and Energy impacts*	*The session deals with design and testing of energy efficient heat pump design. Three different research facets of heat pumps are evaluated here. The first deals with improving efficiency through control system optimization using MATLAB. The second looks at improving the efficiencies of two key heat pumps applications – one being ground source heat pumps and the other being heat pumps for cold climates. Heat pumps suffer from much reduced efficiencies in cold climates, and this paper discusses how to optimize the design to improve capacity and efficiency in these cold climates. The simulations are then compiled into a pareto of options to improve system efficiencies. The third paper discusses long term monitoring of a combination of ground source heat pumps with water heating. The paper looks at the comparison to manufacturer listed COPs and the actual as-observed performance. The water heating efficiency is improved through a desuperheater operated with the ground source heat pump.*	*Identify the primary components of a heat pump;* *Explain how a heat pump operates differently from an air conditioner;* *Explain the operation of the control system of a heat pump;* *Describe the construction and operation of a geothermal heat pump;* *Explain why heat pumps show much lower efficiencies in a cold climate;* *Discuss why variable speed system offer higher efficiencies compared to fixed speed systems;*	**1.5**	**No**	**N/A**
Seminar 6	*Cutting-Edge Japanese Technologies, Part 1: Japan After the Earthquake Crises and SHASE Awarded High-Performance Buildings*	90	*Project systems and Energy impacts*	*The purpose of this session is to explain the latest Japanese HVAC and environmental technologies. However, first, we explain the situation in Japan after the terrible earthquake that occurred on March 11, 2011. Then, we discuss two high-performance buildings that were awarded the SHASE Annual Award in 2011. One is a library building that uses natural energy and thermal environmental properties for meeting its energy requirements. The other is a new shopping center that was designed as a "model eco shopping mall" by using a variety of environmental technologies, including passive energy, recycled materials and greenery use.*	*Describe the damage situation of an air-conditioning system and a plumbing system after the unprecedented terrible disaster;* *Explain the short-term plan for saving power and the measures of restoration support after the disaster;* *Explain the importance of saving energy, the peak shift of energy use, and renewable energy;* *Describe the energy-saving effect obtained by using some properties and the ingenious harmonization of the construction process with an architectural design;* *Describe the importance of a measurement survey and the use of BEMS data at the operation stage;* *Describe A/C systems on the basis of the ultra-large temperature difference in summer and the heat recovery from cold outdoor air in winter using a cascade control.*	**1.5**	**No**	**N/A**

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Seminar 7	*Has Your TRAINing Left the Station?*	*90*	*Site*	*As the industry moves toward green high performance buildings, HVAC equipment and systems are becoming more specialized and customized. Core operating knowledge incubated by design engineers during the design and build processes must be organized, documented, and transferred to the building owner, operation and maintenance staff to ensure systems will be understood, and operated as designed. This seminar provides guidance about how to bring the O&M staff on-board, provides initial and on-going training to maintain high performing systems throughout the building life cycle, and how the Federal Buildings Personnel Training Act may impact some of these processes.*	*Describe what the customer should want or expect from the turn over, commissioning and training phases;* *Describe some of the problems and frustrations that arise when a thorough post-installation turnover does not occur;* *Describe how a large, diverse organization assesses their personnel technology needs;* *Describe what the US federal government is putting forward as their continuing education program for in-house and contracted designers, O&M personnel, safety professionals, and energy managers;* *Explain how to enhance building operations and make buildings more energy efficient by effective use of building automation systems;* *Explain what re-tuning is and how to apply it to large commercial buildings*	**1.5**	**No**	**N/A**
Seminar 9	*Streamlining BIM through Open Information Exchanges, Part 1*	*90*	*Project systems and Energy impacts*	*Defining standard BIM requirements for HVAC-related systems and products is an important step in streamlining the information in BIM. This session introduces a two-part series on building information modeling, with a focus on information exchanges. This seminar starts with an overview of the buildingSMART alliance, which supports collaboration and the development of open standards. Then, two open information exchanges are discussed, COBie and LCie. The construction operations building information exchange (COBie) supports information handover between designs. Life cycle information exchange (LCie) supports information exchanges across the building life cycle.*	*Describe why the current method of delivering paper O&M manuals is problematic and how the problem can be solved;* *Describe the benefits of open BIM standards;* *Describe opportunities that are possible by sharing information in a BIM across a project;* *Describe how business process change is required to practically implement BIM;* *State an explicit definition of the requirements and basis of the exchange necessary for parties to trust the information exchanged;* *List examples and testing tools needed to ensure that practitioners are able to understand and check information received.*	**1.5**	**No**	**N/A**

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Conference Paper Session 3	*How Regulations and Policies are Promoting Sustainable Energy Use and High-Performance Buildings Around the World*	*90*	*Project systems and Energy impacts*	*Sustainable energy use based on the inextricable linkage of energy efficiency and renewable (solar and other RES) implementation, as well as the thermal and electrical energy are to be covered. Session goal is to answer the question "How regulations and policies, at the governmental and municipal level, can promote sustainable energy use and high performance buildings around the world. Is buildings sector (urban and rural) strategic energy planning worldwide appropriate or should it be more "offensive" concerning the current RES technologies and RES technical potential status, demonstration and commercialization, as well as successful decades of RES systems reliable operation, particularly in buildings sectors. Special attention will be drawn to the high IEQ-HVAC (high indoor environment-HVAC) buildings and their further "greening to approach NZEB" dependence on the further commercialization and implementation of RES technologies and RES integrated approach (from modeling through end designs and construction to the operational optimization via BEMS). Not less important are complex energy systems of the combined RES based central utilities energy generation and buildings distributed pure RES or hybrid (fossil and RES based) co-generation. Solar and other RES natural and technical potentials, locally available, are mainly in all world regions well determined and consequently many Governments Strategic Energy Plans are predicting important target - percentage growth of RES utilization in building sector and total.*	*Describe the Role of Solar and other RES on the strategic energy planning in different regions and countries in the world and learn on the state of RES in the Western Hemisphere;* *Explain the potential increase of national RES implementation targets to substitute fossil fuels, exercise critical thinking;* *Describe the barriers to reach defined RES targets;* *Explain how to make predictions on the necessary RES based HVAC and energy supply systems to be further searched and developed;* *Explain how to make predictions on the necessary RES based HVAC and energy supply systems to be produced and related industry further developed and sized;* *List creative thinking: imaginative planning, strategic engineering, production, equipment, industry development knowledge based road-mapping.*	**1.5**	**No**	**N/A**
Conference Paper Session 4	*ID: Goals, Obstacles and Lessons Learned*	*90*	*Project systems and Energy impacts*	*This session wants to highlight some of the obstacles that an IPD can raise among the design team. Facilitation, contracts and insurability are issues that are thoroughly investigated. The lessons learned from two different case studies also are presented. The two high performance buildings show how they were built on Integrated Design to achieve this outstanding result.*	*Describe the importance of facilitator role in a IPD process;* *Describe the contracts and insurance mechanisms available that are suitable with an IPD approach;* *Explain the mechanisms an owner can use to guarantee energy performance and how the design team can deliver the expected performance;* *Explain the inherent characteristic of an integrated design approach in tropical climate;* *Explain the role of the owner, architect, builder, mechanical engineer, and sustainable design consultant in achieving aggressive building energy performance goals;* *Describe the benefit of an energy strategy developed by an integrated design-build delivery team*	**1.5**	**No**	**N/A**

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Conference Paper Session 5	*HPB: Retrofit, Passive House, Performance Measurement Protocol*	*90*	*Project systems and Energy impacts*	*The evolving field of design of high performance buildings requires advancing the use of technology on multiple fronts to provide building owners with facilities that meet their performance goals. The session will provide examples of strategies in several areas. A case study will be presented relating to quantifying the results of a performance evaluation according to ASHRAE's Performance Measurement Protocols. Another paper presents an evaluation of a residential low-energy standard at a location in Urbana, IL including applicability to the standard as shown by monitoring in the subject building. One paper discusses potential methods of retrofitting a historic university building to achieve low energy usage during a modernization project. Energy savings strategies included for envelope, lighting, and HVAC systems. Another aspect of high-performance building will be discussed pertaining to providing cost effective methods of smoke control, including natural ventilation. Natural venting is a growing area of interest in green buildings, with several design approaches to be considered based on project constraints. By saving project costs related to smoke control, investment in other low energy building features may be enhanced.*	*Design high performance retrofits for historical buildings;* *Identify challenges related to natural venting of smoke in atriums;* *Distinguish characteristics of a low energy residence;* *Identify occupancy related factors to energy usage;* *Identify key variables in energy monitoring for buildings;* *Contrast features of high efficiency buildings against conventional technologies*	**1.5**	**No**	**N/A**
Seminar 11	*Exergy Analysis for Sustainable Buildings*	*90*	*Project systems and Energy impacts*	*There is an obvious and indisputable need for an increase in the efficiency of energy utilization in buildings. Heating, cooling and lighting appliances in buildings account for more than one third of the world's primary energy demand. In turn, building stock is a major contributor to energy-related environmental problems. The low exergy approach entails matching the quality levels of exergy supply and demand, in order to streamline the utilization of high-value energy resources. According to the U.S. DOE statistics, healthcare buildings are one of the most energy-extensive buildings all over the world.*	*Demonstrate the practical use of the exergy concept for real building projects;* *Describe benchmarking parameters to evaluate an exergy efficient building design;* *Describe system and component solutions for exergy efficient energy systems;* *Describe the advantages and disadvantages of an exergy efficient design;* *Demonstrate the impact of these new systems on the supply structures in communities;* *Explain cases of innovative community projects with low exergy supply structures*	**1.5**	**No**	**N/A**

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Seminar 12	*Streamlining BIM through Open Information Exchanges, Part 2*	*90*	*Project systems and Energy impacts*	*Defining standard Building Information Modeling (BIM) requirements for HVAC related systems and products is an important step in streamlining the information in BIM. This session completes a two-part series on information exchanges developed to support BIM. The seminar includes research on applying open standard data models for HVAC systems throughout the life cycle using widely available software tools, explains how to assemble high performance building product manufacturer data for use in BIM, and explores how to incorporate sensor and meter data into BIM models after building occupancy for analysis and comparison with facility design.*	*Explain how BIM technologies can help standardize HVAC information and facilitate data exchange across the life cycle;* *Describe how to improve the operational performance of buildings by including detailed information about the design, installation, and required maintenance of HVAC components and systems;* *Explain how open standards play an indispensable role in allowing building product sustainability information to flow from the manufacturer to the analysis software;* *Explain how to make sustainabiility assessments and analysis from a building information model (BIM) through manufacturer provided data;* *Explain why resource consumption is more meaningful if done in the context of a space's (i.e. room's) intended use and its recurring schedule of activities;* *Describe how IFC, oBIX, and COBie data models provide a feasible and appropriate data framework for integrating BIM and telemetry.*	**1.5**	**No**	**N/A**
Seminar 13	*Sustainability in Commercial Buildings: Integration Measures for Bridging the Gaps in Performance from Design to Operations*	*90*	*Project systems and Energy impacts*	*This seminar presents various qualitative and quantitative measures that can be practiced to improve and sustain performance of all building systems and infrastructure elements. All too often a building's energy performance does not meet design expectations, particularly a new building's energy savings projection that overstates achievable performance. Across the high-performing building industry, these unrealistic energy performance goals have come from, among other things, inadequate modeling and benchmarking practices, unreliable monitoring and equipment controls systems, significant changes in space usage and processes during occupancy and tenant improvements and failure to include operations staff in goal setting.*	*Explain key quantitative measures that can be used to monitor, track and compare "energy and environmental performance" of commercial buildings;* *Describe specific steps a property manager can take to ensure that the energy and environmental performance of buildings is sustained during their life-cycle, at the levels intended, after key energy efficiency projects are implemented;* *Explain importance of proper monitoring, tracking and control of utilities through energy management systems, and other measurements and verification technologies;* *Describe how often the buildings should be retro-commissioned and what documentation is required for such periodic retro-commissioning;* *Explain, how an integrated approach with participation of all stakeholders can enable bringing and maintaining existing buildings to high performance buildings with a solid business case;* *Provide an overview of role building operations and maintenance staff towards ensuring the buildings deliver the design-bases performance*	**1.5**	**No**	**N/A**

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Seminar 14	*Why Are We Overcooling Buildings in Summer?*	*90*	*Project systems and Energy impacts*	*Studies conducted by Lawrence Berkeley National Laboratory and Carnegie Mellon have found that many office buildings are being overcooled in summer, consuming large amounts of energy and making occupants uncomfortable and even sick. The summer overcooling happens in both hot/humid and hot/dry climates, in the U.S., Singapore, and elsewhere in the world. In this seminar, panelists discuss engineering challenges that may necessitate a relook at the way air-conditioned buildings in such climates are designed. The presentations 1) look at the possible reasons why the summer overcooling is happening, from social, cultural, operational, system and control design, and psychological and physiological reasons, 2) review some of the fundamental issues of cooling and dehumidification facing the HVAC designer, leading to the inevitable oversized system and its undesirable consequences in terms of an overcooled indoor environment, 3) discuss possible solutions to creating a more thermally comfortable and healthy indoor environment that can also save energy, and 4) discuss how ASHRAE and international standards might be involved to stop the summer overcooling happening in practice.*	*Describe the psychrometric challenges involved in cooling and dehumidification at peak and part loads in hot and humid climates;* *Describe engineering solutions involved in preventing overcooled buildings in such climates and enhancing thermal comfort and IAQ;* *Identify possible paths that may lead to the summer overcooling in office buildings;* *Quantify the energy penalty and occupant overcooling discomfort resulting from summer overcooling;* *Explain to other engineers and designers the issue in order to avoid it happening in designs;* *Describe how a proposed system design approach can be implemented by the ASHRAE Standard 55.*	**1.5**	**No**	**N/A**
Conference Paper Session 6	*Fault Detection and Energy Audits*	*90*	*Project systems and Energy impacts*	*This session will have four papers discussing methods of auditing energy analysis through traditional means and new statistical analysis vs. traditional DDC controls. Discussion of achieving high energy savings thru rated high efficiency equipment, i.e. EER 12, and the use of energy balancing methods to predict energy use utilizing energy models to determine if there is compliance with ASHRAE 90.1. A review of comparative measuring and monitoring approaches in modeling and in reality – can they possibly match up with so many variables? Are we viewing practical approaches that will address true energy savings if we can have utilities and governing authorities work together?*	*Describe how to achieve energy cost savings on HVAC equipment for buildings by simple operation and maintenance procedures such as calibration of sensors, correct sensor placement and checking correct operation of dampers;* *Describe how to measure the energy performance of your building as compared to other similar buildings;* *Test how CUSUM method works on detecting the faults of air handling units;* *Test how the incorporation of a causal network can help in diagnosing the faults;* *Describe how energy audits can tell us about an entire city;* *Describe how to apply first principles to energy data analysis.*	**1.5**	**No**	**N/A**

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Seminar 15	*Chicago Smackdown: Air Source vs. Ground Source or Best Practices for Air Source vs. Ground Source Heat Pump Systems*	90	*Project systems and Energy impacts*	*As engineers we are inundated with claims by sales people that their equipment is more efficient, more sustainable or 'greener' than the competition's. Renewable and conventional technologies compete against each other for the ever shrinking mechanical equipment budget. Which system is best? Which is most efficient? Who do you believe? Air-source vs. ground source: which is better? Neither heat pump system is a one-size fits all solution. As engineers, we need to understand how each system is rated for capacity and efficiency. We need to understand this so that a baseline can be established from which to fairly compare different mechanical systems for our clients. To correctly select equipment it is important to understand the technology's limitations and its applications. With this information an 'apples to apples' comparison of system installed and operating costs may be prepared.*	*Explain how the performance and payback of air-source heat pump water heaters is highly dependant on equipment and selection;* *Explain why air source heat pump water heaters should not be sized to meet 100% of the domestic hot water load;* *Describe one method to size heat pump water heaters in a retrofit application;* *Describe the conditions and assumptions of ANSI/AHRI Standard 210/240, Standard for Unitary Air-Conditioning and Air-Source Heat Pump Equipment;* *Describe the conditions and assumptions of ANSI/AHRI/ASHRAE/ISO Standard 13256-1, Standard for water-to-air and brine-to-air heat pumps;* *Describe a procedure to correct the rated values for ASHPs to conditions that are different than those prescribed in the standard.*	**1.5**	**No**	**N/A**
Conference Paper Session 7	*Integrated Design: Case Studies to Achieve Net-Zero*	90	*Project systems and Energy impacts*	*This session presents the approach and outcome of Integrated Project Delivery processes for energy efficient and even net-zero energy projects. Different methodologies, lessons-learned, and specific results are shown using real world examples for new construction and major renovation.*	*Describe how collaboration between cross-disciplinary teams helps identify possible design synergies during all stages of the design process;* *Describe how the net-zero design elements can be applied to bank/office buildings;* *Describe collaborative energy efficient design in renovation projects with phased-construction;* *Summarize potential benefits gained by employing the integrated design process;* *Explain how principles of green building construction can successfully be applied to large-scale renovation projects;* *Describe how sub-meter data was used in the modeling to identify areas of improvement in the net-zero building.*	**1.5**	**No**	**N/A**

Session Number (User created)	Session Title:	Total minutes of Instruction:	GBCI Topic Category (Pick one only)	Session Description (100 words):	Learning Objectives (Minimum of three)	Approved GBCI CE Hours	Is session LEED-specific?	Session meets LEED-specific requirements for the following LEED AP Specialties:
Conference Paper Session 8	*Complex Facility Design Advances*	90	*Project systems and Energy impacts*	*The conference papers address the latest in technology for understanding design tools for energy intensive highly complex facilities including subway stations and convention centers. Attendees will understand how to approach these complex projects and develop designs that meet owner requirements sustainably.*	*Design systems that utilize the latest strategies for reducing energy in convention halls;* *Explain the key design paramters in underground subway station comfort;* *Apply thermal mass storage concepts to load leveling in convention halls;* *Apply simulation of air flow strategies to underground subway station design;* *Apply methodologies to confirm modelled results to actual field conditions in a subway station;* *Explain the relationship between refirgeration and electrical demand profiles in a convention hall.*	**1.5**	**No**	**N/A**
Conference Paper Session 9	*Hot and Humid Schools and Housing: Occupancy Assumptions on Energy Performance Simulation*	90	*Project systems and Energy impacts*	*This session assists the attendee to understand how occupancy affects energy performance in office buildings, schools and residences. Assumptions of determining occupancy are analyzed along with other factors, such as dew point, to determine accurate energy consumption models. Regression models are explored and compared for estimating energy consumption. Finally, a design guideline to reduce energy consumption is recommended for low-income, low-energy housing in hot and humid climates.*	*Determine impact of occupancy assumptions on simulated energy performance;* *Quantify the difference between energy performance using realistic values for occupancy based on surveys and standard occupancy assumptions;* *Describe how dew point temperatures affect energy consumption in hot and humid climates.* *Describe how scheduling factors affect energy consumption;* *Determine how to reduce residential energy consumption with high humidity levels;* *Apply design guidelines for low-income housing design in hot and humid climates.*	**1.5**	**No**	**N/A**

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Seminar 16	*Air-Handling System Leakage: Benefits and Costs of Field Tests*	90	*Project systems and Energy impacts*	*SMACNA together with ASHRAE is developing a new standard that will contain test procedures and requirements for total HVAC system air leakage in commercial buildings. This activity is needed because as much as one third of a system's airflow can leak through the air distribution system, which in turn causes a loss of comfort and heating or cooling capacity. System air leakage also significantly increases air conditioning and heating bills, and can contribute to indoor air quality problems. This seminar focuses on the benefits and costs of performing system leakage tests from the perspective of a TAB contractor, an association of sheet metal contractors, and researchers. Steps needed to achieve widespread reductions in leakage and improved air-handling system efficiency are also presented.*	*Describe why to determine leakage flows for the entire air-handling system, and the impacts of leakage flows on zone heating and cooling loads and on whole-building energy use in commercial buildings;* *Estimate the energy impacts of system leakage downstream of VAV boxes, and in toilet/kitchen exhaust systems;* *Explain the necessary specifications for system leakage using industry accepted terminology;* *Describe how various codes and standards address system air leakage;* *Apply test protocols for cost-effectively measuring system leakage;* *Recognize that it is the responsibility of the design engineer to specify the maximum allowable system leakage percentage.*	**1.5**	**No**	**N/A**
Seminar 18	*Standard 205P: Hassle-Free Equipment Performance Data for Energy Modeling*	90	*Project systems and Energy impacts*	*Standard 205P (Standard Representation of Performance Simulation Data for HVAC&R and Other Facility Equipment) will shortly be available for public review. The standard formalizes how data about equipment capacity and efficiency are represented for a range of operating conditions. This lays the groundwork for automated import into software applications such as energy simulation models, eliminating the need for laborious and error-prone transfer from printed documents. The session presents general background on the standard and introduces proposed schemes for chiller and unitary equipment performance data.*	*Describe the critical role that Standard 205P plays in achieving calibrated simulations;.* *Explain how Standard 205P will reduce the burden on manfaucturers, design professionals and simulation professionals in developing calibrated models;* *Explain how calibrated equipment models can be used for competitive bids that are based on life-cycle cost;* *Explain how calibrated equipment models can be used for performance verification and commissioning;* *Explain how calibrated equipment models can be used for development of energy efficient sequences;* *Describe how Standard 205P supports the work of Standards 90.1 and 189.*	**1.5**	**No**	**N/A**

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Seminar 19	*The Role of Fossil Fuels in Future Sustainable Buildings*	90	*Project systems and Energy impacts*	*The Energy Independence and Security Act of 2007 requires DOE to issue revised Federal building energy efficiency performance standards that specify a 55% reduction in fossil fuel-generated energy consumption in new and renovated federal buildings immediately and complete elimination of fossil fuel-generated energy consumption by 2030. This seminar provides a unique format to review the EISA requirement, discusses DOE's planned implementation strategy, identifies potential pathways to achieve the goals, and describes the significant challenges related to this requirement. Speaker presentations are followed by an interactive panel discussion.*	*Explain the EISA requirement to eliminate fossil fuel-generated energy consumption in new and renovated federal buildings;* *Describe DOE's near-term and long-term implementation strategy;* *Distinguish direct fossil fuel consumption in buildings from fossil fuel consumption from electricity generation attributable to building operation;* *Characterize fossil fuel reduction opportunities to achieve the EISA requirement;* *Identify key challenges related to successful implementation of the EISA requirements;* *Describe alternative approaches to achieving significant greenhouse gas emission reductions in buildings.*	**1.5**	**No**	**N/A**
Technical Paper Session 3	*Low Energy Design for Army Facilities Buildings*	90	*Project systems and Energy impacts*	*The Army is required by law (EPACT 2005, EISA 2007) to reduce overall facility energy usage by 30% by 2015 and to eliminate fossil fuel use in new and renovated facilities by 2030. Army policy is to achieve eight net zero energy pilot installations by 2020. Results of studies for new construction and major renovation projects which will be presented at this session show that utilization of high performance building envelopes, advanced lighting strategies, and efficient HVAC systems result in significant energy savings (site and source) in Army buildings in all climates. For example, barracks site energy can be reduced by 50–70% (depending on climate) compared to the EPACT 2005 baseline; maintenance facilities by 77–85%, etc. However, source energy use reduction goals of EISA 2007 (65% reduction by 2015) cannot be achieved by efficiency measures alone in any type of building except for maintenance facilities in some climate zones. Additional savings may be achieved with measures related to improved efficiency of power generation supplied to the building (co- and tri-generation), and to the use of energy supplied from renewable energy sources. Connecting a building to a Combined Heat and Power (CHP) plant can further reduce the building's fossil fuel usage by 10–25% depending on the thermal-to-electric load ratio.*	*Describe integrated energy optimization process for buildings and building clusters;* *Demonstrate this process for new construction projects and building retrofits;* *Explain how mission critical building loads effect theoretically possible site and source energy use reduction in Army buildings;* *Describe how energy optimization process can be applied to barracks/dormitories and similar buildings to be constructed and renovated in typical DOE climate conditions;* *Describe how energy optimization process can be applied to dining facilities to be constructed and renovated in typical DOE climate conditions;* *Describe how energy optimization process can be applied to large scale vehicle maintenance facilities to be constructed and renovated in typical DOE climate conditions.*	**1.5**	**No**	**N/A**
Conference Paper Session 10	*Modeling to Improve DHW and Hydronic Systems*	60	*Project systems and Energy impacts*	Understanding and properly applying the inputs is an important requirement for any useful simulation model. Covered in this session is a case study showing how modeling was used to improve performance for the domestic hot water (DHW) system on a large campus and a simulation method is introduced for using energy modeling software to calculate savings associated with hydronic system improvements.	Describe domestic hot water loop characteristics and possible deficiencies Define typical domestic hot water loop control strategies Explain systems improvements that can be implemented to domestic hot water loops Describe the operational characteristics of a modern variable flow HVAC piping system Explain how current popular building simulation programs model HVAC piping systems Describe a mathematical process to differentiate improved valve performance within energy models	**1**	**No**	**N/A**

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Conference Paper Session 11	*Impact of Neural Networks on Energy Consumption Predictions and Shading Systems on Thermal Performance*	60	*Project systems and Energy impacts*	*The ability to accurately predict building thermal dynamics and energy performance has gained momentum in recent years. This conference paper session will present neural networks as a tool to model building energy use, with an emphasis on variability of model accuracy depending on parameter inputs. The session will also examine various dynamic shading systems and determine their effectiveness in reducing thermal loads in buildings. A combined dynamic shading system will also be proposed for improved control.*	*Introduction to neural network modeling* *Understand application of neural networks in predicting hourly building energy consumption* *Understand impact of different input parameters in neural network model accuracy* *Understand parameters affecting effectiveness of dynamic shading systems* *Understand impact of dynamic shading systems on building thermodynamics Introduction to selecting overhang and light shelf characteristics to reduce building energy demand*	**1**	**No**	**N/A**
Conference Paper Session 13	*Technology Advancements.*	60	*Project systems and Energy impacts*	Technologies are presented that lead to both improved IEQ and efficient energy utilization.	Understand the benefits of utilizing a fan powered induction unit (FPIU) system with DOAS compared to other terminal sensible cooling technologies. Understand the benefits of utilizing multiple chilled water systems with a DOAS/FPIU system. Understand the best applications of a DOAS/FPIU system to achieve maximum energy cost savings. Understand impact of DOAS SA temperatures on the sizing of the sensible only chilled water coils in DOAS/FPIU system. Understand the disadvantages of phase change material (PCM) medium, and the benefits of embedding metal foam in phase change materials. Understand the heat transfer performance of a small metal foam-PCM thermal storage system.	**1**	**No**	**N/A**
Seminar 21	*Maximizing the Benefits of Commissioning: Incorporating Design Reviews and the Building Envelope into the Commissioning Scope*	60	*Site*	*Functional performance testing and post-occupancy evaluation of HVAC systems are commonly thought of tasks in the commissioning process. However, commissioning is most beneficial when it is begun early in the design process, and if it includes other building systems beyond HVAC. This seminar covers design phase commissioning and commissioning of the building envelope. Design phase commissioning tasks are discussed, as are suggestions for realizing maximum benefits from commissioning design reviews. The seminar also reviews envelope commissioning, the unfortunate state of the envelope quality if envelope commissioning is not done, and the resulting impact on HVAC operation.*	*Describe the methodology and process of meaningful design reviews;* *Apply presentation strategies to enable the designer and owner to seriously consider suggestions;* *Describe how to support optimized system performance through design review;* *Identify typical air barrier deficiencies observed during construction of new buildings and how these were resolved;* *Describe rated air barrier materials and material compatibility issues;* *Identify common air barrier transition deficiencies and how to avoid them.*	**1**	**No**	**N/A**

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Conference Paper Session 14	*Energy Savings and Performance Improvement through O&M*	60	*Project systems and Energy impacts*	*To operate efficiently and at high levels of performance, commercial buildings require careful attention to achieving efficient operation and then maintaining it persistently over time. This requires effective operation and maintenance practices. Without monitoring of performance and regular maintenance, the performance of building systems degrades, resulting in increased energy use and cost, inadequate indoor conditions, and potentially uncomfortable occupants. The two papers in this session present information on: 1) using building automation system data to guide continual commissioning of built-up building systems and 2) training operators as a means to achieving central plant energy savings.*	*Describe how building automation system (BAS) logs can be used to support re-commissioning of built-up HVAC systems;* *Give an example of how specific data from a BAS can be used to detect a performance problem so that it can be corrected;* *Explain what the ratio of actual COP for a chiller to the (reverse) Carnot cycle COP represents;* *Identify advantages of using videos to present training information;* *Explain the consequences of over-pumping the primary loop in a primary-secondary chilled water system;* *Describe capacity-based scheduling of chillers in a multi-chiller system.*	**1**	**No**	**N/A**
Seminar 23	*Design Best Practices from the Server to the Data Center, What the Operator Should Know*	60	*Project systems and Energy impacts*	*Today's data centers and IT equipment have complex thermal management schemes to enable optimization of power and performance, while ensuring the reliability required in data center applications. This seminar covers the IT equipment and the data center. Data center designers and operators often have misconceptions on how the IT thermal management and available features work. This seminar reviews these and how data center environmental conditions affect them. It also reviews best practices for air-cooled data centers; reporting on a first-of-its kind direct comparison of hot and cold aisle containment. The attendee gains an advanced understanding of best practices.*	*Describe the thermal management system of today's IT equipment;* *Apply how the knowledge gained is setting features in IT equipment thermal management control schemes;* *Explain how the data center environmental conditions affect the server thermal management operations;* *Define the different air-cooling architectures available for modern data centers;* *Explain the efficiency implications and advantages of hot aisle vs cold aisle containment;* *Apply the right decision criteria in specifying cold aisle or hot aisle containment for a new installation.*	**1**	**No**	**N/A**

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Seminar 25	*Vibration Induced Noise and Mechanical Equipment Vibration Isolation, Balance and Predictive Maintenance*	60	*Project systems and Energy impacts*	*This seminar explains how vibration isolation should be specified and installed. Case studies and real world experiences are discussed. Also, proper HVAC equipment balancing is discussed for low noise and reliable operation. Lastly, use of machinery vibration signatures to indicate potential equipment failures is discussed.*	*Explain the mechanisms of vibration induced noise;* *Describe general guidelines for minimizing vibration induced noise;* *Explain how vibration isolation should be specified and installed;* *Describe common pitfalls in vibration isolation installations and strategies for how to avoid them;* *Describe the use of vibration to monitor equipment health;* *Explain the contributors to successful equipment balancing for low noise and reliable operation.*	**1**	**No**	**N/A**
Seminar 26	*YEA for Air Cleaning!*	60	*Improvements to the indoor environment*	*Air cleaning through filtration is increasingly one of the critical factors in sustainability and energy efficiency of an HVAC system and facility occupant health. Most courses in HVAC give passing reference to this critical factor. LEED requires it, ASHRAE standardizes it, and TC 2.4 and TC 2.3 have it. Here it is, everything you need to know about air filtration for both particles and gas-phase contaminants. This seminar provides the young engineer (and slightly older ones also) with the best overall view of air filtration including types of media filters, molecular media and special applications.*	*Explain how a filter functions;* *Describe how different particles are captured by different principles of filtration;* *Explain MERV and describe ANSI/ASHRAE Standard 52.2 method of test;* *Distinguish between particle capture and molecular capture of contaminants;* *Explain special filtration in critical applications i.e. hospital and healthcare, schools, isolation rooms, hazardous environments;* *Design systems that incorporate correct application of particle and molecular air filtration systems.*	**1**	**No**	**N/A**

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Technical Paper Session 4	*Ventilation Applications: Hybrid System for High-Rise and Measured Rates in Bars*	60	*Improvements to the indoor environment*	*This session will include two presentations. The first presenter will be discussing the results of a case study involving the comparison of actual ventilation rates found in Minnesota bars and restaurants to ASHRAE 62.1 guideline criteria. Carbon dioxide tracer gas levels were measured to determine the effective ventilation rates in bars and restaurants in this state prior to implementation of a statewide smoking ban. 65 bars and restaurants were studied, and the results of this study are presented in this session. The 2nd presenter for this session will be discussing a case study involving a hybrid ventilation system applied to a super high-rise building in Tokyo, Japan, focusing on the indoor environment in the building and the effects of the system on the variation of thermal load.*	*Explain the methods used to determine the levels of CO(2) in hospitality environments where smoking is allowed;* *Explain the factors that affect CO(2) concentration levels in a hospitality venue;* *Describe the CO(2) concentration levels recommended by ASHRAE 62.1-2007 for a variety of hospitality venues;* *Explain what comprises a hybrid ventilation system;* *Explain how to assess air movement sensation and thermal environment as sensed by occupants;* *Explain how variations in concrete slab temperature affect the HVAC ventilation system.*	**1**	**No**	**N/A**
Seminar 27	*Approaching Net-Zero and Maintaining Your Course: O&M Tools to Maintain Building Performance*	90	*Project systems and Energy impacts*	*The moniker "net-zero energy building" does not just refer to building design. Building operation and maintenance are equally, if not more, important in today's energy conscious environment. As we embrace a future with building performance labeling, net metering and sustainability criteria, O&M are playing an increasingly more visible role. This seminar reviews three ASHRAE tools—the recently updated Chapter 39 in the Applications Handbook, Standard 180, and the newly introduced Guideline 22—that are available to assist designers, owners and operators in planning and implementing O&M practices that ensure investments in high performance buildings retain their value.*	*Identify ASHRAE resources for building operation and maintenance planning and implementation;* *Describe state-of-the-art technologies and tools used in building operation and maintenance;* *Describe the recommended practices for an O&M program that provides for the minimal acceptable level of performance for HVAC system maintenance;* *Describe the recommended practices for an O&M program that maintains building high performance;* *Explain the primary differences between ASHRAE Standard 180 and Guideline 32; and explain how the implementation of each can reduce building operating costs;* *Identify the documents required to be in an O&M Manual and explain the role this manual plays in meeting building performance criteria.*	**1.5**	**No**	**N/A**

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Seminar 28	*Improving Energy Modeling Consistency*	90	*Project systems and Energy impacts*	*Credible, whole-building energy analysis that is reliable and consistent will help the U.S. achieve increasingly aggressive performance targets established for buildings. Some headway has been made to promote modeling consistency through standardizing methods but many aspects of modeling can still benefit from a structured model development processes. This session presents best-practice methods that support BEM reliability and consistency, namely: informing modeling assumptions using published BEM resources, incorporating benchmarking procedures to check results, and effectively using measured data for model calibration.*	*Use key BEM resources to inform early modeling assumptions;* *Employ accepted methods for converting equipment efficiency values into model input values;* *Identify key BEM benchmarking resources and parameters to support results checking;* *Incorporate benchmarking modeling techniques as part of modeling quality assurance procedures;* *Identify plausible causes of discrepancies between measured and modeled performance based on utility-level data;* *Prioritize calibration efforts based on plausible causes of discrepancies*	**1.5**	**No**	**N/A**
AHR Expo Session 1	*Selection, Operation & Maintenance and Water Treatment for Multi-Metal Boilers*	90	*Project systems and Energy impacts*	*Modern boilers made from Aluminum may make them lighter to carry and obtain higher efficiencies, especially when under less than full load. Incorporating different metals into multi-metal systems requires selection and specification of system components and water treatment specific to the desired system metallurgy. This seminar explores why ASHRAE membership should recommend aluminum, condensing boilers to increase hydronic system efficiency, special commissioning considerations, how to address multi-metal systems from a water treatment approach and assist ASHRAE membership with specifying both of the aforementioned system components.*	*Describe and identify metallurgies and systems that are suspect to severe corrosion;* *Explain which boilers will need to be treated differently than before and why;* *Design the pre-treatment requirements for mixed metal aluminum boilers and be able to describe and explain the same;* *Identify and describe the basic differences between water treatment for new age mixed metallurgy aluminum boilers and metallurgies used previously;* *Describe how to monitor the success of the water treatment program;* *To be able to identify water treaters with experience and expertise with treating aluminum boilers*	**1.5**	**No**	**N/A**

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Conference Paper Session 16	*Integrated Design Energy Retrofits*	90	*Project systems and Energy impacts*	*Commercial, institutional and large multi-family building account for about 25% of primary U.S. energy. The average energy use for all existing buildings has essentially remained flat since the early 1980s at about 88,000 Btu/ft2 (277.4 kW/m2). Furthermore, 98% of all buildings are less than 100,000 ft2 (9,290 ft2) with the distribution heavily weighted to buildings between 25,000 and 50,000 ft2 (4,645 and 2,323 m2). These conference papers define the problem facing adoption of deep energy retrofits, the multifaceted plan of attack to transform a fragmented market and the modeling, technology and integrated design approach to deliver results.*	*Explain the primary energy and environment issues regarding today's existing building stock;* *Explain the Federal government's new focus on building energy efficiency;* *Explain DOE's Building Energy Efficiency HUB's mission and focus on commercial/institutional energy retrofits;* *Describe how the HUB intends to attack critical market barriers to energy efficient retrofits;* *Describe how ASHRAE will interact with the HUB;* *Describe what the HUB will deliver*	**1.5**	**No**	**N/A**
Conference Paper Session 17	*Radiant, Boilers, Ductless AC and Microchannel Evaporators*	90	*Project systems and Energy impacts*	*This session includes papers that offer in-field performance information of condensing boilers, introduction of ductless task air conditioning system concept, and understanding of two-phase refrigerant distribution in a parallel microchannel evaporator.*	*Explain how DTAC is able to circumvent the need for ducting;* *Describe the proof needed to show that DTAC can achieve its claim of not requiring an outdoor heat exchanger;* *Identify the critical system parameters which affect the efficiency of hydronic heating systems employing condensing boilers and baseboard convectors;* *Describe ways to improve the installed efficiency &/or performance of a typical condensing boiler system in residential applications;* *Explain how to improve system response time and increase occupant satisfaction;* *Explain how refrigerant flow is distributed among the multiple parallel tubes in microchannel evaporator.*	**1.5**	**No**	**N/A**

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Conference Paper Session 18	*Complex Fenestration Systems*	90	*Project systems and Energy impacts*	*This session focuses on the building heating and cooling load calculations. Two of the papers concentrate on the building envelop while the other discusses climatic data used in the load calculation process. The topic of envelope concentrates on alternate methods of improving building performance beyond the more conventional method of increasing insulation or decreasing window area. The climate discussion explores why the more traditional climate data is not consider accurate for today's building design. Each of these topics is important as they influence the overall building performance and the accuracy of design*	*Understand the difference between a Complex Fenestration System and a standard Fenestration System.* *Recognize that a Complex Fenestration Systems can contribute to the success of a design to meet the user's needs without sacrificing building energy efficiency.* *Explore alternate data and methods to determine climatic conditions for building design.* *Describe the need to use climate data that is different that has been traditionally used in the past for building design.* *Define the attic radiant barriers and interior radiation control coatings.* *Understand the appropriate application of radiant barriers and their potential energy savings.*	**1.5**	**No**	**N/A**
Seminar 29	*HVAC&R Resarch Journal:Controls*	90	*Project systems and Energy impacts*	*This session, chaired by University of Maryland mechanical engineering professor and HVAC&R Research Journal editor, Reinhard Radermacher, is comprised of three papers selected from recently published works of the ASHRAE HVAC&R Research Journal.*	*Describe virtual sensing technology and understand the significance of the virtual sensing technology in building systems;* *Describe heat pump model development using a modular approach, where the three main components being modeled are the evaporator, compressor and condenser;* *Determine for each set of the cooling rate and outside and inside temperatures there is an optimal fan and compressor speeds as well as subcooling that will result in lowest energy consumption (highest COP);* *Determine if it is more efficient to run economizer mode (free cooling) depending upon outside temperature and the fan energy use in economizer mode or total energy when running with compressor on;* *Explain the difference between the adiabatic saturation temperature and the true wet-bulb temperature and what factors contribute to the largest sources of error in the measurement of the wetbulb temperature;* *Explain the measurement of the wet-bulb temperature can be a very good predictor of the adiabatic saturation temperature even though they are two different quantities.*	**1.5**	**No**	**N/A**

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Seminar 30	*Humidification: Why Is It Necessary and How to Do It Safely*	90	*Improvements to the indoor environment*	*Air contains humidity because this is the way our world is! Humidity is nothing else than water vapour, mainly coming from the natural evaporation of sea water, lakes and rivers; part of it is also generated by mankind's processes. It's fundamental for all living creatures, human beings included, both for surviving and, for humans and animals, for well-being. It's also necessary for a number of industrial processes, which usually require the proper control of the humidity level. Humidification systems add vapour to the air in a controlled way so as to reach and maintain the desired humidity level. They can add vapour into ventilation systems or directly into the ambient and in both cases this can be done in hygienically safe ways provided the relevant guide-lines and best practices are followed. The seminar presents the requirements of German norm VDI 6022 for humidification systems.*	*Describe what humidity is and why humidity is necessary for living creatures as well as many applications;* *Describe where humidification is required;* *Describe how humidification can be done and controlled;* *Describe the hygienic aspects related to humidification, in particular about Legionnaires' disease;* *Describe relevant sections of Guideline 12 and Standard 188;* *Describe the relevant German hygienic standard VDI 6022 related to the humidification in AHU/duct*	**1.5**	**No**	**N/A**
Seminar 32	*Thermal Displacement Ventilation Applications for High Performance Buildings, Part 1*	90	*Project systems and Energy impacts*	*This seminar explores recent developments in Thermal Displacement Ventilation (TDV) systems and describes their performance in combination with complimentary cooling as well as heating systems. The audience learns how TDV can improve building energy performance and Indoor Environmental Quality (IEQ). TDV applications, control strategies and impact on ASHRAE Standards 55-2010 (thermal comfort) and 62-2010 (indoor air quality) are presented.*	*Define how TDV can improve building energy performance and Indoor Environmental Quality;* *Describe appropriate applications for TDV;* *Describe TDV system design strategies;* *Describe temperature control strategies with TDV;* *Describe design strategies when combining TDV with complimentary heating and cooling systems;* *Explain how ASHRAE Standards 55-2010 and 62.1-2010 impact TDV system design*	**1.5**	**No**	**N/A**

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Technical Paper Session 5	*Laboratory Testing of Heat Pump Water Heaters*	90	*Project systems and Energy impacts*	*When we think of hot water and water heating efficiency we often think of the big tank in our basements or garages, but that is only part of the story. Service hot water is a system consisting of not only a water heater, but piping, fixtures, and people too. In this session authors will discuss field and lab work that characterized hot water usage, distribution system effects and how these whole system approaches effect how we think about efficiency. Heat Pump Water Heaters (HPWHs) have been around for a long time. New product offerings indicate renewed interest in this technology. This session presents laboratory performance results from testing of the residential tank-integrated HPWHs available currently on the US market, and discusses climate-region-specific opportunities for energy savings in residential buildings. The HPWHs are evaluated with both standard and non-standard performance metrics, over a range of operating conditions and usage patterns.*	*Explain typical residential hot water draw patterns;* *Explain the effects different draw patterns on energy consumption;* *Explain water waste in showers and how to reduce it;* *Explain the effect different types of distribution systems can have on water waste;* *Explain the performance of heat pump water heaters for different usage patterns;* *Explain how water heating is not just a water heater, it is a system that includes many aspects*	**1.5**	**No**	**N/A**
Conference Paper Session 19	*Net-Zero Labs and Data Center Cooling System Design*	60	*Project systems and Energy impacts*	*Process loads are unique and differ from comfort cooling and heating loads in many ways. Safety, mission critical, climate and regulatory requirements are among the factors that relate to options and opportunities and in some cases constraints to achieving efficiencies above and beyond traditional designs. In this session we take a look at specific aspects of two different process load scenarios that can be considered when designing. In labs, we discuss heat recovery, building envelop and horsepower reduction. For data centers, we cover how best to select cooling equipment, and what to take into consideration when deploying a containment solution.*	*Apply concepts learned here when deciding upon a containment strategy;* *Design based on how you want to operate your space and be able to determine what equipment you should used depending on operating conditions desired;* *Determine what airflow rate you will need once you've chosen operation conditions;* *Explain how to reduce ventilation requirements in labs while maintaining safe conditions;* *Utilize knowledge gained in this session to reduce horsepower consumption in the laboratory environment;* *Apply heat recovery methodologies in an efficient but safe manner*	**1**	**No**	**N/A**

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Conference Paper Session 20	*Multi-Zone VRF*	60	*Project systems and Energy impacts*	*Variable Refrigerant Flow (VRF) systems are continuing to advance in the HVAC market due to their flexibility, individual zone control, and capability for energy efficient operation. This session monitors ongoing efforts to suitably characterize the performance of VRF systems by two different measures: modeling and testing. The modeling study tackles a five-zone VRF system and simulates the performance using a structured approach, identifying key variables and comparing the simulated results to an actual equipment model. A new methodology for testing VRF systems in a laboratory environment is also explored in detail and contrasted against a more traditional dual room psychrometric chamber approach.*	*Describe difficulties involved in testing multi-split HVAC systems in a two chamber; psychrometric chamber;* *Explain the need for testing and performance mapping of a variable refrigerant flow system;* *Present a novel solution for testing multi-split systems;* *Describe the methodology of modeling a multi-split VRF vapor compression system;* *Identify calibration techniques which help enable a VRF system model to represent real product performance;* *Assess the system model and calibration techniques in multiple modes, including space cooling, space heating, combined space cooling and water heating, and dedicated water heating.*	**1**	**No**	**N/A**
Seminar 33	*Basics of Computational Fluid Dynamics (CFD) for the Built Environment*	60	*Project systems and Energy impacts*	*With increased emphasis on high performance and energy efficient building operations, the use of Computational Fluid Dynamics (CFD) as a design and analysis tool is increasing. Although the colorful pictures are compelling and usually informative to experienced practitioners, there is frequently a lack of understanding about the basics, benefits, limitations and pitfalls of CFD simulation and analysis. This session provides nuts and bolts of CFD to practicing engineers and managers to help them separate substance and value out of CFD simulations and discusses a few selected applications of CFD for improved design of the built environment.*	*Describe Computational Fluid Dynamics (CFD) process;* *Explain the basic transport processes involving fluid flow, heat transfer, and mass transfer;* *Explain what a computational mesh is;* *Explain what a converged CFD simulation is;* *Explain the level of input required for CFD simulations;* *Explain how to interpret and employ CFD simulation results as a design tool*	**1**	**No**	**N/A**

Session Number (User created)	Session Title:	Total minutes of Instruction:	GBCI Topic Category (Pick one only)	Session Description (100 words):	Learning Objectives (Minimum of three)	Approved GBCI CE Hours	Is session LEED-specific?	Session meets LEED-specific requirements for the following LEED AP Specialties:
Seminar 34	*HVAC&R Research Journal: Heat Exchangers*	60	*Project systems and Energy impacts*	*Chaired by Prof. Reinhard Radermacher of the University of Maryland, this session features two recently published papers on heat exchanger technology, in ASHRAE's HVAC&R Research Journal.*	*Describe the basic concept of approximation assisted optimization and know the different steps in approximation assisted optimization;* *Describe the geometry parameters that are most influential in single-phase flow in plate heat exchangers, along with model-based-optimization and some of the challenges in modeling of plate heat exchangers;* *Describe the operation of brazed plate-type condensers cooled by cooling towers and learn a new methodology to make simulated cooling tower water;* *Explain the definition and measurements of fouling resistance in brazed-plate type condensers;* *Identify the water fouling effects on the heat transfer performance of brazed-plate type condensers under fouling operating conditions;* *To recognize the water fouling effects on the water side pressure drop of brazed-plate type condensers.*	**1**	**No**	**N/A**
Technical Paper Session 6	*Modeling the Performance of Terminal Units in Single Duct VAV Systems*	60	*Project systems and Energy impacts*	*Electronically commutated motors (ECMs) have significantly improved the performance of Fan Powered Terminal Units (FPTUs). This session provides comparisons of the estimated performance of systems employing ECM versus PSC controlled motors for series and parallel terminal units in five different U.S. cities. The simulations were based on experimental data from three terminal unit manufacturers and two motor manufacturers that were used to develop semi-empirical models of FPTU airflow and power. The papers in this session are an extension to the prior work on FPTUs with SCR controllers in 1292-RP.*	*Describe the system level influence of the parallel FPTU;* *Describe the difference in performance of SDVAV systems using SCR controlled PSC motors and ECM motors;* *Describe the improvements in performance of SDVAV systems using ECM motors over systems using PSC controlled motors in parallel fan powered terminal units;* *Explain why the expected reductions in power with ECM motors over PSC controlled motors was not realized for parallel fan powered terminal units;* *Explain how to model the zone and system level performance of SDVAV systems using parallel fan powered terminal units;* *Explain the impact of leakage on systems that use parallel fan powered terminal units.*	**1**	**No**	**N/A**

Session Number (User created)	Session Title:	Total minutes of Instruction:	GBCI Topic Category (Pick one only)	Session Description (100 words):	Learning Objectives (Minimum of three)	Approved GBCI CE Hours	Is session LEED-specific?	Session meets LEED-specific requirements for the following LEED AP Specialties:
Conference Paper Session 21	*Surgical Operating Theaters, Healthcare Worker Exposures and Controlling Pressurization*	90	*Project systems and Energy impacts*	*This session has 3 papers: The first paper covers the investigation of the influence of the surgical operating theatre architecture design on the efficiency of the flow of air-conditioned supply to create sterile and comfort environment in the theatre. The present work is devoted to investigate the relation between airflow movement and air age and the operating room architecture. The second paper examines the effectiveness of a currently used Airborne Infection Isolation Room (AIIR) in protecting health-care workers (HCWs) from airborne-infectious (AI) exposure. The goal is to assess ventilation design to mitigate this exposure for the HCW. The research also compared HCW AI exposures within an AIIR and a traditional patient room, and assessed ventilation design options for the two rooms. The third paper analyzes the effect of mechanical parameters, especially the envelope leakage as it ranges from tight to effectively zero. When the room is sealed, or nearly sealed, mechanical coupling between air flows in and out of the room complicates control loop dynamics. Flow and pressure loops that are ordinarily almost independent become tightly coupled with the potential to destabilize one another.*	*Describe the coupled dynamic components of a room pressurization system;* *Describe the utility and limits of simplified mathematical model of room flows and pressures;* *Describe a computational method for assessing the effectiveness of existing ventilation arrangements in an airborne-infection isolation room (AIIR) in protecting health-care workers (HCWs) from airborne-infection exposure;* *Simulate airflow patterns in a regular patient room;* *Define operating theatre air conditioning requirements, objectives and design methodologies;* *Describe how the air conditioning system of operating theatres depends on air distribution, local temperature and relative humidity under positive pressure conditions.*	**1.5**	**No**	**N/A**
Conference Paper Session 22	*UK Perspectives on Incentives for Technologies to Reduce Energy Use*	90	*Project systems and Energy impacts*	*The EU carbon reduction commitment is a legally enforceable target to reduce the carbon impact of the built environment by 80% by 2050. The aim is not only to reduce carbon emissions but improve energy security. This has accelerated the implementation of legislation in all states across Europe and specifically, in the case of the studies in this session, in the UK. The four presentations consider the incentives that are being used to encourage development and application of technologies to not only reduce the need for energy use in buildings but also in delivering heat and power from renewable sources. By considering both existing and new build projects the reality of prediction, costing, assessment and integration of renewable technologies are discussed, supported by real world case studies undertaken in metropolitan London.*	*Explain the practical experiences of performance and financial viability of photovoltaic (PV) installations that have been retrofitted to 8 operating fire stations in London;* *Describe the challenges and application of integrating renewable energy technologies in an inner city demonstration 'energy centre';* *Provide an overview of how legal mechanisms are being introduced in UK/Europe to incentivise low or zero carbon technologies, or to require standards of building fabric performance that will reduce dependency on energy imports;* *Explain the various standards that are being applied to dwellings in UK/Europe to reduce the building energy use and identify the benefits offered by the schemes;* *Describe how computer tools and processes need to evolve to allow the industry to accurately predict and control carbon in the built environment;* *Discuss some of the key factors affect the internal rate of return (financially effectiveness) of an example renewable energy installation.*	**1.5**	**No**	**N/A**

Session Number (User created)	Session Title:	Total minutes of Instruction:	GBCI Topic Category (Pick one only)	Session Description (100 words):	Learning Objectives (Minimum of three)	Approved GBCI CE Hours	Is session LEED-specific?	Session meets LEED-specific requirements for the following LEED AP Specialties:
Conference Paper Session 23	*Modern Treatment of Water and Ice Based TES Systems*	90	*Project systems and Energy impacts*	*Sensible heat thermal storage systems are efficiently used to cool large thermal loads. Water treatment for such systems can be achieved through various methods. Proper water treatment maintains the many advantages of thermal storage by reducing corrosion, increasing asset life and maintaining efficient heat transfer. Three methods for effective treatment of water for large, sensible heat, thermal storage systems will provide a state of the art look at water treatment.*	*Describe the distinctions of low temperature fluid (LTF) thermal energy storage (TES) compared to traditional chilled water (CHW) TES and Ice TES;* *Describe the types and details of applications of LTF TES;* *Describe the results of LTF TES operation, in terms of the long-term control of corrosion and microbiological activity;* *Maximize the actual operational energy performance of buildings and facilities;* *Describe how the development of improved HVAC&R components ranging from residential through commercial provides improved system efficiency, affordability, reliability and safety;* *Apply energy efficiency, environmental quality and the design of buildings in engineering and architectural education*	**1.5**	**No**	**N/A**
Seminar 36	*Cutting-Edge Japanese Technologies, Part 2: 2011 SHASE Annual Award and Development of CFD on the Basis of BIM*	90	*Project systems and Energy impacts*	*The purpose of this session is to explain the latest Japanese HVAC and modeling technologies. Some of these technologies were awarded the SHASE Annual Award in 2011. The first of these technologies is a desiccant cooling system that can realize a non-condensing environment using a non-condensing air-conditioning system. The second is an innovative energy- and resource-saving air-cleaning system that was developed by separating the heat treatment and air-cleaning functions and by using the minimum elements required for clean rooms. Finally, we introduce the development of CFD parts for HVAC elements on the basis of BIM, and explain the usable features and format of the CFD for HVAC design engineers.*	*Describe IAQ problems related to microorganism pollution, non-condensing environments both in HVAC systems and in room regeneration of a desiccant with a CO2 heat pump as a dedicated outdoor air-conditioning system;* *Describe the features of an energy- and resource-saving air-cleaning system (task and ambient air-cleaning system);* *Describe the air-cleaning performance of this newly developed system compared with conventional systems;* *Describe the reduction of the amount of CO2 emission of this system compared with conventional systems;* *Describe the features and format of the CFD parts;* *Provide some examples of CFD parts that are used for the CFD analysis of indoor air distribution.*	**1.5**	**No**	**N/A**

Session Number (User created)	Session Title:	Total minutes of Instruction:	GBCI Topic Category (Pick one only)	Session Description (100 words):	Learning Objectives (Minimum of three)	Approved GBCI CE Hours	Is session LEED-specific?	Session meets LEED-specific requirements for the following LEED AP Specialties:
Seminar 37	*Issues Update: U.S. State Building Energy Codes Legislation and Regulations*	90	*Stakeholder involvement in innovation*	*States are one of the most active areas of building codes legislation and regulations in the United States. They often look to each other for direction, and the actions of a few key states can impact several others, and possibly the entire nation. Legislation has been introduced in several states that would use ASHRAE standards to help accomplish policymakers' energy efficiency and other goals. This session updates members on the current status and chances of passage of building codes legislation in key states, providing insight into the intersection between what is politically acceptable and what is helpful, in a technical sense, to the building industry.*	*Define ASHRAE's priority advocacy areas;* *Describe how states sometimes influence each other in terms of building-related legislation;* *Provide a list of key states that could influence other states, in terms of building-related legislation;* *Explain how ASHRAE seeks to use the Society's technical expertise to inform public policymaking at the state level;* *Describe the political barriers to increasing building efficiency in key states;* *Describe possible solutions to overcoming political barriers to increasing building efficiency at the state level.*	**1.5**	**No**	**N/A**
Technical Paper Session 7	*Effect of Typical Inlet Conditions on Air Outlet Performance*	90	*Project systems and Energy impacts*	*Building air distribution system designers and installers require accurate quantitative information on the performance of the installed system to achieve optimum efficiency and occupant comfort. This session covers an ASHRAE research project that established both baseline performance according to ASHRAE Standard 70-2006, and the field installation adjustment values for throw, pressure loss, and sound generation. Testing covered the air output performance of six types of ceiling diffusers each with three inlet sizes at three inlet velocities. Results include predictive models and look-up tables that can be used to easily predict performance of the installation configuration compared to published data.*	*Explain the difficulties of predicting installed system performance based on published outlet performance data;* *Describe the usefulness and limitations of published baseline data;* *Distinguish between ideal and less than ideal air outlet installations in regards to pressure loss and intended diffuser discharge throw;* *Explain how field installations of air outlets may have pressure and air distribution performance degraded from manufacturer published outlet performance data;* *Distinguish between ideal and less than ideal air outlet installations in regards to diffuser sound generation;* *Explain how many field installations of air outlets will have sound performance degraded from manufacturer published outlet performance data.*	**1.5**	**No**	**N/A**

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Seminar 38	*Advancing the "I" in BIM*	90	*Project systems and Energy impacts*	*Holding great promise for lowering costs and improving building performance, seemingly everybody in the AEC community wants a piece of Building Information Modeling. Unfortunately many in the HVAC&R industry have regarded early attempts at BIM as nothing more than glorified coordination drawings. This seminar is aimed at learning how some leading owners, contractors, and academic institutions are overcoming early challenges to exploit the "I" in BIM, leading to better cost efficiencies and maintenance practices. What will it take to reap the intended value of BIM? After brief background presentations, four industry leaders share their knowledge through a forum discussion.*	*Describe the barriers contractors face in making productive use of architect and engineer developed BIM models;* *Communicate contractor cost and resource implications for turning BIM into an informational tool;* *Describe through actual examples how BIM can lead to construction cost and scheduling efficiencies;* *Describe through actual examples how BIM can improve building operation and maintenance practices;* *Describe strategies for building the engineer, contractor, owner collaboration required to harness the informational capabilities of BIM;* *Communicate BIM best practices learned through leading edge field research projects.*	**1.5**	**No**	**N/A**
Seminar 39	*Comparison of Laboratory and Field Performance Testing and Ratings of Fans*	90	*Project systems and Energy impacts*	*Manufacturers adopt AMCA standard methods in the laboratories for performance testing and generate fan curves. In-situ fan performance and system curve in almost all situations do not match laboratory results. Of course, there are different reasons for these differences. One reason is the use of different techniques and tools used to measure the performance in the laboratory and field. Also, the accuracy of the available field methods are not well-established and standardized. This seminar discusses the different methods and tools available and used together with their comparisons.*	*Describe fan performance testing and ratings;* *Explain different methods and tools available for testing;* *Provide the reference standards used in testing;* *Describe what type of tools and methods used in laboratories;* *Explain the differences between the lab and field testing tools;* *Explain why there are differences in the performance result obtained in the lab and field.*	**1.5**	**No**	**N/A**
Seminar 40	*Advanced Control and Diagnostic Techniques for Efficient Operation of High Performance Buildings*	90	*Project systems and Energy impacts*	*There is considerable interest in the building energy community of ways to design low energy and even net-zero energy buildings. In conjunction with this focus, there needs to be an equal amount of emphasis placed on ways to operate such buildings so that the full advantages of all the new elements and control features being proposed are being fully realized. Many of these features involve dynamic control of building elements. This seminar covers promising and emerging techniques by three distinguished speakers on active daylighting control, on mixed mode cooling strategies, and embedded supervisory control strategies for building systems.*	*Explain the need for effective control of solar gains so as to reduce cooling loads and achieve good comfort;* *Describe the importance of appropriate modeling of fenestration and building thermal response in the development of predictive control strategies for peak load reduction;* *Describe mixed-mode (MM) cooling strategy;* *Describe the approach adopted in developing a general linear model (GLM) method for extracting control rules from the near-optimal testing result;* *Describe the importance of utilizing generic control algorithms that could be embedded within individual controlled devices;* *Describe the opportunities and approaches associated with embedded diagnostics for HVAC equipment.*	**1.5**	**No**	**N/A**

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Seminar 41	*Loads on the Move: Mobile Apps*	90	*Project systems and Energy impacts*	*In the world of technology, mobile applications, for load calculations and energy analysis, are becoming a reality. Come find out the pros and cons of HVAC mobile applications. There are four presentations on mobile applications technologies followed by a moderated roundtable on different sides of the mobile app benefits and shortcomings.*	*Describe what is currently available in mobile applications for load calculations;* *Describe why mobile applications have limitations;* *Describe why mobile applications of load calculations are popular;* *Describe what the limits are for mobile applications of load calculations;* *Describe about on-going developments in load calculation mobile applications;* *Describe the risks of using mobile load calculations.*	**1.5**	**No**	**N/A**
Conference Paper Session 24	*The Role of Energy Efficiency and Renewable Energy*	90	*Project systems and Energy impacts*	*Sustainable energy use in high performance buildings based on the inextricable linkage of energy efficiency and renewable (solar and other RES) implementation – optimized by the BPS and co-simulation via integrated building design, is to be covered. Session goal is to answer the question "Is buildings sector (urban and rural) strategic energy planning worldwide appropriate or should it be more "offensive" concerning the current RES technologies (thermal and electrical) and RES technical potential status, demonstration and commercialization, as well as successful decades of RES systems reliable operation, particularly in buildings sectors. Special attention will be drawn to the high IEQ-HVAC (high indoor environment-HVAC) buildings and their further "greening to approach NZEB" dependence on the further commercialization and implementation of RES technologies and RES integrated approach (from modeling through end designs and construction to the operational optimization via BEMS). Not less important are complex energy systems of the combined RES based central and/or municipal utilities energy generation and buildings distributed pure RES or hybrid (fossil and RES based) co-generation. Solar and other RES natural and technical potentials, locally available, are mainly in all world regions well determined and consequently many Governments Strategic Energy Plans are predicting important target - percentage growth of RES utilization in building sector and total.*	*Explain the role of solar and other RES on the strategic energy planning in different regions and countries in the world;* *Describe the potential increase of national RES implementation targets to substitute fossil fuels, exercise critical thinking;* *Describe the barriers to reach defined RES targets;* *Describe how RES-based HVAC and energy supply systems can be further searched and developed;* *Describe how RES-based HVAC and energy supply systems can be produced and related industry further developed and sized;* *Apply creative thinking: imaginative planning, strategic engineering, production, equipment, industry development knowledge based road-mapping.*	**1.5**	**No**	**N/A**

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Conference Paper Session 25	*Heat Exchangers: Benefits and Models*	90	*Project systems and Energy impacts*	*This session features papers on applications and tools for ground-coupled heat pumps and hydrothermal energy conversion. The four papers cover the following topics: an overview of hydrothermal energy conversion with case studies; two papers on modeling techniques for ground couple heat pump fields; and a field test methodology to evaluate the ground thermal properties for ground-couple heat field design.*	*Describe how an organic rankine cycle can be used to generate electricity from stratified ocean or lake water;* *Describe how heat exchange in thermal ground fields relies on properties of the soil, borehole spacing, water tempeature and air temperature;* *Describe how to derive ground field properties from a thermal test;* *Describe the auxiliary non-energy benefits of pumping deep lake or ocean water for an organic rankine cycle plant;* *Describe why multiple year simulations are necessary to fully assess the performance of a ground-coupled heat pump system;* *Explain mathematical techniques to speed up simulations of ground fields.*	**1.5**	**No**	**N/A**
Conference Paper Session 26	*Natural Ventilation Impacts and Applications in Large Buildings*	90	*Project systems and Energy impacts*	*Natural ventilation is being considered for a wider range of large buildings. The selection of natural, hybrid or mechanical ventilation strategies involves an understanding of the effect of different climates, acceptable comfort conditions, energy, capital and maintenance costs. In addition within large, naturally ventilated buildings, there are often specific areas of the building which are mechanically conditioned. The interaction of these spaces with the naturally ventilated space can have significant effects. This session discusses these impacts, as well as other design considerations and tools for informed design of a large naturally-ventilated building.*	*Explain how the interaction between specific mechanically conditioned areas and building central areas affects the conditioning of the central building areas;* *Explain the effect of climate in selecting the most appropriate ventilation strategy (natural, hybrid or mechanical) for central areas;* *Describe issues surrounding entranceways and localized thermal comfort in large buildings;* *Describe a methodology for using a new airflow network tool and CFD to design naturally-ventilated buildings;* *Describe how building geometry and buoyancy driven flows play a role in ventilation performance and effectiveness.* *Describe the microclimatic environment of a building cluster to facilitate the design of urban ventilation strategies, and help landscape architecture and urban planning to achieve a better urban environment.*	**1.5**	**No**	**N/A**

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Seminar 42	*Case Studies: New Equipment and Applications to Improve Energy Efficiency*	90	*Project systems and Energy impacts*	*Energy efficiency opportunities abound for new and older buildings. Major improvements can be made by upgrading equipment, applying equipment in innovative ways, and using energy modeling and metering. This showcases three unusual approaches to improving performance in buildings.*	*Describe how to apply multiple new HVAC technologies in retrofit applications;* *Describe installation methods for older buildings;* *Explain campus chilled water diversity which can be significantly different from a building's air-conditioning diversity;* *Explain why hydraulic modeling is also energy modeling for new and old buildings;* *Explain how to successfully apply a geothermal central plant and avoid some of the potential pitfalls;* *Explain the importance of metering.*	**1.5**	**No**	**N/A**
Seminar 43	*Industrial Refrigeration Worst Practices*	90	*Project systems and Energy impacts*	*Most ASHRAE seminars try to teach participants about the latest, greatest, best and the brightest methods for designing built environments. But what about the other end of the spectrum - the worst? There is just as much to learn from the implementation of bad ideas, the application of poor practices and the operation of facilities without proper procedures. And nowhere does this become more evident than in industrial refrigeration applications. This seminar highlights fairly common designs, maintenance practices and operational SNAFU's throughout the industrial refrigeration world that often lead to more problems. The presenters provide methods to correct the design or operation to alleviate the resulting problems.*	*Describe the importance of preventing outside air from infiltrating a refrigerated structure;* *Explain common methods for preventing infiltration into a freezer;* *Describe keys to avoid installations that are not code/standard/guideline compliant;* *Describe techniques to a achieve sustainable system operations;* *Describe the importance of installing a proper insulation system on refrigerated piping;* *Explain the importance of the insulation system for refrigerant piping at various temperature levels.*	**1.5**	**No**	**N/A**

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Seminar 44	*Integrated Multi-Domain Simulations for Innovative Building Design and Operation, Part 1*	90	*Project systems and Energy impacts*	*Integrated performance simulation of buildings and heating, ventilation and air-conditioning (HVAC) systems can help in reducing energy consumption and increasing occupant comfort. As part one of the two seminars in integrated building simulation, this seminar first discusses why, when and how we can use integrated multi-domain simulation for innovative building design and operation. The concepts and principles are then demonstrated by using two applications, including integrated simulation of energy and airflow for natural ventilation, as well as coupled simulation of building physics and energy system.*	*Describe what the integrated simulation is;* *Describe ntegrated simulation for buildings;* *Explain when to use integrated simulation for buildings;* *Explain the basic process of integrated building simulation through the exemplar applications;* *Design a more effective natural and hybrid ventilation building with integrated energy and airflow simulation;* *Apply the process of low energy building design by using integrated simulation of building energy and thermal systems.*	**1.5**	**No**	**N/A**
Seminar 45	*Trying Hard to Play Nice: Assessing Industry Barriers to the Use of IPD*	90	*Project systems and Energy impacts*	*IPD (Integrated Project Delivery) with "BIM" and "green" are key aspects of the design and construction "hot list". IPD execution promises to streamline project delivery and optimize outcomes but IPD hinges on a collaborative process both in philosophy and in practice. The industry is often much more adversarial. Special legal issues encountered on publically-funded projects and when doing retrofits will be included. The program identifies principal barriers and how to overcome them so that the marketplace can realize the value of IPD.*	*Explain what integrated project delivery is in relation to more traditional building design/delivery practices;* *Explain what some of the benefits are of IPD;* *Explain what some of the barriers are to achieving those benefits: legal, control, responsibility/liability;* *Explain the nature of some "Separations Act" or "Wick Law" legislation, why they were enacted, and what their effect is on green building design and possible workarounds;* *Explain how green cities initiatives that would use USGBC recommended charettes for design are affected by some state laws requiring separation of trades bidding from case studies in Chicago;* *Explain what DOE's Energy Innovation Hub for Energy Efficient Building retrofits is approaching this problem in the Philadelphia area*	**1.5**	**No**	**N/A**

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Technical Paper Session 8	*Effects of Various Factors on Heat Exchanger Performance*	90	*Project systems and Energy impacts*	*The purpose of this technical session is to inform design engineers of how the performance of air and water to refrigerant heat exchangers are affected by factors such as condensation temperature, water quality, frost growth, and air-side particulate fouling.*	*Identify critical operating parameters in water-side fouling for brazed-plate type condensers;* *Explain how fouling affects the heat transfer performance and pressure drop of brazed-plate type condensers under fouling operating conditions;* *Describe the performance changes of microchannel heat exchangers when they are used as outdoor coils in heat pump systems and undergo frosting conditions;* *Identify the impact of the fin surface temperature on the frost growth and air flow blockage;* *Apply a protocol including reference test dusts and test procedures for experimental evaluation of air-side particulate fouling performance of heat exchangers;* *Describe how the fouling performance of heat exchangers is affected by the test dust types and the heat exchanger application modes (heating or cooling).*	**1.5**	**No**	**N/A**
Technical Paper Session 9	*Pressure Loss Measurements in Air Duct Junctions*	90	*Project systems and Energy impacts*	*The first paper in this session reports results from RP-1488. The purpose of that study was to obtain experimental loss coefficient data for various diverging flow flat oval tees and laterals. The results for branch loss coefficient data for tee and lateral fittings were shown to fit a power law correlation developed previously. The main loss coefficient data could not be correlated by power law. The average value for the main loss coefficient for straight-body tees was found to be -0.167. Likewise the main loss coefficient for straight-body laterals was found to be -0.216. This session also presents a method of correlating main and branch loss coefficients for saddle tap tees operated in the diverging and converging flow modes. The goal of that test program was to determine if the saddle tap tee is an efficient air moving junction, and if so to include the resulting loss coefficient data in the ASHRAE Duct Fitting Database (DFDB).*	*Describe a power law model that correlates diverging flow flat oval tee and lateral branch loss coefficient data as a function of branch-to-common flow rate and area ratios;* *Understand how diverging flow flat oval tee and lateral main loss coefficient data do not vary with flow rate ratio;* *Describe for diverging flow in straight-body flat oval junctions the main loss coefficient;* *Understand how for saddle tap tees, a power law curve-fit is used for diverging flow tees to correlate branch loss coefficients as a function of branch-to-common flow rate and area ratios;* *Understand for diverging and converging flows in saddle tap tees main loss coefficients are correlated in terms of an inverse linear relationship with the straight-to-common flow rate ratio;* *Explain how saddle tap field fabricated tees can be incorporated into duct systems with a conical branch tapered into the body.*	**1.5**	**No**	**N/A**

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Conference Paper Session 27	*Correct Sizing of HVAC Equipment and Systems for Standard 62.1*	60	*Project systems and Energy impacts*	*This session addresses the correct sizing of HVAC equipment and systems and overall building energy consumption for compliance with Std. 62.1. Discussions include the use of a standard way to deal with Zmax so that significant amounts of energy and money can be saved. On the water side, a case study comparing the energy savings of full flow, side stream, and basin sweeping is compared and the energy savings potential reported.*	*Provide an overview of ASHRAE 62.1 ventilation calculation procedures for single supply multi-zone systems;* *Describe approach to optimizing ASHRAE 62.1 calculations to minimize energy use;* *Analyze results of example system optimization of generic office building across a range of climate zones;* *Describe different filtration strategies for open recirculating systems and the advantages and limitations of each strategy;* *Determine which filtration strategy is best for an application whether it is a new or existing system;* *Explain how a basic evaporative cooling system works and why filtration is essential to maintain the energy efficiency of the system.*	**1**	**No**	**N/A**
Conference Paper Session 28	*Carbon Fiber Air Filters: U-Bend and L-Bend Anchor Forces*	60	*Project systems and Energy impacts*	*This session contains presentations about two typical elements for HVAC applications. It is widely known that an ionizer operated upstream of a ventilation air filter can significantly enhance the filtration efficiency. Based on an experimental investigation, the first paper presents how different fiber materials and filter classes will influence this efficiency enhancement. The second paper aims to address the anchor forces in L-bend and U-bend piping due to thermal expansion. Anchor force results are calculated following different methodologies (ASHRAE, Kellogg, Grinnell-Spielvogel, and simple cantilever methods). The large discrepancy among the results is explained and recommendations are made for ASHRAE Handbook edits and future research.*	*Explain how air filters improve indoor air quality;* *Describe the effects of an ionizer on the removal of ultrafine and submicron particles by fibrous air filters;* *List factors that affect ionizer performance in a ventilation system;* *Define thermal expansion and its effect on piping runs and anchor force;* *Apply multiple methodologies to find anchor force;* *Analyze discrepancies between methodology results*	**1**	**No**	**N/A**

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Seminar 46	*Case Study: Swedish Issaquah, Taking Hospital Energy Efficiency to the Next Level through an Integrated Project Delivery Approach*	60	*Project systems and Energy impacts*	*Establishing an aggressive, achievable building EUI mandated an innovative mechanical design approach that resulted in an energy saving of 40%. This project integrated the cooling, heating and domestic water systems utilizing a heat recovery chiller. The team's presentation covers an overview of systems selection, design concepts, modeling results, construction and commissioning lessons learned and the importance of training to correctly operate a non-traditional system. There is a deep dive into the IPD processes which were integral to the project's success.*	*Apply IPD process thinking to healthcare projects;* *Target a low EUI and understand how every decision can be made to support that goal;* *Explain how a decision/responsibility matrix is created and changed over time;* *Describe how to select and model non-traditional mechanical systems;* *Create an IPD environment and build the systems needed to be successful;* *Explain how IPD can have a profoundly positive effect on budget, schedule and EUI*	**1**	**No**	**N/A**
Seminar 48	*Smart Buildings: Implementing Predictive Energy Optimization Technology to Drive Efficiency and Savings*	60	*Project systems and Energy impacts*	*Commercial buildings consume 20% of U.S. energy. Building operators are looking to save energy and reduce their utilities expense with less capital and resources. Many existing energy management systems do not have the capabilities to incorporate predictive modeling-based optimization strategies that address real-time and forecasted weather data, real-time and future energy supply pricing/constraints, and the occupant comfort the current environment demands. This session explores the next generation of intelligent building energy management, showcasing how predictive energy optimization technology can manage energy consumption in buildings and save 10-30% energy with little or no capital and no impact on occupant comfort.*	*Describe core issues facing building owners in balancing building performance, tenant satisfaction, and managing costs;* *Describe new technologies and approaches that positively overcome challenges facing building owners;* *Describe the concept of predictive energy optimization and how it is different from typical controls operation;* *Describe how to achieve real savings and operational improvements;* *Explain how the latest building automation technologies can be used to reduce operational energy expenses while maintaining occupant comfort, with no capital outlay;* *Explain the growing trend of utility demand response programs and how owners can take advantage of these new utility programs to overcome budget constraints.*	**1**	**No**	**N/A**

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Conference Paper Session 29	*HVAC Controls and Heat Pump Electric Resistance Heat*	90	*Project systems and Energy impacts*	*This session will focus on Heat Pump operation in low-ambient conditions as well as improved controls to accommodate the increase in ventilation air in this era of energy conservation. The operation of Heat Pump systems in low ambient outdoor conditions regularly requires heavy reliance on the electric resistance heat installed in the system. This paper will cover alternate system design to alleviate this resistance heat demand. ASHRAE Standard 62.1 requires elevated outdoor air levels, hese control strategies will show energy conservation measures available that will satisfy these requirements.*	*Reduce the demand on electric resistance heat during low ambient outdoor air conditions while using air-to-air heat pumps.* *Equipment that allows the operation of an air-to-air heat pump in low ambient outdoor air conditions.* *Reductions in electric resistance heat that can be realized with this technology?* *Sequences of operation that will allow higher ventilation rates in AHUs with lower energy penalties.* *Equipment that is utilized in these control sequences?* *Level of energy savings that can be realized with these controls.*	**1.5**	**No**	**N/A**
Seminar 49	*Impact of Extreme Ambients on Performance of Unitary Air Conditioners and Heat Pumps*	*60*	*Project systems and Energy impacts*	*Typically air conditioner and heat pump performance is well characterized for average temperature conditions but not that well understood for either low temperatures applications for heat pumps or very high temperatures. This session will focus on both lab and field experience with this equipment operating at extreme conditions.*	*Describe how the vapor injection cycle operates* *Describe the benefits of the vapor injection cycle* *Provide an understanding of what changes can be made to heat pumps to improve cold weather performance.* *Describe how heat pumps designed for cold climates perform in these climates.* *Explain the impact of cool roofs on condenser air temperature.* *Describe methods of improving a/c design and technology for hot climates*	***1***	**No**	**N/A**
Seminar 50	*DOAS Parallel Systems, Configuration and Control*	90	*Project systems and Energy impacts*	*Energy recovery is often used with a dedicated outdoor air system (DOAS). This energy recovered can be utilized for two purposes. Energy recovery from the exhaust air can be used to trim the ventilation heating/cooling/dehumidification load. Exhaust air can also be used to change the sensible heat ratio of the cooling provided to better dehumidify the air.*	*Control DOAS systems that utilize parallel energy recovery with multiple components;* *Examine typical equipment configurations that employ air-to-air energy recovery devices and review a variety of performance metrics in addition to identifying the advantages and limitations of each configuration and provide practical and climate-specific recommendations;* *Focus on the simplest control DOAS control strategies that automate control actions for heat recovery, cooling and dehumidification, free cooling, building pressurization, central heating primarily with heat recovery, freeze protection, limits to terminal reheat—including demand controlled ventilation, and supply/return fan operation;* *Show how exhaust air can be used to change the sensible heat ratio of the cooling supply air to better dehumidify the conditioned space;* *Examine aspects of DOAS control systems with respect to how they regulate heat recovery, cooling, freeze protection, demand control ventilation and supply/return fan operation;* *Examine the basic common DOAS equipment arrangements.*	**1.5**	**No**	**N/A**

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Seminar 51	*Indoor Air Quality in Green Building Programs: Are They Really Serious About It?*	90	*Improvements to the indoor environment*	*For the last several years, green buildings have been taking the building community by storm. Green buildings are intended to save energy, improve indoor air quality, and limit a range of environmental impacts, and there has been much debate about how successful they are in achieving these noble goals. In particular, how green buildings address indoor air quality is sometimes viewed with skepticism, in part based on concerns that energy efficiency is driving the green train. Everyone agrees that buildings need to change, both inside the building and out, and a balanced, thoughtful and honest approach is needed to get the job done.*	*Describe the indoor air quality requirements in existing green building programs;* *Describe what other aspects of indoor air quality are not fully dealt with in existing green building programs;* *Describe the multiple benefits of achieving good indoor air quality;* *Explain the key design, construction and commissioning aspects of achieving good indoor air quality;* *Describe the many unknowns related to indoor air quality and the limitations of current research;* *Explain what resources are available to provide good indoor air quality.*	**1.5**	**No**	**N/A**
Seminar 52	*Integrated Design and Commissioning on the Same Building: Collaboration or Collision?*	90	*Project systems and Energy impacts*	*Integrated building design (IBD) and building commissioning are both strategies for improving a new building's ability to meet the needs of the owner and occupants. IBD involves getting all the participants in the design process together to work out common issues. Commissioning that (appropriately) starts early in the design process drives participants to coordinate a commissioning plan and design activities. How do the two interact? This seminar includes presentations from an IBD professional that included commissioning in a project and presentations from commissioning authorities who were involved in projects that included IBD.*	*Describe how the owner's goals and objectives are characterized and communicated in an integrated building design (IBD);* *Explain how commissioning (Cx) interprets and implements the the owner's objectives in an IBD process;* *Determine how IBD and Cx interact at the intersection between building design and operation;* *Describe techniques for ensuring that IBD and Cx are coordinated and that the professionals involved collaborate effectively;* *Describe how IBD may have to be adapted to include a Cx process that starts during the design phase of the building;* *Explain how Cx may have to be adapted to integrate itself into an IBD process.*	**1.5**	**No**	**N/A**

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Seminar 53	*Integrated Multi-Domain Simulations for Innovative Building Design and Operation, Part 2*	90	*Project systems and Energy impacts*	*As the part 2 of the integrated multi-domain building simulation seminars, this seminar will introduce the development of common platforms for co-simulation for multiple computer programs and hardware. The platforms include Building Control Virtual Test Bed and Functional Mock-up Interface. It will discuss the concepts and advantages of using a common platform in integrated building simulation. Examples of using these platforms for innovative low energy building design and operations will also be demonstrated.*	*Explain the concept of using a platform for integrated simulation;* *Describe the principles of the open-source co-simulation platform BCVTB;* *Describe the principles of the open-source co-simulation standard FMI;* *Describe which platform fits the need;* *Design lighting and daylighting control with low whole building energy consumption by using integrated simulation;* *Describe the impacts of occupancy patterns on overall building energy performance.*	**1.5**	**No**	**N/A**
Seminar 54	*Optimizing Cleanrooms for High Performance, Energy Reduction and Sustainability*	90	*Project systems and Energy impacts*	*Cleanroom facilities consume 5-50 times more energy than commercial spaces in the same sizes to achieve specified air cleanliness. Recent design and research developments focus more on achieving high performance while reducing energy consumption and improving sustainability. The seminar starts with a presentation addressing general cleanroom design criteria, such as cleanliness, particle, temperature, humidity, pressure, filter type and exhaust/make-up air in relationship with energy use. The second presentation reveals the findings from recent ASHRAE project which utilized real-time particle sensors to trace particle migration between rooms of different cleanliness classes and pressures to identify the minimum pressure differentials under various scenarios and conditions. The last topic covers case studies in energy reductions by using particle monitoring to reduce airflow, by recapturing lost pressure air, and by switching from ducted to fan-powered systems, etc.*	*Estimate approximate total energy costs associated in operating cleanrooms;* *Calculate energy savings by using simple controls for monitoring of particles counts and occupancy schedules;* *Predict energy effects on adjustments made to cleanliness, temperature, humidity, make-up air flow, pressure, and type of filters;* *Decide if an airlock is needed based on conditions that more particles migrate during door-being-opened condition than door-closed condition;* *Explain the factors impacting the minimum pressure differential requirement, such as room air-tightness, room air cleanliness classes across door, auxiliary device (clean branch, mini-environment or containment hood), etc;* *Explain how to achieve energy reductions by using particle monitoring to reduce airflow, by recapturing lost pressure air, and by switching from ducted to fan-powered systems.*	**1.5**	**No**	**N/A**