

CONTENTS

Host Chapter, Officers, and Conferences and Expositions Committee	xiv
State of the Society Address, Farooq Mehboob, 2022–2023 ASHRAE President	xv
Technical Program	xviii

CONFERENCE PAPERS

AT-23-C001	Building Envelope Performance and Design Considerations for Mechanical Engineers Cheryl M Saldanha; Corey Wowk; Leonidia Garbis; Ali Yalaz	3
AT-23-C002	Test, Adjust and Balance: Lessons Learned for Engineers, Cx and Energy Providers James E. Hall, PE, TBE, CxA, Full Member ASHRAE	12
AT-23-C003	Visualizing Automated HVAC Performance Analysis on Floor Plans for Meaningful Insights Sanaz Saadatifar, Student Member ASHRAE; Amulya Surapaneni, Associate Member ASHRAE; Kathryn Lee, PE, Full Member ASHRAE; Benjamin VanderSluis, PhD, Full Member ASHRAE; John G. Williams, PE, CEng, Full Member ASHRAE	25
AT-23-C004	Performance Evaluation of a Hyperloop Ground Source Heat Pump System in a Residential Building Rui Miao, Student Member ASHRAE; Yao Yu, PhD, Associate Member ASHRAE; Xiaouu Hu, Student Member ASHRAE; Richard A. Gordon, PE	34
AT-23-C005	Archetype Energy Models for Residential Sector and Application to Conceptual Design Seyed Matin Abtahi, MAsC, Student Member ASHRAE; Andreas Athienitis, PhD, PE, Fellow ASHRAE; Benoit Delcroix, PhD	42
AT-23-C006	Simulation of PCM- Integrated Wall Designs for Residential Buildings in Sacramento Shubhankar Raykar, MS, Student Member ASHRAE; Vinod Narayanan, PhD, Full Member ASHRAE	50
AT-23-C007	Vibration-Analysis in Failure Detection: Opportunities, Limits and Outlook Christian Ellwein, PhD, Full Member ASHRAE	60
AT-23-C008	Electrical Grid Problems: Monitoring and Solutions for Compressors, Pumps and Fans Christian Ellwein, PhD, Full Member ASHRAE	68
AT-23-C009	System-Level Performance Modeling of a Sub-Wet Bulb Evaporative Chiller Coupled to a Microchannel Polymer Heat Exchanger for Residential Cooling Applications Emily Fricke; Vinod Narayanan, PhD, Full Member ASHRAE	74
AT-23-C010	Burner Design Considerations for Hydrogen-blended Gas Operation Aleksandr Fridlyand, PhD, PE, Associate Member ASHRAE; Yan Zhao, PhD, Associate Member ASHRAE; William Asher, PhD, Associate Member ASHRAE; Paul Glanville, PE, Associate Member ASHRAE	83
AT-23-C011	From Town Gas to Hydrogen: Historical and Modern Perspectives on Transitions Between Delivered Fuels in the Built Environment Paul Glanville, PE, Full Member ASHRAE; Aleksandr Fridlyand, PhD, PE, Full Member ASHRAE; Yan Zhao, PhD, Full Member ASHRAE	92
AT-23-C012	Inline Hydrogen Sensor Monitoring of a Tankless Water Heater Operating Up to 30% Hydrogen Blending Yan Zhao, PhD, Full Member ASHRAE; Paul Glanville, PE, Full Member ASHRAE; Aleksandr Fridlyand, PhD, PE, Full Member ASHRAE; Brian Sutherland, PE, Full Member ASHRAE	103

AT-23-C013	District Feasibility Assessment for Wastewater Heat Exchanger Integrated Ground Source Heat Pump System Connor Dacquay, PE; Ed Lohrenz, Full Member ASHRAE; John Hood	112
AT-23-C014	Opportunities and Challenges for Low Carbon Heat Supply in Urban Neighbourhoods— A Central London Case Study Akos Revesz; Kristina Roszynski; Chris Dunham; Phil Jones; Henrique Lagoeiro; Graeme Maidment	120
AT-23-C015	Driving Success Towards Zero Carbon Energy Targets for UK’s Local Authorities Helen Turnell, PhD; Cat Marques, PhD; Phil Jones, MSc; Chris Dunham, MSc; Akos Revesz, PhD; Graeme Maidment, PhD, PE	129
AT-23-C016	Continuous Insulation Inward of Sheathing, High-Performance and Net-Zero Energy George David Schoenhard, AIA, Full Member ASHRAE	138
AT-23-C017	Measured Space Heating Hot Water Distribution Losses in Large Commercial Buildings Paul Raftery, PhD, Full Member ASHRAE; David Vernon, Full Member ASHRAE; Rupam Singla, PE, Full Member ASHRAE; Mia Nakajima, Student Member ASHRAE	148
AT-23-C018	Pump Right-Sizing and Flow Control Strategies to Improve Hydronic Building Space Heating Systems Abinesh Ravi, PE, Associate Member ASHRAE; Douglas Kosar, Full Member ASHRAE; Jason LaFleur, Associate Member ASHRAE; Jason Stein, Associate Member ASHRAE; Spencer Kennedy	156
AT-23-C019	VAV HW Reheat Terminal Units: Temperature Stratification, Performance at Low HWST, and Myths from the Field Patrick Wendler, EIT, Student Member ASHRAE; Paul Raftery, PhD, Full Member ASHRAE; Hwakong Cheng, PE, Full Member ASHRAE	165
AT-23-C020	Cold Climate Performance Assessment of a Natural Gas Engine-Driven Heat Pump Rooftop Design Patricia Rowley, Associate Member ASHRAE; Isaac Mahderekal, PhD, Full Member ASHRAE; Abinesh Ravi, PE, Associate Member ASHRAE; Adam Walburger; Nicholas Genzel; Hugh I. Henderson Jr., PE, Full Member ASHRAE; Jordan Dentz; Shengming Zhu	173
AT-23-C021	Hydrocarbon Refrigerant Safety Considerations and Implications for Air Conditioning System Design Steve Kujak, Full Member ASHRAE; Michael Petersen, Full Member ASHRAE	181
AT-23-C022	Impacts of Retrofitting Lower GWP Refrigerants for Aftermarket Applications Michael Petersen, Full Member ASHRAE; Steve Kujak, Full Member ASHRAE	191
AT-23-C023	Review of Systems and Refrigerants for Ultra-low Temperature Refrigeration Rui Liu; Daniel Bacellar, PhD, Full Member ASHRAE; Vikrant Aute, PhD, Full Member ASHRAE	200
AT-23-C024	Evaluation of Advanced Architectures for Commercial Refrigeration Systems using Low Global Warming Potential Refrigerants Fabrizio Codella, MEng; Chris Parker, MEng; Samer Saab, PhD	208
AT-23-C025	Reduced-order Model to Predict Dispersion of Flammable Refrigerant into a Space K. Dean Edwards, PhD; Ahmad Abu-Heiba, Full Member ASHRAE; Miroslav Stoyanov, PhD	222
AT-23-C026	Comparing the Economics and Emissions Impact of Residential Heat Pump Conversions versus Increasing Bioblends in Liquid Fueled Heating Appliances Richard Sweetser, Life Member ASHRAE	231
AT-23-C027	Seasonal Impact on Optimal Energy Storage Sizing in Residential Applications Joseph Elio, Student Member ASHRAE; Ryan Milcarek, PhD, Full Member ASHRAE	241

AT-23-C028	Evaluation of Life Cycle Carbon Emission Under Energy Flexibility Strategy: A Case Study of Residential Buildings in Shenzhen, China Yingyue Li; Rui Miao; Yi Zhang, PhD; He Qi, PhD	251
AT-23-C029	Opportunities for Rural Electrification of Space Heating in U.S.A. Sreenidhi Krishnamoorthy, PhD, Associate Member ASHRAE.....	260
AT-23-C030	Performance Analysis of Double Skin Air Handling Unit With Active Purification System Vaibhav Jain, PhD; Sonal Khurana; Gulshan Sachdeva; Dhruv Malhotra, Student Member ASHRAE; Gaurav Choraria, Student Member ASHRAE	267
AT-23-C031	The Importance of Heat Pump COP in the Economics of 5th Generation Heating and Cooling Networks Akos Revesz, PhD; Henrique Lagoeiro, PhD; Catarina Marques, PhD; Phil Jones, MSc; Chris Dunham, MSc; Graeme Maidment, PhD.....	275
AT-23-C032	Impacts from Electrification of Space Heating in Residences and Offices: A Simulation of Greenhouse Gas Emissions Across the United States Subhrajit Chakraborty, Student Member ASHRAE; Mazen Daher; Theresa Pistochini, PE, Student Member ASHRAE	283
AT-23-C033	WITHDRAWN	
AT-23-C034	Translating Equipment Efficiency to Delivered Efficiency in Thermally Driven Heat Pump Combi Systems Jason Stein, Associate Member ASHRAE; Paul Glanville, PE, Full Member ASHRAE; Aleksandr Fridlyand, PhD, PE, Associate Member ASHRAE; Jason LaFleur, Associate Member ASHRAE; Michael Mensinger Jr., Associate Member ASHRAE	293
AT-23-C035	Controlling Wind Pressure Around Buildings: Using Automated Multi-Angle Ventilation Louvers for Higher Natural Ventilation Potential SungHwan Lim, Student Member ASHRAE; Ali Malkawi, PhD; Leslie Norford, PhD, Full Member ASHRAE	302
AT-23-C036	Challenges of Integrating mCHP and SOFC Systems in Nano-Grid Environments for Thermal and Power Management Solutions in Integrated Energy Systems Alejandro Baez Guada, Full Member ASHRAE; Tim Kingston, Full Member ASHRAE	311
AT-23-C037	Energy Management and Control System for a PV-Battery System to Improve Residential Building Resiliency Under Extreme Weather Conditions Mingjun Wei, Student Member ASHRAE; Wenqi Jia, Student Member ASHRAE; Yangyang Fu, PhD, Full Member ASHRAE; Zhiyao Yang, PhD, Full Member ASHRAE; Zheng O'Neill, PhD, PE, Fellow ASHRAE	320
AT-23-C038	An Adaptive Model-Predictive Control Informed Rule-based Control for Residential Cooling Operations under Extreme Weather Events Tao Yang, Student Member ASHRAE; YangYang Fu, PhD, Full Member ASHRAE; Zheng O'Neill, PhD, PE, Fellow ASHRAE; Rich Kimball, Student Member ASHRAE; Jin Wen, PhD, Full Member ASHRAE.....	331
AT-23-C039	Using Deep Neural Network to Predict Natural Ventilation Behavior in Student Dorms Pratik Raj Pandey, Student Member ASHRAE; Bing Dong, PhD, Associate Member ASHRAE; Nina Sharifi, PhD	340
AT-23-C040	Determination of Energy Savings Potential from Varying Power to Ionization Stage of an Electrostatic Air Filter Larry Rothenberg, MS, JD; Ramin Rezaei, MSC; Igor Krichtafovitch, PhD; Alan Viosca, MSC.....	348
AT-23-C041	Results from Air Quality Monitoring and Surveys in UK Residences Parag Rastogi, PhD, CEng, Full Member ASHRAE; Olivia Nile Sobek, PhD; Linda Toledo, PhD; Rowanne Fleck, PhD; Graeme Jephson, MSc; Tim Sharpe, PhD	355

AT-23-C042	Development and Validate an Occupant-Centric Control of An Integrated Air and Domestic Hot Water System for Residential Buildings Zhipeng Deng, PhD, Student Member ASHRAE; Yuewei Li; Bing Dong, PhD, Full Member ASHRAE	366
AT-23-C043	Potential Approach to Comparatively Evaluate Whole-building Energy Use and Indoor Environmental Quality in Passive House and Conventional Buildings Homeira Mirhosseini, Student Member ASHRAE; Lily X. Li, Student Member ASHRAE; James Freihaut, Ph.D., Full Member ASHRAE	374
AT-23-C044	Classroom Conditions in Higher Education: Thermal Comfort and Effect on Student Success Pouria Fariborzi; Karina Nguyen; Jennifer Mott, PhD, Full Member ASHRAE	385
AT-23-C045	Development of A Hardware-In-the-Loop (HIL) Testbed for Cyber-Physical Security in Smart Buildings Guowen Li, Student Member ASHRAE; Zhiyao Yang, PhD, Full Member ASHRAE; Yangyang Fu, PhD, Full Member ASHRAE; Lingyu Ren, PhD, Full Member ASHRAE; Zheng O'Neill, PhD, PE, Fellow ASHRAE; Chirag Parikh, Full Member ASHRAE	393
AT-23-C046	WITHDRAWN	
AT-23-C047	Design Verification of the Impact of Electrochromic Glazing Kimberly Cowman, PE, HFDP, Full Member ASHRAE; Michael Kuhlenengel, Student Member ASHRAE	401
AT-23-C048	Maximum-Impact Adversary Design for Network-based Control System: A Case Study on Grid-Interactive Efficient Buildings Mengyuan Chu, Student Member ASHRAE; Yangyang Fu, PhD, Full Member ASHRAE; Zheng O'Neill, PhD, PE, Fellow ASHRAE	410
AT-23-C049	Experimental Assessment of PCM Roof Layers on Thermal Comfort in a Hot Semi-Arid Climate Caribay Godoy-Rangel, MSc, Student Member ASHRAE; Miguel Ángel Gijón-Rivera, PhD, Full Member ASHRAE; Carlos Iván Rivera-Solorio, PhD, Full Member ASHRAE; Seyedehniloufar Mousavi, MSc ...	419
AT-23-C050	Computational Fluid Dynamics (CFD) Analysis for Design Optimization of a Pharmaceutical Cleanroom Kishor Khankari, PhD, Fellow ASHRAE	429
AT-23-C051	Contamination Removal Assessment of the Various Ventilation Systems Within an Operating Room Mehran Salehi, PhD, Full Member ASHRAE; John G. Williams, PE, CEng, Full Member ASHRAE; Kathryn Lee, PE, Full Member ASHRAE	437
AT-23-C052	Using Network Modeling to Test for ASHRAE 90.4 Standard Compliance Aaron P. Wemhoff, PhD, Associate Member ASHRAE; Russ Tipton, PE, Life Member ASHRAE; Mark Seymour, PE, Full Member ASHRAE	445
AT-23-C053	Energy Recovery in Life Science and Healthcare Applications Grace Kolb, PE, Associate Member ASHRAE; Jake Canale, PE, Associate Member ASHRAE; Ryan McCulloch, PE	454
AT-23-C054	Waste Heat Recovery from Electrical Substations Gareth Davies, PhD; Henrique Lagoeiro, PhD; Akos Revesz, PhD; Graeme Maidment, PhD, PE	462
AT-23-C055	Heat Recovery Opportunities from Wastewater Treatment Plants Henrique Lagoeiro, PhD; Gareth Davies, PhD; Akos Revesz, PhD; Graeme Maidment, PhD, PE	472
AT-23-C056	An Overview of Occupant Behaviour Modelling in Urban Energy Simulation Aya Doma; Mohamed Ouf, PhD, PEng, Fellow ASHRAE	482

AT-23-C057	Reinforcement Learning Approach for Predicting Occupant Preferences in Thermostat Set-Points Hussein Elehwany, Student Member ASHRAE; Mohamed Ouf, PhD, Associate Member ASHRAE; Burak Gunay, PhD, Associate Member ASHRAE; Nunzio Cotrufo, PhD; Jean-Simon Venne, PE, Associate Member ASHRAE.....	490
AT-23-C058	Bayesian Artificial Neural Network for Personalized Thermal Comfort Modeling Hejia Zhang, Student Member ASHRAE; Seungjae Lee, Full Member ASHRAE; Athanasios Tzempelikos, Full Member ASHRAE	498
AT-23-C059	Microgrid Tiered Circuits Effects for a Planned Housing Community in Puerto Rico Daniel Villa, PE, Full Member ASHRAE; Jimmy E. Quiroz, PE; Efrain O'Neill-Carrillo, PhD; Robert Jeffers, PhD	507
AT-23-C060	Supervisory Multi-Objective Economic Model Predictive Control for Heat Pump Water Heaters for Cost and Carbon Optimization Loren dela Rosa; Caton Mande; Matthew J. Ellis, PhD.....	517
AT-23-C061	Review of Ice Thermal Energy Storage (ITES) using Conventional Control Strategies in Commercial Buildings Hao Dong, Student Member ASHRAE; Soham Vanage, Student Member ASHRAE; Kristen Cetin, PhD, PE, Full Member ASHRAE	526
AT-23-C062	Simulated Use Performance of an Integrated Energy System for Thermal and Power Management with Micro-combined Heat and Power in Nano-grid Environments Tim Kingston, Full Member ASHRAE; Alejandro Baez Guada, Full Member ASHRAE	536
AT-23-C063	A Comparative Energy Analysis of Liquid and Solid Desiccant Technologies in Indoor Cannabis Cultivation Lavanya Jakka, Associate Member ASHRAE; John H. Hammond, Associate Member ASHRAE	545
AT-23-C064	Reproducibility of an Emulator-Type Assessment Method for the Evaluation of the Dynamic Performance of Air Conditioners Ryohei Mori; Shun Matsui, MD; Niccolo Giannetti, Dr. Eng; Jongsoo Jeong, Dr. Eng; Hifni Ariyadi, Dr. Eng; Yoichi Miyaoka, Dr. Eng; Eisuke Togashi, PhD; Kiyoshi Saito, Dr. Eng, Full Member ASHRAE	553
AT-23-C065	Field Measurement and CFD Simulation Investigation on Airflow Parallelism of a Cleanroom for Optical Fabs Indra Permana, Student Member ASHRAE; Fujen Wang, PhD, PE, Fellow ASHRAE; Alya Penta Agharid, Student Member ASHRAE	561
AT-23-C066	Employing Water Vapor-Selective Membranes for Sustainable Humidification of Ventilation Air Andrew Fix, BS, Student Member ASHRAE; James Braun, PhD, Fellow ASHRAE; David Warsinger, PhD, Associate Member ASHRAE	569
AT-23-C067	Oil Management Design Considerations for Large Commercial Transcritical CO ₂ Systems Alessandro Silva.....	580
AT-23-C068	Methodology for Design and Predictive Control of Zones with STPV Windows, Motorized Venetian Blinds, and Hydronic Floor Heating for Net-Zero Energy Buildings John Hill, MAsc. Student; Andreas Athienitis, PhD, PE, Fellow ASHRAE; Gilbert Larochelle-Martin	590
AT-23-C069	Accurate Prediction of CO ₂ Concentration using CFD Simulations to Validate Ventilation Strategies to Achieve Healthy CO ₂ Levels in Indoor Spaces Praveen Kumar R; Sandip Jadhav, Full Member ASHRAE; Rohit Chavan.....	598
AT-23-C070	Ensembled Deep Learning-based Model Predictive Control for Automatic Window Operations in Winter Elence Xinzhu Chen, Student Member ASHRAE; Xu Han, PhD, Full Member ASHRAE; Ali Malkawi, PhD; Na Li, PhD	607

AT-23-C071	Passive or Active, Mapping the Highest Impact HVAC Design Interventions Across the USA Patrick Pease, PE, Full Member ASHRAE; Jayati Chhabra, Affiliate Member ASHRAE; Akshay Padwal, Associate Member ASHRAE; Zahra Zolfaghari	616
AT-23-C072	Meeting Net Zero Carbon Emission Targets: A Case Study Tailored to Local Industry Catarina Marques, PhD; Helen Turnell, PhD; Phil Jones; Chris Dunham; Matthew Fox; Akos Revesz, PhD; Graeme Maidment, PhD	626
AT-23-C073	Using Grid Integration Metrics to Enhance Carbon Reductions with Building Performance Standards Kim Cheslak, Full Member ASHRAE; Alexi Miller, PE, Full Member ASHRAE; Kevin Carbonnier, PhD	635
AT-23-C074	Decarbonization of Liquid Heating Fuels Thomas A. Butcher, PhD, Fellow ASHRAE	644
AT-23-C075	Energy Signatures of Mixed-Mode Cooling and Ventilation Jeongseo Lee, Student Member ASHRAE; Elizabeth Kowalchuk, Student Member ASHRAE; Hyojin Kim, PhD, Full Member ASHRAE	651
AT-23-C076	Evaluation of Energy and Ventilation Performance of Individual Room Control Ventilation System in Residential Building Chanhyung Shim, Student Member ASHRAE; Namchul Seong, PhD, Full Member ASHRAE; Goopyo Hong, PhD, Full Member ASHRAE	661
AT-23-C077	MySmartE—A Cloud-Based Smart Home Energy Application for Energy-Aware Multi-unit Residential Buildings Huijeong Kim, Student Member ASHRAE; Sangwoo Ham, Student Member ASHRAE; Marlen Promann; Hemanth Devarapalli; Vanessa Kwarteng; Geetanjali Bihani; Tatiana Ringenberg; Ilias Billionis; James E. Braun, Associate Member ASHRAE; Julia Taylor Rayz; Panagiota Karava, Associate Member ASHRAE	667
AT-23-C078	Data Acquisition System Selection and Calibration of Resistive Moisture Content Measurements for Large-Scale Field Studies in Cold Climate Residential Building Envelope Performance Fatih Evren, Student Member ASHRAE; Garrett Mosiman, AIA; Pat Huelman, Full Member ASHRAE; Andre Desjarlais, Full Member ASHRAE; Antonio Aldykiewicz, Jr., Full Member ASHRAE	676
AT-23-C079	Short-Term Occupant Numbering Prediction via Machine Learning Approaches Zixin Jiang, Student Member ASHRAE; Bing Dong, PhD, Full Member ASHRAE	685
AT-23-C080	Machine Learning Occupancy Prediction Models—A Case Study Bashar Alfalah, P.Eng, Full Member ASHRAE; Mehdi Shahrestani, PhD, Full Member ASHRAE; Li Shao, PhD	694
AT-23-C081	Generation of Load Profile Based on GAN and LSTM Network in Smart Grid Yuhang Zhang, Student Member ASHRAE; Xiangtian Deng, PhD, Student Member ASHRAE; Yi Zhang, PhD, Full Member ASHRAE; Yi Zhang, PhD, Full Member ASHRAE	703
AT-23-C082	Commissioning in the Post-COVID Era Noelle Thornton, PE, CxA, BCxP, Associate Member ASHRAE; Brett Farbstein, LEED AP, CEM, CBCP, EBCP; Amir Rezaei, PhD, BEMP; Brett Horin, LEED AP BD+C	711
AT-23-C083	Balancing Thermal Comfort with Energy Consumption in Buildings Using Digital Twins, IoT Sensors, and Real-time Dashboards to Inform Occupant Decision Making Sanaz Saadatifar, Student Member ASHRAE; Azadeh O. Sawyer, PhD, Full Member ASHRAE; Daragh J. Byrne, PhD, Full Member ASHRAE; Yuming Zhang, Student Member ASHRAE	720

AT-23-C084	Analysis and Optimization of Integrated Hydronic Heating and Air-Source Ductless Heat Pump Systems Neehad T. Islam, Affiliate Member ASHRAE	730
AT-23-C085	A Codes and Standards Framework for Delivered Low and Zero Carbon Gaseous Fuels Jim Edelson, Full Member ASHRAE; Diana Burk; Kim Cheslak, Full Member ASHRAE	738
AT-23-C086	Physics-Informed Generative Adversarial Networks (GANs) for Fast Prediction of High-Resolution Indoor Air Flow Field Xiaoshi Wang, Student Member ASHRAE; Xu Han, PhD, Full Member ASHRAE; Ali Malkawi, PhD; Na Li, PhD	746
AT-23-C087	Stochastic Analysis of Heat Pump Operation under Varying Use Scenarios in Commercial Building Seon-Jung Ra; Han-Gyeong Chu; Young-Sub Kim; Sun-Sook Kim, PhD; Cheol-Soo Park, PhD	756
AT-23-C088	Enhancement of Energyplus Phase Change Material Hysteresis Model to Simulate Grid-Interactive Efficient Buildings Fan Feng, Student Member ASHRAE; Yangyang Fu, Full Member ASHRAE; Zhiyao Yang, Full Member ASHRAE; Zheng O'Neill, PhD, PE, Fellow ASHRAE	764
AT-23-C089	Simulating and Optimizing Mechanical Equipment for Candy Manufacturing Gabriel Legorburu, PhD, PE, Associate ASHRAE	774
AT-23-C090	Retrofit of Buildings for Low-Temperature Heating and High-Temperature Sensible Cooling with Heat Pipe Technology Birol Kilkis, PhD, Fellow ASHRAE; Atilla Biyikoglu, PhD, Full Member ASHRAE; Malik Caglar.....	782
AT-23-C091	Numerical Analyses of Buoyancy Driven Ventilation for the Indoor Temperature and Thermal Load by Opening Ratio Calculation Kei Shimonosono, PhD, Full Member ASHRAE; Kimiko Kohri, PhD, Full Member ASHRAE; Hisaya Ishino, PhD, Full Member ASHRAE	792
AT-23-C092	An Investigation into Gender and Clothing's Effect on Indoor Thermal Comfort in Hot-Desert Climate: A Case Study in Kuwait Sana El-Azzeh, PhD, Full Member ASHRAE; Andrew Wright, PhD; Sanober Khattak, PhD; Mohamed Salem, PhD, CPEng; Farraj Al-Ajmi, PhD	800
AT-23-C093	Comparison of Economizer Control Methods in a Campus Building According to Korean Climatic Conditions Namchul Seong, PhD, Full Member ASHRAE; Goopyo Hong, PhD, Full Member ASHRAE.....	809

TECHNICAL PAPERS

AT-23-001	A Simplified Methodology to Evaluate and Optimize the Geothermal Energy Application Using Depleted Hydrocarbon Wells Jiajun Liao, PhD, PE, Full Member ASHRAE; David E Claridge, PhD, PE, Fellow/Life Member ASHRAE.....	819
AT-23-002	Insulation and Vapor Permeability Values of Staff and Patient Medical Ensembles for Use in ASHRAE Standard 55, ISO 7730, and ISO 9920 (RP-1760) Simon Hodder, PhD, Full Member ASHRAE; George Havenith, PhD.....	835
	Index of Papers, Volume 129, Part 1.....	871