# Gregor P. Henze, Ph.D., P.E.

University of Colorado Boulder Department of Civil, Environmental and Architectural Engineering Boulder, Colorado 80309-0428 U.S.A. E-Mail; gregor.henze@colorado.edu Scholar: http://scholar.google.com/citations?hl=en&user=A8K0LGEAAAAJ Researcher ID: http://www.researcherid.com/rid/C-5505-2015



JULY 2017 - PRESENT

# **Experience**

# ASSOCIATE DIRECTOR RENEWABLE AND SUSTAINABLE ENERGY INSTITUTE

Providing leadership in the development and execution of sponsored research programs; mentor junior faculty and facilitate R&D partnerships between all UC Boulder faculty and potential collaborators at NREL with expertise in building systems, building efficiencies and other renewable and sustainable research topics.

BOULDER, COLORADO

### VISITING SCIENTIST

INSTITUTE FOR PROSPECTIVE TECHNOLOGICAL STUDIESSEVILLA, SPAINOCTOBER 2014 - JUNE 2015Visiting scientist in research group providing global long-term (100 year) energy forecasting and analysis as<br/>part of the European Commission's Joint Research Center.

### VISITING PROFESSOR

UNIVERSIDAD DE SEVILLA SPAIN SEPTEMBER 2014 – JUNE 2015 Visiting professor in Department of Electrical Engineering with focus on building-to-grid integration and electric grid innovation.

### JOINT PROFESSOR

 NATIONAL RENEWABLE ENERGY LABORATORY
 GOLDEN, COLORADO
 OCTOBER 2013 - PRESENT

 Joint appointment in the Commercial Buildings Research Group
 COURT - PRESENT
 COURT - PRESENT

### AREN FACULTY DIRECTOR

UNIVERSITY OF COLORADO BOULDER, COLORADO JULY 2012 – JUNE 2014 AREN Faculty Director for Department of Civil. Environmental and Architectural Engineering

### ASSOCIATE CHAIR

 UNIVERSITY OF COLORADO
 BOULDER, COLORADO
 JULY 2010 - JUNE 2012

 Associate Chair for Department of Civil, Environmental and Architectural Engineering
 Second Sec

### FOUNDER/CHIEF SCIENCE OFFICER

QCOEFFICIENT, INC.CHICAGO, ILLINOISJULY 2008 - PRESENTFounder and chief science officer for Chicago-based company developing model predictive control solutions to<br/>integrate commercial building HVAC operation with electric grid operations.JULY 2008 - PRESENT

### PROFESSOR

UNIVERSITY OF COLORADOBOULDER, COLORADOAUGUST 2008 - PRESENTFaculty member in the Building Systems Engineering Program of the Department of Civil, Environmental and

Architectural Engineering in the College of Engineering and Applied Science at the University of Colorado. Teaching focus on thermal environmental engineering, mechanical systems design, building control and automation systems, advanced solar systems, applied data analysis for energy scientists and engineers, as well as sustainable building design.

His research includes model predictive optimal control of building energy systems and building thermal mass, control strategies for mixed-mode buildings that incorporate both natural and mechanical ventilation,

uncertainty quantification of occupant behavior and its impact, occupancy detection using distributed sensor networks as well as the integration of building energy system operations with the electric grid system.

### VISITING SCIENTIST

FRAUNHOFER INSTITUTE FOR SOLAR ENERGY SYSTEMSFREIBURG, GERMANYSEPTEMBER 2005 - JULY 2006a) Solar Buildings Group: 1) Impact of adaptive comfort criteria and heat waves on optimal building thermal<br/>mass control. 2) Primary energy and comfort performance of ventilation assisted thermo-active building<br/>systems in continental climates.September 2005 - JULY 2006

b) Fuel Cell Group: Heat transfer analysis of a micro-reformer fuel cell system (µ-RFCS).

### VISITING PROFESSOR

UNIVERSITY OF APPLIED SCIENCES BIBERACH BIBERACH, GERMANY SEPTEMBER 2005 – JULY 2006 Teaching responsibility for courses in heat and mass transfer, control theory, as well as building energy system modeling and simulation. Developed two new courses in computational intelligence in control engineering as well as modeling and system theory.

### PRINCIPAL

HENZE ENERGY CONSULTINGBOULDER, COLORADOSEPTEMBER 2005 - PRESENTSole proprietor of small business that provides consulting services on renewable energy systems, building<br/>energy system engineering, and for the analysis of thermal and hydraulic problems.September 2005 - PRESENT

### VISITING SCIENTIST

SIEMENS BUILDING TECHNOLOGIESZUG, SWITZERLANDMAY 2005 - AUGUST 2005a) HVAC Laboratory: Measured and recommended modifications for the radiative/convective split of sensible<br/>heat gains from cooling load simulators and human subjects for spaces employing thermo-active building<br/>structures (concrete core conditioning) using scanning net radiometry.Investigated air velocity dependence of<br/>relative humidity sensors. b) Energy Controlling and Monitoring: Analysis and recommendation for<br/>enhancements.

### ASSOCIATE PROFESSOR

| UNIVERSITY OF NEBRASKA – LINCOLN   | Omaha, Nebraska   | FALL 2004 – JULY 2008                                      |
|--|---|--|
| VISITING PROFESSOR   |   |  |
| TECHNICAL UNIVERSITY OF DRESDEN  | DRESDEN, GERMANY  | AUGUST – SEPTEMBER 2002                                    |
| Research exchange at the Institute of T develop an approach for the real-time p thermal storage inventory. | hermodynamics and Building Systems<br>redictive optimal control of combined | Engineering to collaboratively active and passive building |
| ASSISTANT PROFESSOR  |   |  |

UNIVERSITY OF NEBRASKA - LINCOLNOMAHA, NEBRASKAOCTOBER 1999 - SUMMER 2004Founding faculty member of the Architectural Engineering Program in the College of Engineering at the<br/>University of Nebraska - Lincoln. Responsibilities include assisting in the development of the Architectural<br/>Engineering curriculum for the B.S., M.Eng., M.A.E., and Ph.D. degrees, developing and teaching undergraduate<br/>and graduate courses, recruiting and advising students, and establishing a research and an international<br/>exchange program.

### ENERGY ENGINEERING MANAGER

JOHNSON CONTROLS, INC. ESSEN, GERMANY OCTOBER 1998 – SEPTEMBER 1999 Manager of engineering department responsible for energy engineering activities in Germany. Duties included project coordination, customer relations, quality assurance, standardization of business processes, and strategic planning.

#### PROJECT MANAGER

JOHNSON CONTROLS, INC. FRANKFURT, GERMANY OCTOBER 1997 - SEPTEMBER 1998 Development of a building energy performance monitoring database management system suitable for continuously monitoring and analyzing large groups of remote building sites over multiyear periods.

#### ENERGY ENGINEER

JOHNSON CONTROLS, INC. ESSEN. GERMANY JANUARY 1996 - SEPTEMBER 1997 Responsible for energy engineering in start-up energy savings performance contracting (ESPC) group. Tasks included energy analysis of more than 40 commercial buildings throughout Europe, development of strategies to improve energy utilization and decrease utility costs including financing procedures.

#### POST-DOCTORAL ASSISTANT

UNIVERSITY OF COLORADO BOULDER, COLORADO JULY 1995 - DECEMBER 1995 Development of a predictive optimal controller for thermal energy storage systems subject to uncertainty in thermal loads, ambient conditions, and underlying system models.

### **RESEARCH ASSISTANT**

UNIVERSITY OF COLORADO BOULDER, COLORADO JANUARY 1993 - JUNE 1995 (1) Development of optimal control strategies for ice storage systems in commercial building cooling plants and comparison of their performance with conventional controls. (2) Experiments on the performance and robustness of direct digital control systems in a large-scale HVAC laboratory.

### TEACHING ASSISTANT

TECHNICAL UNIVERSITY OF BERLIN BERLIN, GERMANY Assisted in courses in thermodynamics and renewable energy sources. Generation of a simulation model and setup of a digital data acquisition system for a solar domestic hot water system.

### **RESEARCH ENGINEER**

EMS CHEMIE AG

DOMAT/EMS, SWITZERLAND

FEBRUARY 1990 - APRIL 1990

Development of improved waste heat removal concepts for polymer and synthetic fiber production at a Swiss chemical engineering company.

## Consulting

- Carrier Corp. v. Goodman Global, Inc., et al (D. Del): Representing Carrier in patent infringement action regarding HVAC technology as technical expert; jury trial won September 2014 (2012-2014).
- Robert Bosch GmbH: Investigation of short-term forecasting models and advanced algorithms for energy efficiency in commercial buildings (2007-2013).
- Belimo Automation AG: Evaluation of novel control valve designs (2007-today).
- Boehringer Ingelheim Pharmaceuticals: Optimal design and control of a chilled-water thermal energy storage system (2006-2007).
- Fraunhofer Institute for Solar Energy Systems: Simplified hybrid modeling of buildings and associated parameter estimation, automated fault detection and diagnostics (2006-today).
- Bruehlmann IMR Consulting: Modeling and simulation of coupled hydraulic and thermal networks (2005 2007).
- MCE Stangl GmbH: Consultant for energy services (2005 2007).
- Johnson Controls, Inc.: Consultant assisting in the preparation of proposals for federal energy savings performance contracts, in particular for the U.S. Air Force and U.S. Army. Contributions include energy engineering, development of measurement and verification methods according to FEMP guidelines, and proposal writing (2000 - 2005).

June 1. 2017

May 1990 – March 1992

# Education

| University of Colorado         | <b>Doctor of Philosophy</b> – Ph.D.<br>Civil Engineering – Building Systems Engineering, 1995<br>Dissertation: <i>"Evaluation of Optimal Control for Ice</i><br><i>Storage Systems"</i> Advisor: Moncef Krarti  |
|--------------------------------|---|
| Technical University of Berlin | <b>Diplom-Ingenieur</b> – DiplIng.<br>Mechanical Engineering (Energy and Processes), 1992<br>Thesis: <i>"Performance Characterization and Optimization</i><br>of a Ceramic Vehicular Gas Turbine on the Basis of<br>Turbo-Charger Units" Advisor: Helmut Pucher |
| Oregon State University        | Master of Science – M.S.<br>Mechanical Engineering (Thermal Sciences), 1991<br>Project: "Order-of-Magnitude Analysis: An Approximate<br>Approach to the Solution of Selected Engineering Problems"<br>Advisor: Murty Kanury                                     |
| Technical University of Berlin | Vor-Diplom – B.S.<br>Mechanical Engineering (Energy and Processes), 1989  |

# **Professional Registration**

ASHRAE-certified High-Performance Building Design Professional (HBDP).

Licensed professional mechanical engineer in Nebraska (license no. E-10692).

# **Honors and Awards**

- RASEI Associate Director for Energy Systems for the Built Environment 2017
- Charles Victor Schelke Endowed Chair 2017
- University of Colorado Architectural Engineering Appreciation Award 2015
- University of Colorado CEAE Department Service Award 2014
- Endowed Lewis-Worcester Faculty Fellowship 2014-2018
- Architectural Engineering Institute (AEI) 2013 Conference Best Paper Award
- University of Colorado CEAE Department Distinguished Achievement Award 2012
- Colorado Cleantech Industry Association Research and Commercialization Award 2011
- University of Colorado CEAE Department Research Development Award 2011
- Renewable and Sustainable Energy Institute (RASEI) Founding Fellow and Executive Committee Member 2010
- University of Nebraska-Lincoln College of Engineering Holling Family Distinguished Teaching Award for Innovative Use of Instructional Technology 2006
- University of Nebraska-Lincoln College of Engineering Holling Family Teaching Award 2006
- University of Nebraska at Omaha Alumni Outstanding Teaching Award 2006
- American Society of Mechanical Engineers (ASME): **Best Paper Award**, International Solar Energy Conference 2004, Portland, Oregon

- UNL College of Engineering Faculty Fellowship for 2003 and 2004
- American Society of Mechanical Engineers (ASME): **Best Paper Award**, National Solar Energy Conference 2002, Reno, Nevada.
- American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE): **New Investigator Award** for the year 2001 (one per year).
- American Society of Mechanical Engineers (ASME): **Best Paper Award**, International Solar Energy Conference 1996, San Antonio, Texas.
- Texas A&M University, College Station, Texas: Winner of Energy Predictor Shootout II in team effort with Robert H. Dodier, 1995.
- William Fulbright Scholarship for graduate study at Oregon State University 1990 1991.

## Grants

- WSP Parsons Brinkerhoff: "Evaluating the Value of Intelligent Building Systems." \$72,981, 2017-2018, G.P. Henze (PI).
- National Renewable Energy Laboratory: "Reduced Order Models for Fuel Cell Integrated Commercial Buildings." \$11,659, 2017, G.P. Henze (PI).
- Construction Industry Institute: "Modeling and Optimizing the Lifecycle Business Return of Building Investments." \$128,330, 2017-2019, G.P. Henze (Co-PI).
- National Renewable Energy Laboratory: "Building-to-Grid Model Development for Advanced Sensing in the Distribution Grid." \$121,725, 2016-2018, G.P. Henze (PI).
- National Renewable Energy Laboratory: "Load Disaggregation for Distributed Energy Resource Siting and Optimization" \$39,176, 2016, G.P. Henze (PI).
- National Renewable Energy Laboratory: "Hybrid Model-Based and Data-Driven Fault Detection and Diagnostics for Buildings." \$49,149, 2014-2015, G.P. Henze (PI).
- Belimo, Switzerland: "Investigation Central Plant Benefits of Energy Valves." \$37,630, 2014, G.P. Henze (PI).
- National Renewable Energy Laboratory: "Energy Signal Tool." \$82,762, 2013-2014, G.P. Henze (PI).
- Belimo, Switzerland: "Investigation Central Plant Benefits of Energy Valves." \$36,000, 2013, G.P. Henze (PI).
- National Renewable Energy Laboratory: "Energy Systems Integration (ESI) Visualization Framework." \$78,180, 2013, G.P. Henze (PI).
- The Energy Research Corporation: "Monitoring Based Commissioning Using Calibrated Building Models." \$93,291, 2012-2013, G.P. Henze (PI).
- Belimo, Switzerland: "Investigation Central Plant Benefits of Energy Valves." \$34,000, 2012, G.P. Henze (PI).
- NSF EAGER: "Centralized Control of Large-Scale Distributed Sensor/Actuator Networks: Self-organizing Amorphous Facades." \$120,000, 2012-2013, G.P. Henze (Co-PI) with Nikolaus Correll (PI).
- Clean Urban Energy, Inc.: "Buildings2Grid: Integration of Commercial Buildings Operation with the Electric Grid System." \$376,465, 2011-2013, G.P. Henze (PI).
- Belimo, Switzerland: "Experimental Investigation of Pressure-Independent Control Valves." \$32,000, 2011, G.P. Henze (PI).
- Clean Urban Energy, Inc.: "Reduced Order Modeling for Dynamic Building Control in Response to Real-Time Utility Signals." \$80,519, 2011, G.P. Henze (PI).
- American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE): "Stochastic Control Optimization of Mixed-Mode Buildings for U.S. Climates," \$297,866, 2010-2012, G.P. Henze (PI), G.S. Brager (co-PI, University of California), C. Felsmann (Co-PI, Technical University of Dresden).

- ITG Dresden, Ltd.: "Control of Thermally Activated Building Structures," \$47,540, 2010, G.P. Henze (PI).
- Tendril Networks, Inc.: "Evaluation and Validation of Smart Grid Automated Control Strategies for Residential Buildings," \$37,484, 2009-2010, G.P. Henze (PI).
- Clean Urban Energy, Inc.: "Dynamic Building Control in Response to Real-Time Utility Signals." \$77,556, 2009, G.P. Henze (PI).
- U.S. Green Building Council: "HVAC Control Strategies for Mixed Mode Buildings," \$249,915, 2009-2011, G.P. Henze (PI), C. Felsmann (Co-PI, Technical University of Dresden), J. Pfafferott (co-PI, Fraunhofer Institute for Solar Energy Systems).
- German Ministry for Commerce and Technology (Bundesministerium für Wirtschaft und Technologie): "Low-Exergy System Integration," 2008-2011, level of funding: €1,170,000 (\$1,837,000), Co-PI. (PI: J. Pfafferott, Fraunhofer Institute for Solar Energy Systems with German industrial partners Johnson Controls, DS-Plan, ITG Dresden, and others.).
- U.S. Department of Education: "Nebraska Graduate Assistance in Areas of National Need (GAANN) in Engineering and Assistive Technology," 2007-2010, level of funding \$383,643, Co-Pl.
- German Ministry for Commerce and Technology (Bundesministerium für Wirtschaft und Technologie): "ModBen – Development of a Procedure for Model-Based Building Performance Analysis," 2006-2010, level of funding: €1,200,000 (\$1,680,000), Co-PI. (PI: C. Neumann, Fraunhofer Institute for Solar Energy Systems with German industrial partners M+W Zander and Ennovatis).
- U.S. Department of Energy National Energy Technology Laboratory: "Development of an Accurate Feed-Forward Temperature Control Tankless Water Heater," 2005 – 2008, funding level: \$456,395, Consultant. (PI: G. Yuill).
- Johnson Controls, Inc.: "Evaluation of Modelica for Building Control Systems Analysis," 2005-2007, level of funding: \$90,000, Pl.
- American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE): "Evaluation of Building Thermal Mass Savings (1313-TRP)," 2004 2006, level of funding: \$89,101, Pl.
- University of Nebraska Lincoln Strategic Cluster Research Grant: "Integrated Wireless Systems for Assistive Technology", 2004 2006, funding level: \$80,000, Co-Pl.
- State Technologies Advancement Collaborative Solicitation 03-STAC-1: "Real-Time Predictive Optimal Control of Active and Passive Building Thermal Storage Systems" STAC. 2004 – 2005, level of funding: \$151,656, Co-Pl.
- U.S. Department of Energy National Energy Technology Laboratory: "Converging Redundant Sensor Network Information for Improved Building Control", 2004 2006, funding level: \$354,440, Co-Pl.
- University of Nebraska Lincoln: Layman Award, 2003, level of funding: \$10,000, PI.
- Nebraska Research Initiative "Development of the University of Nebraska Center for Building Integration", 2002 2004 level of funding: \$130,732, Co-PI.
- U.S. Department of Energy National Energy Technology Laboratory: "Analysis, Laboratory Testing, and Field Implementation of Predictive Optimal Control of Active and Passive Building Thermal Storage Inventory", 2001 – 2004, level of funding: \$401,179, Pl.
- American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE): "Evaluation of Predictive Optimal Control of Active and Passive Building Thermal Storage Inventory" (New Investigator Award for 2001), 2001 – 2002, level of funding: \$61,185, PI.
- University of Nebraska Lincoln: Layman Award, 2001, level of funding: \$7,000, Pl.
- American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE): "Metering Residential Hot Water by End Use (Development of Standard Protocol)," ASHRAE 1172-TRP, 2000 2003, level of funding: \$70,354, Co-PI.

# **Professional Memberships and Service**

Associate Editor for IEEE Control Systems Letters 2017 – 2020

- Co-Chair for Workshop on Intelligent Building Operations, Purdue University, June 2016
- Editorial Board Member for Journal Building Performance Simulation since 2015
- Associate Editor for ASCE Journal of Architectural Engineering since 2015
- Associate Editor of Elsevier Journal *Renewable Energy* in the topical area of "Low Energy Architecture and Buildings" for 2014 2015.
- Renewable and Sustainable Energy Institute (RASEI) Executive Committee Member
- Chair for Workshop on Intelligent Building Operations, Boulder, June 2013
- Taskforce on Applications of Approximate Dynamic Programming and Reinforcement Learning for the IEEE Computational Intelligence Society ADPRL Technical Committee
- Chair for Workshop on Model Predictive Control in Buildings, Montreal, June 2011.
- American Society of Mechanical Engineers Solar Energy Division Technical Committee Chair for Conservation and Solar Buildings for 2008-2014.
- Associate Editor of the *Journal of Solar Energy Engineering* in the topical area of "Conservation and Solar Buildings" for 2008-2014.
- Member of ASHRAE committee charged with developing a certification program on Sustainable Building Design and Operation
- American Society of Heating, Refrigerating, and Air Conditioning Engineers
  - ✓ Technical Committee 7.5 Smart Building Systems: member
  - ✓ Technical Committee 1.4 Control Theory: member

### **Patents**

### Application Pending

G.P. Henze, V.J. Cushing, C.D. Corbin, and S. Plamp, Integration of Commercial Building Operations with Electric System Operations and Markets, application submitted Feb 24, 2012, US PTO.

V.J. Cushing and G.P. Henze, Optimization of Attributes in a Portfolio of Commercial and Industrial Facilities, application submitted Feb 24, 2012, US PTO.

### Awarded

C.J. Sloup, D. Karnes, and G.P. Henze (2011) Real-Time Global Optimization of Building Setpoints and Sequence of Operation, patent no. 7,894,943, awarded Feb 22, 2011, US PTO.

# **Publications**

### **Publications – Under Review**

Pfafferott, J., G. P. Henze, T. Lang "Bauteilaktivierung: Welche Betriebsführungsstrategie passt zu welchem Gebäude?" (In German) Bauphysik; submitted May 26, 2017.

C. Liu, A. Akintayo, Z. Jiang, G.P. Henze, S. Sarkar "Multivariate Exploration of Non-Intrusive Load Monitoring via Spatiotemporal Pattern Network." *Applied Energy*; to submitted.

Karpilow, A., G. P. Henze, C. W. Beamer "Assessment of Intelligent Lighting as a Frequency Regulation Resource." *LEUKOS;* submitted January 26, 2017.

Z. Jiang, C. Liu, A. Akintayo, G.P. Henze, S. Sarkar "Energy Prediction using Spatiotemporal Pattern Networks." *Applied Energy*; submitted January 18, 2017.

Bruggmann, P, G.P. Henze "Towards Grid Friendly Zero Energy Buildings." *Journal of Architectural Engineering;* submitted June 20, 2016.

### **Book Chapters**

Henze, G.P. and C. Neumann (2010) "Modelling and Simulation in Building Automation Systems." Chapter 14 in *Building Performance Simulation for Design and Operation* (eds. J.L.M. Hensen and R. Lamberts), Taylor and Francis.

### Journal Publications – Published, In Print, or Accepted for Publication

Wang, N., Phelan, P. E., Gonzalez, J., Harris, C., Henze, G. P., Hutchinson, R., ... & Roth, K. (2017). Ten questions concerning future buildings beyond zero energy and carbon neutrality. *Building and Environment*.

Ryan, M., G.P. Henze, "Airside System Type Prediction Enabled by Intelligent Pressure Independent Control Valves." *Journal of Architectural Engineering;* accepted March 8, 2017.

Boxer, E., G.P. Henze, A.I. Hirsch, "A Model-Based Decision Support Tool for Building Portfolios Under Uncertainty." *Automation in Construction*; <u>http://dx.doi.org/10.1016/j.autcon.2017.01.015</u>.

C.D. Corbin & G.P. Henze (2017) Predictive control of residential HVAC and its impact on the grid. Part I: simulation framework and models, *Journal of Building Performance Simulation*, 10:3, 294-312, DOI: 10.1080/19401493.2016.1231220

Corbin, C. D. & Henze, G. P. (2016). Residential HVAC as a Supply Following Resource Part II: Simulation Studies and Results. *Journal of Building Performance Simulation*.

Lawrence, T. M., Boudreau, M. C., Helsen, L., Henze, G. P., Mohammadpour, J., Noonan, D., Patteeuw, D., Pless, S., & Watson, R. T. (2016). Ten questions concerning integrating smart buildings into the smart grid. *Building and Environment*.

Pavlak, G. S., Henze, G. P., Hirsch, A. I., Florita, A. R., & Dodier, R. H. (2016). Experimental verification of an energy consumption signal tool for operational decision support in an office building. *Automation in Construction*, *72*, 75-92.

Giuliani, M., Henze, G. P., & Florita, A. R. (2016). Modelling and calibration of a high-mass historic building for reducing the prebound effect in energy assessment. *Energy and Buildings*, 116, 434-448.

Patteeuw, D., Henze, G. P., & Helsen, L. (2016). Comparison of load shifting incentives for low-energy buildings with heat pumps to attain grid flexibility benefits. *Applied Energy*, 167, 80-92.

Henze, G. P., Pless, S., Petersen, A., Long, N., & Scambos, A. T. (2015). Control limits for building energy end use based on frequency analysis and quantile regression. *Energy Efficiency*, 8(6), 1077-1092.

Pavlak, G. S., Henze, G. P., & Cushing, V. J. (2015). Evaluating synergistic effect of optimally controlling commercial building thermal mass portfolios. *Energy*, 84, 161-176.

Harmer, L. C. and Henze, G. P. (2015). Building Commissioning Using Calibrated Energy Models. *Energy and Buildings*, 92, 2014-2015.

Henze, G. P., Pavlak, G. S., Florita, A. R., Dodier, R. H., & Hirsch, A. I. (2015). An energy signal tool for decision support in building energy systems. *Applied Energy*, 138, 51-70.

Zhao, P., Henze, G. P., Brandemuehl, M. J., Cushing, V. J., & Plamp, S. (2015). Dynamic frequency regulation resources of commercial buildings through combined building system resources using a supervisory control methodology. *Energy and Buildings*, 86, 137-150.

Pavlak, G. S., Henze, G. P., & Cushing, V. J. (2014). Optimizing commercial building participation in energy and ancillary service markets. *Energy and Buildings*, 81, 115-126.

Pavlak, G. S., Florita, A. R., Henze, G. P., & Rajagopalan, B. (2013). Comparison of Traditional and Bayesian Calibration Techniques for Gray-Box Modeling. *Journal of Architectural Engineering*, 20(2).

Tanner, R. A., & Henze, G. P. (2014). Stochastic control optimization for a mixed mode building considering occupant window opening behaviour. *Journal of Building Performance Simulation*, 7(6), 427-444.

Olivieri, S. J., Henze, G. P., Corbin, C. D., & Brandemuehl, M. J. (2014). Evaluation of commercial building demand response potential using optimal short-term curtailment of heating, ventilation, and air-conditioning loads. *Journal of Building Performance Simulation*, 7(2), 100-118.

Zhao, P., Henze, G. P., Plamp, S., and Cushing, V. J. (2013). Evaluation of commercial building HVAC systems as frequency regulation providers. *Energy and Buildings*, 67, 225-235.

Henze, G. P. (2013). Model predictive control for buildings: a quantum leap?. *Journal of Building Performance Simulation*, 6(3), 157-158.

Burhenne, S., Tsvetkova, O., Jacob, D., Henze, G. P., & Wagner, A. (2013). Uncertainty quantification for combined building performance and cost-benefit analyses. *Building and Environment*, 62, 143-154.

Tanner, R. A., G. P. Henze, and S. Pless (2013) Optimized Control of Automatic Windows for Energy Savings and Occupant Comfort. *ASHRAE Transactions*, 119, 274.

Chinnis, D., and Henze, G. P. (2012). A Comparison of Lighting Energy Modeling Methods to Simulate Annual Energy Use and Peak Demand. *LEUKOS*, 9(2), 109-126.

May-Ostendorp, P. T., Henze, G. P., Rajagopalan, B., and Corbin, C. D. (2013). Extraction of supervisory building control rules from model predictive control of windows in a mixed mode building. *Journal of Building Performance Simulation*, 6(3), 199-219.

Surles, W., and Henze, G. P. (2012). Evaluation of automatic priced based thermostat control for peak energy reduction under residential time-of-use utility tariffs. *Energy and Buildings*, 49, 99-108.

Corbin, C. D., Henze, G. P., & May-Ostendorp, P. (2013). A model predictive control optimization environment for real-time commercial building application. *Journal of Building Performance Simulation*, 6(3), 159-174.

Langner, M. R., Henze, G. P., Corbin, C. D., & Brandemuehl, M. J. (2012). An investigation of design parameters that affect commercial high-rise office building energy consumption and demand. *Journal of Building Performance Simulation*, 5(5), 313-328.

Henze, G. P., & Floss, A. G. (2011). Evaluation of temperature degradation in hydraulic flow networks. *Energy and Buildings*, 43(8), 1820-1828.

Greensfelder, E. M., Henze, G. P., & Felsmann, C. (2011). An investigation of optimal control of passive building thermal storage with real time pricing. *Journal of Building Performance Simulation*, 4(2), 91-104.

Guo, X., Tiller, D. K., Henze, G. P., & Waters, C. E. (2010). The performance of occupancy-based lighting control systems: A review. *Lighting Research and Technology*, 42(4), 415-431.

Tiller, D. K., Guo, X., Henze, G. P., & Waters, C. E. (2010). Validating the application of occupancy sensor networks for lighting control. *Lighting Research and Technology*.

Rizk, A. A., & Henze, G. P. (2010). Improved airflow around multiple rows of buildings in hot arid climates. *Energy and Buildings*, 42(10), 1711-1718.

May-Ostendorp, P., Henze, G. P., Corbin, C. D., Rajagopalan, B., & Felsmann, C. (2011). Model-predictive control of mixed-mode buildings with rule extraction. *Building and Environment*, 46(2), 428-437.

Felsmann, C., Henze, G. P., May-Ostendorp, P., & Corbin, C. D. (2010). Regelalgorithmen für Mixed-Mode-Gebäudesysteme. *GI-Gesundheitsingenieur*, 131(6), 203.

Yuill, D. P., Coward, A. H., & Henze, G. P. (2010). Performance Comparison of Control Methods for Tankless Water Heaters. *HVAC&R Research*, 16(5), 677-690.

Henze, G. P., Florita, A. R., Brandemuehl, M. J., Felsmann, C., & Cheng, H. (2010). Advances in near-optimal control of passive building thermal storage. *Journal of Solar Energy Engineering*, 132(2), 271-280.

Klotz, L., Loftness, V., Henze, G., Sailor, D., & Riley, D. (2009). Technical Research Needs for Sustainable Buildings: Results from a Multidisciplinary NSF Workshop. *Journal of Green Building*, 4(4), 101-112.

Henze, G., Biffar, B., Wienecke, M., & Becker, M. P. (2009). Analysis of Thermal Energy Storage for a Pharmaceutical CompanyAnalyse eines thermischen Energiespeichers für ein pharmazeutisches Unternehmen. *at-Automatisierungstechnik Methoden und Anwendungen der Steuerungs-, Regelungs-und Informationstechnik*, 57(9), 443-451.

Guo, X., Tiller, D. K., Henze, G. P., & Waters, C. E. (2009). Analytical methods for application to sensor networks for lighting control. *LEUKOS*, 5(4), 297-311.

Tiller, D. K., Guo, X., Henze, G. P., & Waters, C. E. (2009). The application of sensor networks to lighting control. *LEUKOS*, *5*(*4*), 313-325.

Florita, A. R., & Henze, G. P. (2009). Comparison of short-term weather forecasting models for model predictive control. *HVAC&R Research*, 15(5), 835-853.

Henze, G. P., Yuill, D. P., & Coward, A. H. (2009). Development of a model predictive controller for tankless water heaters. *HVAC&R Research*, 15(1), 3-23.

Henze, G. P., Brandemuehl, M. J., Felsmann, C., Cheng, H., Florita, A. R., & Waters, C. E. (2008). Optimization of Building Thermal Mass Control in the Presence of Energy and Demand Charges. *ASHRAE Transactions*, 114(2).

Cheng, H., Brandemuehl, M. J., Henze, G. P., Florita, A. R., & Felsmann, C. (2008). Evaluation of the Primary Factors Impacting the Optimal Control of Passive Thermal Storage. *ASHRAE Transactions*, 114(2).

Henze, G. P., Biffar, B., Kohn, D., & Becker, M. P. (2008). Optimal design and operation of a thermal storage system for a chilled water plant serving pharmaceutical buildings. *Energy and Buildings*, 40(6), 1004-1019.

Henze, G. P., Felsmann, C., Kalz, D. E., & Herkel, S. (2008). Primary energy and comfort performance of ventilation assisted thermo-active building systems in continental climates. *Energy and Buildings*, 40(2), 99-111.

Henze, G. P., Pfafferott, J., Herkel, S., & Felsmann, C. (2007). Impact of adaptive comfort criteria and heat waves on optimal building thermal mass control. *Energy and Buildings*, 39(2), 221-235.

Henze, G. P., Le, T. H., Florita, A. R., & Felsmann, C. (2007). Sensitivity analysis of optimal building thermal mass control. *Journal of Solar Energy Engineering*, 129(4), 473-485.

Liu, S., & Henze, G. P. (2007). Evaluation of reinforcement learning for optimal control of building active and passive thermal storage inventory. *Journal of solar energy engineering*, 129(2), 215-225.

Dodier, R. H., Henze, G. P., Tiller, D. K., & Guo, X. (2006). Building occupancy detection through sensor belief networks. *Energy and Buildings*, 38(9), 1033-1043.

Liu, S., & Henze, G. P. (2006). Experimental analysis of simulated reinforcement learning control for active and passive building thermal storage inventory: Part 1: Theoretical Foundation. *Energy and Buildings*, 38(2), 142-147.

Liu, S., & Henze, G. P. (2006). Experimental analysis of simulated reinforcement learning control for active and passive building thermal storage inventory: Part 2: Results and analysis. *Energy and buildings*, 38(2), 148-161.

Bunz, K. R., Henze, G. P., & Tiller, D. K. (2006). Survey of sustainable building design practices in North America, Europe, and Asia. *Journal of Architectural Engineering*, 12(1), 33-62.

Le, T. H., Knabe, G., & Henze, G. P. (2005). Operating Behavior of Single Split Coil Systems Under Modulating and Two-Position Control. ASHRAE transactions, 111(2).

Henze, G. P., Plamp, S., & Strassberger, G. (2005). A Mobile Laboratory for Building Automation and Control Systems Part 1: Laboratory Development. *ASHRAE Transactions*, 111(2).

Henze, G. P., & Plamp, S. (2005). A Mobile Laboratory for Building Automation and Control Systems--Part 2: Application in Education. *ASHRAE Transactions*, 111(2).

Henze, G. P. (2005). Energy and cost minimal control of active and passive building thermal storage inventory. *Journal of Solar Energy Engineering*, 127(3), 343-351.

Henze, G. P., Kalz, D. E., Liu, S., & Felsmann, C. (2005). Experimental analysis of model-based predictive optimal control for active and passive building thermal storage inventory. *HVAC&R Research*, 11(2), 189-213.

Zhou, G., Krarti, M., & Henze, G. P. (2005). Parametric Analysis of Active and Passive Building Thermal Storage Utilization. *Journal of Solar Energy Engineering*, 127(1), 37-46.

Tiller, D. K., Goepfert, R., Henze, G. P., & Guo, X. (2004). Domestic Hot Water End Use Analysis Methods and Preliminary Results. *ASHRAE Transactions*, 110(2).

Ihm, P., Krarti, M., & Henze, G. P. (2004). Development of a thermal energy storage model for EnergyPlus. *Energy and Buildings*, 36(8), 807-814.

Henze, G. P., Kalz, D. E., Felsmann, C., & Knabe, G. (2004). Impact of forecasting accuracy on predictive optimal control of active and passive building thermal storage inventory. *HVAC&R Research*, 10(2), 153-178.

Liu, S., & Henze, G. P. (2004). Impact of Modeling Accuracy on Predictive Optimal Control of Active and Passive Building Thermal Storage Inventory. ASHRAE Transactions, 110(1).

Henze, G. P., Felsmann, C., & Knabe, G. (2004). Evaluation of optimal control for active and passive building thermal storage. *International Journal of Thermal Sciences*, 43(2), 173-183.

Dodier, R. H., & Henze, G. P. (2004). Statistical analysis of neural networks as applied to building energy prediction. *Journal of Solar Energy Engineering*, 126(1), 592-600.

Henze, G. P. (2003). An overview of optimal control for central cooling plants with ice thermal energy storage. *Journal of Solar Energy Engineering*, 125(3), 302-309.

Henze, G. P., & Schoenmann, J. (2003). Evaluation of reinforcement learning control for thermal energy storage systems. *HVAC&R Research*, 9(3), 259-275.

Henze, G. P., & Dodier, R. H. (2003). Adaptive optimal control of a grid-independent photovoltaic system. *Journal of Solar Energy Engineering*, 125(1), 34-42.

Henze, G. P. (2003). Impact of real-time pricing rate uncertainty on the annual performance of cool storage systems. *Energy and Buildings*, 35(3), 313-325.

Henze, G.P. (2003). Parametric Study of a Simplified Ice Storage Model under Conventional and Optimal Control Strategies. *Journal of Solar Energy Engineering*, 125(1), 2-12.

Henze, G. P., Krarti, M., & Brandemuehl, M. J. (2003). Guidelines for improved performance of ice storage systems. *Energy and Buildings*, 35(2), 111-127.

Henze, G.P. (2002). Economic Performance of Thermal Energy Storage Systems. *Journal of Architectural Engineering*, 8(4), 133-141.

Henze, G. P., & Hindman, R. E. (2002). Control of air-cooled chiller condensor fans using clustering neural networks. *ASHRAE Transactions*, 108, 232.

Henze, G. P., Tiller, D. K., Fischer, M. A., & Rieger, M. (2002). Comparison of event inference and flow trace signature methods for hot water end-use analysis. *ASHRAE Transactions*, 108, 467.

Henze, G. P. (2001). Building energy management as continuous quality control process. *Journal of Architectural Engineering*, 7(4), 97-106.

Henze, G. P., & Krarti, M. (1998). Ice storage system controls for the reduction of operating cost and energy use. *Journal of Solar Energy Engineering*, 120(4), 275-281.

Henze, G. P., Dodier, R. H., & Krarti, M. (1997). Development of a predictive optimal controller for thermal energy storage systems. *HVAC&R Research*, 3(3), 233-264.

Henze, G. P., Krarti, M., & Brandemuehl, M. J. (1997). A simulation environment for the analysis of ice storage controls. *HVAC&R Research*, 3(2), 128-148.

### Proceedings – Full Paper Refereed as Basis for Acceptance

Cruickshank, R.F., G.P. Henze, B.-M. Hodge, A.R. Florita (2017) "Empirical Investigations of the Opportunity Limits of Automatic Residential Electric Load Shaping." IEEE GreenTech 2017 Conference on 29-31 March 2017 at the Denver Marriott Tech Center.

Frank, S., M. Heaney, X. Jin, J. Robertson, H. Cheung, R. Elmore, G.P. Henze (2016) "Hybrid Model-based and Data-driven Fault Detection and Diagnostics for Commercial Buildings." Proceedings of the 2016 ACEEE Conference, Pacific Grove, CA.

Giuliani, M., G.P. Henze, and A.R. Florita (2015) "Model Calibration and Uncertainty Analysis of Historic Building Energy Performance." Proceedings of Building Simulation 2015 in Hyderabad, India; International Building Performance Simulation Association.

Thuillard, M., F. Reider, and G.P. Henze (2014) "Energy Efficiency Strategies for Hydronic Systems through Intelligent Actuators." ASHRAE Transactions, Paper Number NY-14-C073.

Hauswirth, J. and G.P. Henze (2013) "Evaluating the Tradeoffs of Occupant Comfort and Energy Savings a Study of Window Control Sensitivity." Proceedings of the 2013 ASCE Architectural Engineering Conference, April 2-5, 2013, State College, PA.

Pavlak, G.S., A.R. Florita, G.P. Henze, and B. Rajagopalan (2013) "Probabilistic Identification of Inverse Building Model Parameters." Proceedings of the 2013 ASCE Architectural Engineering Conference, April 2-5, 2013, State College, PA.

Tanner, R.A. and G.P. Henze (2013) "Quantifying the Impact of Occupant Behavior in Mixed Mode Buildings." Proceedings of the 2013 ASCE Architectural Engineering Conference, April 2-5, 2013, State College, PA.

Rader-Neely, E., G.P. Henze, L. Gentile Polese, L.J. Brackney (2013) "A Library of Standardized Model Components for Retail Plug Loads." Proceedings of the 2013 ASCE Architectural Engineering Conference, April 2-5, 2013, State College, PA.

Henze, G.P., W. Henry, and M. Thuillard (2013) "Improving Campus Chilled Water Systems with Intelligent Control Valves: A Field Study." Proceedings of the 2013 ASCE Architectural Engineering Conference, April 2-5, 2013, State College, PA.

May-Ostendorp, P.T., G.P. Henze, B. Rajagopalan, M. Fischer, J. Mehnert, and D. E. Kalz (2012) "Experimental Investigation of Model Predictive Control-Based Rules for a Radiantly Cooled Office." Proceedings of the 2nd International Conference on Building Energy and Environment. August 1-4, 2012, Boulder, Colorado.

Jacob, D., S. Burhenne S. Herkel, A. Wagner, R.H. Dodier and G.P. Henze (2011) "Comparing two Methods of Stochastic Modeling for Buildings." Proceedings of Building Simulation 2011 in Sidney, Australia; International Building Performance Simulation Association.

Burhenne, S., D. Jacob and G.P. Henze (2011) "Sampling Based on Sobol' Sequences for Monte Carlo Techniques Applied to Building Simulations." Proceedings of Building Simulation 2011 in Sidney, Australia; International Building Performance Simulation Association.

Jacob, D., S. Burhenne, A.R. Florita and G.P. Henze (2010) "Optimizing Building Energy Simulation Models in the Face of Uncertainty." Proceedings of SimBuild 2010 in New York City; International Building Performance Simulation Association.

Burhenne, S., D. Jacob and G.P. Henze (2010) "Uncertainty Analysis in Building Simulation with Monte Carlo Techniques." Proceedings of SimBuild 2010 in New York City; International Building Performance Simulation Association.

Greensfelder, E.M., G.P. Henze and V.J. Cushing (2010) "Towards Optimizing Building Energy Use to Reduce Electric System Carbon Emissions." Proceedings of the ASME 4th International Conference on Energy Sustainability, May 17-22, 2010, Phoenix, AZ.

Henze, G.P., A.R. Florita, M.J. Brandemuehl, C. Felsmann and H. Cheng (2009) "Advances in Near-Optimal Control of Passive Building Thermal Storage." Proceedings of the ASME 3rd International Conference on Energy Sustainability, July 19-23, 2009, San Francisco, CA.

Yosten, A.J. and G.P. Henze, (2009) "Modeling and Optimal Control of Distributed Generation Systems for Demand and Energy Management." Proceedings of the ASME 3rd International Conference on Energy Sustainability, July 19-23 2009, San Francisco, CA.

Tiller, D.K., G.P. Henze, X. Guo and C.E. Waters (2009) "Sensor Networks for Lighting Control." Proceedings of the ASME 3rd International Conference on Energy Sustainability, Paper No. 90269, July 19-23 2009, San Francisco, CA.

Tiller, D.K. and G.P. Henze (2005) "Converging Redundant Sensor Network Information for Improved Building Control." Proceedings of CLIMA2005 in Lausanne, Switzerland.

Tiller, D.K. and G.P. Henze (2005) "Construction Trends and Current Domestic Hot Water Use in the United States." Proceedings of CLIMA2005 in Lausanne, Switzerland.

Becker, M., G.P. Henze, A. Köhler, R. Koenigsdorff, M. Lehnertz, H. Scherer (2005) "Integrated Autonation and Simulation Test Environments for Building Energy Systems." Proceedings of CLIMA2005 in Lausanne, Switzerland.

Liu, S. and G.P. Henze (2005) "Calibration of Building Models for Supervisory Control of Commercial Buildings." Proceedings of the 2005 International Building Performance Simulation Association Conference in Montreal, Canada; pp. 641-648.

Le, T.H., G. Knabe, and G.P. Henze (2005) "Fault Detection and Diagnosis of Control Strategies for Air-Handling Units." Proceedings of the 2005 International Building Performance Simulation Association Conference in Montreal, Canada, pp. 609-616.

Liu., S. and G.P. Henze (2005) "Reinforcement Learning Control for Building Active and Passive Thermal Storage Inventory." Proceedings of the 2005 International Solar Energy Conference in Orlando, Florida; American Society of Mechanical Engineers, New York, New York.

Henze, G.P., T.H. Le, and A.R. Florita (2005) "Sensitivity Analysis of Optimal Building Thermal Mass Control." Proceedings of the 2005 International Solar Energy Conference in Orlando, Florida; American Society of Mechanical Engineers, New York, New York.

Liu, S. and G.P. Henze (2004) "Investigation of Reinforcement Learning for Building Thermal Mass Control." Proceedings of SimBuild 2004 in Boulder, Colorado; International Building Performance Simulation Association.

Henze, G.P. (2004) "Trade-Off between Energy Consumption and Utility Cost in the Optimal Control of Active and Passive Building Thermal Storage Inventory." Proceedings of the 2004 International Solar Energy Conference in Portland, Oregon, pp. 111-119; American Society of Mechanical Engineers, New York, New York.

Henze, G.P. (2004) "Effect of Design Parameters on the Performance of Thermal Energy Storage Systems." Proceedings of the 2004 International Solar Energy Conference in Portland, Oregon, pp. 135-143; American Society of Mechanical Engineers, New York, New York.

Zhou, G., M. Krarti, and G.P. Henze (2004) "Parametric Analysis of Active and Passive Building Thermal Storage Utilization." Proceedings of the 2004 International Solar Energy Conference in Portland, Oregon, pp. 193-203; American Society of Mechanical Engineers, New York, New York.

Tiller, D.K., G.P. Henze, and X. Guo (2004) "Online Domestic Hot Water End Use Database (1172-RP)." ASHRAE Transactions, Vol. 110, Part 2, pp. 682-689, American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Atlanta, Georgia.

Zhou, G., P. Ihm, M. Krarti, S. Liu, and G.P. Henze (2003) "Integration of Optimization Routines Within EnergyPlus", Proceedings of the Eighth International IPBSA Conference Building Simulation 2003, pp. 1475-1482, Eindhoven, Netherlands.

Ihm, P., M. Krarti, and G.P. Henze (2003) "Integration of a Thermal Energy Storage Model within EnergyPlus", Proceedings of the Eighth International IPBSA Conference Building Simulation 2003, pp. 531-538, Eindhoven, Netherlands.

Henze, G.P. and R.H. Dodier (2002) "Adaptive Optimal Control of a Grid-Independent Photovoltaic System." Proceedings of the 2002 International Solar Energy Conference in Reno, Nevada; pp. 139-148, American Society of Mechanical Engineers, New York, New York.

Henze, G.P. (2002) "Parametric Study of a Simplified Ice Storage Model under Conventional and Optimal Control Strategies." Proceedings of the 2002 International Solar Energy Conference in Reno, Nevada; pp. 83-95, American Society of Mechanical Engineers, New York, New York.

Krarti, M., G.P. Henze, and D. Bell (1999) "Planning Horizon for a Predictive Optimal Controller for Thermal Energy Storage Systems." ASHRAE Transactions, Vol. 105, Part 2, pp. 543-552.

Henze, G.P. and M. Krarti (1999) "The Impact of Forecasting Uncertainty on the Performance of a Predictive Optimal Controller for Thermal Energy Storage Systems." ASHRAE Transactions, Vol. 105, Part 2, pp. 553-561.

Henze, G.P. and M. Krarti (1996) "Ice Storage System Controls for the Reduction of Operating Costs and Energy." Proceedings of the 1996 International Solar Energy Conference in San Antonio, Texas; pp. 395-404, American Society of Mechanical Engineers, New York, New York.

Dodier, R.H. and G.P. Henze (1996) "Statistical Analysis of Neural Networks as Applied to Building Energy Prediction." Proceedings of the 1996 International Solar Energy Conference in San Antonio, Texas; pp. 495-505, American Society of Mechanical Engineers, New York, New York.

Henze, G.P. and M. Laguna (1995) "Optimal Control of Thermal Energy Storage." Institute for Operations Research and the Management Sciences (INFORMS), New Orleans, Louisiana.

Henze, G.P., M. Laguna, and M. Krarti (1995) "Heuristics for the Optimal Control of Thermal Energy Storage." Proceedings of the Metaheuristics International Conference, Norwell, Massachusetts: Kluwer Academic Publishers.

### Proceedings – Abstract Refereed as Basis for Acceptance

Henze, G.P. (2006) "Sustainable Building Design in the U.S.A." Seventh Biberach Forum Building Systems Engineering, Biberach, Germany, March 22, 2006.

Henze, G.P. (2002) "Order-of-Magnitude Analysis for the Approximate Solution of Engineering Problems." *International Conference on Engineering Education*, Manchester 2002.

### Trade Magazines

Henze, G.P. (1996) "Performance Contracting in the Context of Political Agendas" (in German) Facility Management, Issue 5/96, pp. 66-68, Gütersloh: Bertelsmann Fachzeitschriften GmbH.

Moehl, U. and G.P. Henze (1996) "Investing Without Financing, Performance Contracting Increases the Value of Buildings" (in German) Contracting Wärmedienst, Issue 5/96, pp. 37-44, Düsseldorf: Krammer Verlag.

### **Contract Reports**

Henze, G.P., G.S. Pavlak, A.R. Florita, R.H. Dodier, A.I. Hirsch (2015) "An Energy Signal Tool for Decision Support in Building Energy Systems." National Renewable Energy Laboratory Technical Report Number: NREL/TP-5500-63130. <u>http://www.nrel.gov/docs/fy15osti/63130.pdf</u>

Tanner, R.A, G.P. Henze, M. Pigman, K. Ackerley, G. Brager (2014) "Stochastic Control Optimization of Mixed-Mode Buildings." Final Report for ASHRAE Research Project 1597-RP, June 2014.

Henze, G.P., S. Pless, A. Petersen, N. Long, A.T. Scambos (2014) "Control Limits for Building Energy End Use Based on Engineering Judgment, Frequency Analysis, and Quantile Regression." National Renewable Energy Laboratory Technical Report Number: NREL/TP-5500-60020, February 2014. http://www.nrel.gov/docs/fy14osti/60020.pdf

ModQS-Heizsysteme in Bürogebäuden optimal betreiben - Automatisierte Fehlererkennung und -analyse verbessert den laufenden Gebäudebetrieb, Bundesministerium für Wirtschaft und Technologie (BMWi) Berlin, ISSN 0937 – 8367, May 2013.

Henze, G.P. and P.T. May-Ostendorp (2012) "United States Green Building Council Green Building Research Fund Final Report - HVAC Control Algorithms for Mixed Mode Buildings." United States Green Building Council.

Neumann, C. et al. (2011) "Modellbasierte Methoden für die Fehlererkennung und Optimierung im Gebäudebetrieb (English Translation: 'Model-Based Methods for Fault Detection and Optimization in Building Operations')." Fraunhofer ISE, Technical Report 0327410A-C.

Tiller, D.K., G.P. Henze and X. Guo (2008) "U.S. Department of Energy Cooperative Agreement DE-FC26-04NT41971 – Converging redundant sensor network information for improved building control – Final Report."U.S. Department of Energy – National Energy Technology Laboratory.

Henze, G.P., M.J. Brandemuehl, C. Felsmann, A. Florita, and H. Cheng (2007) "Final Project Report for ASHRAE Research Project 1313-RP: Evaluation of Building Thermal Mass Savings." American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Atlanta, Georgia.

Henze, G.P. and S. Liu (2005) "U.S. Department of Energy Cooperative Agreement DE-FC-36-03G013026 -Real-Time Predictive Optimal Control of Active and Passive Building Thermal Storage Inventory - Final Report for Phase II: Laboratory Testing." U.S. Department of Energy – National Energy Technology Laboratory.

Henze, G.P. and M. Krarti (2005) "U.S. Department of Energy Cooperative Agreement DE-FC-26-01NT41255 – Predictive Optimal Control of Active and Passive Building Thermal Storage Inventory – Final Report." U.S. Department of Energy Information Bridge: <a href="https://www.osti.gov/servlets/purl/894509-GH9Mqf/">www.osti.gov/servlets/purl/894509-GH9Mqf/</a>.

Tiller, D.K. and G.P. Henze (2003). "Final Report on ASHRAE Project 1172-TRP: Metering Residential Hot Water by End Use (Development of Standard Protocol)." American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Atlanta, Georgia.

Henze, G.P. (2003) "ASHRAE New Investigator Award – Final Report." American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Atlanta, Georgia.

Krarti, M., M.J. Brandemuehl, and G.P. Henze (1995) "Final Project Report for ASHRAE 809-TRP: Evaluation of Optimal Control for Ice Storage Systems." American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Atlanta, Georgia.

Krarti, M., G.P. Henze, D. Bell, J.F. Kreider, M.J. Brandemuehl, and L.K. Norford (1997) "Model Based Optimizer Systems With TES: Final Report." JCEM Technical Report TR/97/15, University of Colorado at Boulder.

# **Professional Presentations**

- IBPSA Building Simulation Applications Conference Bolzano, Italy, February 2017: Keynote seminar on Exploration of Building Model Complexity for Residential and Commercial MPC.
- IBPSA Building Simulation Applications Conference Bolzano, Italy, February 2017: Research seminar on Weather Scenario Generation for Stochastic Model Predictive Control using Vector Autoregressive Prediction.
- NREL Power Systems Engineering Center, September 2015: Research seminar on End-to-End Impact of Building Systems Response and Load Flexibility.
- International Institute for Energy Systems Integration (iiESI), August 2015: Research seminar on End-to-End Impact of Building Systems Response and Load Flexibility.

- Joint Research Center Institute for Prospective Technological Studies, June 2015: Research seminar on Opportunities for Building Systems Response and Load Flexibility.
- Universidad de Sevilla, Spain, May 2015: Presentation of research seminar on the integrating of building energy consumption in smart grids focusing on residential building portfolios.
- Universidad de Sevilla, Spain, April 2015: Presentation of research seminar on the integrating of building energy consumption in smart grids focusing on commercial building portfolios.
- Universidad de Sevilla, Spain, November 2014: Presentation of research seminar on a probabilistic decision support system for building energy management.
- Joint Research Center Institute for Prospective Technological Studies, September 2014: Research seminar on Impact of Large-Scale Distributed Residential HVAC Control Optimization on Electricity Grid Operation and Renewable Energy Integration.
- Portland State University, May 2014: Research seminar on Impact of Large-Scale Distributed Residential HVAC Control Optimization on Electricity Grid Operation and Renewable Energy Integration, available at <u>https://youtu.be/Ai6vxETH7ZM</u>
- Universidad de Sevilla, Spain, January 2014: Presentation of research seminar on Optimizing Building Operations in the Presence of Grid Feedback.
- University of California Davis, November 2013: Keynote speaker at "Green City. Smart City" German Innovation Seminars on Green Buildings: "Low-Energy Building Design and Optimal Operation"
- Santa Clara University, San Jose, California, November 2013: Keynote speaker at "Green City. Smart City" German Innovation Seminars on Green Buildings: "Net Zero Energy Buildings: State of the Industry"
- IEEE Power and Energy Society General Meeting in Vancouver, BC, July 2013: Presentation of one research seminar.
- ASHRAE Annual Meeting, Denver, Colorado, June 2013: Presentation of one research seminar.
- Intelligent Building Operations Workshop, Boulder, Colorado, June 2013: Presentation of four research seminars.
- RASEI 2013 Summer School on Energy Efficiency, Boulder, CO, May 2013: Presentation of one research seminar.
- University of Minnesota, Institute for Mathematics and Its Applications: Mathematical and Computational Challenges in the Control, Optimization, and Design of Energy-Efficient Buildings, Minneapolis, Minnesota, June 2013: Presentation of research seminar on Optimizing Building Operations in the Presence of Occupant-Driven Uncertainty and Grid Feedback
- Architectural Engineering Institute Conference, State College, PA, April 2013: Presentation of five technical papers.
- Institute for Energy Efficiency at the University of California at Santa Barbara, Oct 2012: Invited research seminar speaker on opportunities and challenges of advanced building controls.
- Joint Research Center of European Community, Ispra, Italy, June 2012: Invited research seminar speaker on opportunities and challenges of advanced building controls.
- Bosch Research and Technology Center, Pittsburgh, PA, April 2012: Invited research seminar speaker on advanced algorithms for energy efficiency in buildings.
- Society of Industrial and Applied Mathematics (SIAM) Conference on Uncertainty Quantification, Raleigh, NC, April 2012: Research seminar speaker on "Uncertainty Quantification for Better Commercial Buildings: From Design to Operation."
- University of Colorado Deming Center for Entrepreneurship, March 2012: Keynote speaker at "Entrepreneurship under the Microscope" annual celebration event.

- Nanyang Technological University, February 2012: Invited research seminar speaker on opportunities and challenges of advanced building controls.
- United States Green Building Council, December 2011: Invited research seminar speaker on mixed mode building design and associated advanced control.
- Lawrence Berkeley National Laboratory, Berkeley, CA, November 2011: Invited research seminar speaker on thermal mass and demand response.
- General Electric Co. (GE) Controls Symposium, Schenectady, NY, September 2011: Invited research seminar speaker on opportunities and challenges of advanced building controls.
- United Technologies Research Center, Hartford, CT, August 2011: Invited research seminar speaker on advanced building controls, past and current projects.
- Natural Resources Canada, Montreal, Canada, June 2011: Invited research seminar speaker on NZEB control.
- ASHRAE Annual Meeting, Montreal, Canada, June 2011: Presentation of research seminar.
- TetraTech, Inc. Annual Meeting, Denver, CO, May 2010: Invited dinner speaker on sustainable building design
- Lawrence Berkeley National Laboratory, Berkeley, CA, March 2010: Invited research seminar speaker
- 2009 Energy Symposium: Business and Regulatory Climate Check and Industry Forecast, Kansas City, Missouri, October 2009: Invited speaker on alternative energy technologies.
- ASME Energy Sustainability Conference, San Francisco, CA, July 2009: Presentation of three technical papers.
- Henze, G.P. 2009, "Advanced Building Control Strategies." NSF CMMI Workshop on Multifunctional Materials and Distributed Renewable Energy for Sustainable Infrastructure, Honolulu, Hawaii, June 22, 2009.
- Henze, G.P. 2007, "European Perspectives and Experiences with High-Efficiency Commercial Buildings." SolWest, John Day, Oregon, July 31, 2007.
- Henze, G.P. 2007, "Optimal Building Operation." Eighth Biberach Forum Building Systems Engineering, Biberach, Germany, March 15, 2007.
- Henze, G.P. 2006, "Passive and Low-Energy Cooling Systems for Continental Climates." Research seminar at the University of Applied Sciences Biberach, Germany, Nov. 10, 2006.
- Henze, G.P. 2006, "Optimal Building Operation." Seminar at the federally funded workshop *Konzepte Konzepte zur optimierten Betriebsführung von Gebäuden* held in Frankfurt, Germany, July 7, 2006.
- Henze, G.P. 2006, "Impact of Adaptive Comfort Criteria and Heat Waves onOptimal Building Thermal Mass Control" Research seminar at the University of Applied Sciences Biberach, Germany, June 22, 2006.
- Henze, G.P. 2006, "Sustainable Building Design in the U.S.A." Seventh Biberach Forum Building Systems Engineering, Biberach, Germany, March 22, 2006.
- Waters, C.E., K.W. Houser, D.K. Tiller, G.P. Henze, A.R. Florita, S. Plamp, 2005, "Center for Building IntegrationResearch," American Council of Engineering Companies/Nebraska Annual Conference, Omaha,Nebraska, June 9, 2005.
- Waters, C.E., K.W. Houser, D.K. Tiller, G.P. Henze, E. Bowden, M. Eble-Hankins., 2005, "Center for BuildingIntegration Research," The Built Environment Conference, Omaha, Nebraska, March 3, 2005.
- Channel 7 KETV: Discussion of Ground-Source Heat Pump Heating of Residences in Nebraska, <u>http://www.theomahachannel.com/news/4161240/detail.html</u>; aired February 3, 2005.
- Swiss Federal Institute of Technology (ETH), Zurich, Switzerland, November 2004: Invited speaker at the Research Symposium "Architectural Engineering".

- ASME Solar Energy Engineering Conference, Portland, OR, July 2004: Presentation of three technical papers.
- ASHRAE Annual Meeting, Nashville, TN, June 2004: Presentation of one technical paper and two seminars.
- ASHRAE Winter Meeting, Anaheim, CA, January 2004: Presentation of one technical paper.
- Eighth International IPBSA Conference Building Simulation 2003 in Eindhoven, Netherlands, August 2003: Presentation of two technical papers.
- American Institute of Architects, Omaha Chapter, November 2002: Invited panelist in discussion on the role of architecture in the community.
- Technical University of Dresden, Sep. 2002: Institute of Thermodynamics seminar series.
- ASHRAE Annual Meeting, Honolulu, HI, June 2002: Presentation of two technical papers.
- ASME Solar Energy Engineering Conference, Reno, NV, June 2002: Presentation of two technical papers.
- Pacific Energy Center, San Francisco, CA, December 2001: Invited speaker at day-long "Cool Thermal Storage" Seminar.
- Lawrence Berkeley National Laboratory, Berkeley, CA, December 2001: Invited speaker at Environmental Energy Technologies Division Seminar.
- ASHRAE Annual Meeting, Seattle, WA, June 1999: Presentation of one technical paper.
- ASHRAE Winter Meeting, San Francisco, CA, January 1998: Presentation of two technical papers.
- Umwelt-Campus Birkenfeld, Germany, October 1998: Invited speaker at day-long energy management workshop.
- Metaheuristics International Conference, Breckenridge, CO, July 1995: Presentation of one paper.

## **Graduate Student Advising**

- Doctor of Philosophy (Ph.D.):
  - ✓ Robert Cruickshank (current): Building-to-Grid Model Development for Advanced Sensing in the Distribution Grid
  - ✓ Samual Currie (current): Development of a Stochastic Model Predictive Control Environment for Building Control
  - ✓ Anthony Florita (May 2016): Learning Bayesian Networks for Building Energy Fault Decision Support.
  - ✓ Peng Zhao (May 2014): Dynamic Building-to-Grid Integration Through Combined Building System Resources for Frequency Regulation Service.
  - ✓ Marco Giuliani (April 2014): Development of An Energy Modeling Approach to Analyse Historical Building Performance.
  - ✓ Gregory Pavlak (April 2014): Building-to-Grid Integration through Commercial Building Portfolios Participating in Energy and Frequency Regulation Markets.
  - ✓ Charles Corbin (April 2014): Assessing Impact of Large-Scale Distributed Residential HVAC Control Optimization on Electricity Grid Operation and Renewable Energy Integration.
  - ✓ Ryan Tanner (Jan 2014): Stochastic Optimization of Building Control Systems for Mixed-Mode Buildings.
  - ✓ Sebastian Burhenne (Nov 2013): Monte Carlo Based Uncertainty and Sensitivity Analysis for Building Performance Simulation.
  - ✓ Darcie Chinnis (Dec 2012): Exploration of a Dynamic Lighting Energy Modeling Algorithm for Data Collection Support.

- ✓ Peter May-Ostendorp (May 2012): Offline Model Predictive Control of Mixed Mode Buildings for Near-Optimal Supervisory Control Strategy Development.
- ✓ Dirk Jacob (Jan 2012): Optimization of Commercial Building Operations.
- ✓ Abigail Watrous (Nov 2011): Environmental Impacts of the Socioeconomic Factors Affecting Energy Use for Rural Families and Migrant Workers in China.
- ✓ Simeng Liu (May 2005): Analytical and Experimental Comparison of Model-Based, Model-Free, and Hybrid Learning Control of Active and Passive Building Thermal Storage Inventory.
- Master of Science (M.S.):
  - ✓ Catherine Dressler (Aug 2017): Data Science Modules for Energy and Buildings
  - ✓ Philipp Bruggmann (April 2016): Grid-Friendly Zero Energy Building Design and Operation
  - ✓ Eric Boxer (April 2015): Empirical Testing of an Energy Signal Tool: An Application of Building Energy Performance Monitoring
  - ✓ Miles Ryan (Dec 2014): Optimal Control Strategy Selection for Intelligent Pressure Independent Control Valves
  - ✓ Benjamin Brannon (Dec 2013): Modeling and Control Strategy Development of a Thermally Activated Residence
  - ✓ Lincoln Harmer (May 2013): Monitoring Based Commissioning Using Calibrated Energy Models
  - ✓ Bryce Buchanan (Nov 2012): Chilled Water Plant Taxonomy and Energy Valve Modeling
  - ✓ Forest Reider (Apr 2012): Adaptive Real-Time Cooling Coil Curve Fitting Using a Computationally Simple Approach
  - ✓ Jeanne Stratton (Apr 2012): Dominant Wavelengths Comprising 3- and 4-Color Combinations of LED and Laser White Light with Optimal CQS and LER
  - ✓ Justin Bellucci (Apr 2012): Model Development and Experimental Validation of Pressure Independent Hydronic Circuits
  - ✓ Jordan Mann (Oct 2011): Fault Detection and Diagnosis using a Probabilistic Modeling Approach
  - ✓ Emily Rader (Aug 2011): Populating a Building Component Library with Retail Plug Load Model Snippets Derived from Measured Data
  - ✓ James Hauswirth (Aug 2011): Design and Control of a Mixed-Mode University Building in a Continental Climate
  - ✓ William Surles (May 2011): Development of a Control Analytic Tool for Evaluating Automated Residential Smart Grid Controls Strategies
  - ✓ Simon Olivieri (Dec 2010): Evaluation of Commercial Building Demand Response Potential Using Optimal Short-Term Curtailment of HVAC Loads
  - Rois Langner (Dec 2010): Managing the complexity of energy modeling with time efficiency: An investigation of driving factors that affect commercial high-rise office building energy consumption and demand
  - ✓ Erik Greensfelder (August 2009): An Investigation of the Cost Savings Potentials Found Using Optimal Control of Passive Thermal Storage with Real Time Pricing and an Exploration of Temporal Carbon Emissions Signals
  - ✓ Anthony Florita (August 2007): Development of a Simulation and Optimization Environment for theAnalysis of Building Thermal Mass Control.
  - ✓ Sandro Plamp (May 2006): Development of Learning Modules for Building Control and Automation Systems.

- ✓ Doreen E. Kalz (May 2004): Experimental Analysis of Model-Based Predictive Optimal Control for Active and Passive Building Thermal Storage Inventory.
- Master of Architectural Engineering (M.A.E.):
  - ✓ Matthew Pfannenstiel (2008): An Essential Utility System for a Healthcare Building in St. Luce, Madagascar.
  - ✓ Shaun Nienhueser (2008): Investigation of a Carbon-Neutral Medical Building through the Use of Cogeneration and Photovoltaics.
  - ✓ Jennifer Machacek (2008): Improving Abilities of Building Automation and Control Systems to Better Meet Client Needs.
  - ✓ Clayton Miller (2007): Technical and Economic Feasibility Study of the Peter Kiewit Institute in Attaining LEED-EB Certification.
  - ✓ Andrew Yosten (2007): Building Load Management by Means of Optimal Operation of Distributed Generation Equipment.
  - ✓ Daniel Karnes (2005): Investigation of Global Setpoint Optimization of HVAC Systems in an Office Building.
  - ✓ Chad Liechti (2005): Verification of Evaporative Cooling and Cooling Coil Model.
  - ✓ Stephanie Wright (2005): Life Cycle Cost Analysis of Cold Air Distribution Systems.
  - ✓ Daniel Barnes (2004): Modeling of Indirect/Direct Evaporative Cooling.
  - ✓ Kimberly Bunz (2004): A Comparative Study of Sustainable Building Design Practices inNorth America, Europe, and Asia.
  - ✓ Nick Rosenberry (2004): Guidelines for the Selection of Chiller Technologies to Minimize Life Cycle Cost.
  - ✓ Nathan Sheets (2004): Comparison of Neural Network Based Controllers for Building Control.
- Diplom-Ingenieur (Dipl.-Ing.): Sebastian Kurz, Sandro Plamp, Jens Klostermann, Gregor Strassberger, Jobst Schoenmann, Ronny Goepfert, Magnus Fischer, Mathias Rieger, Mathias Roemhild.
- Post-Doctoral and Research Scholars: Matteo Saviozzi (2015), Ahmed Rizk (2007-2008), Robert Dodier (2004-2005) and Thoi Le (2004-2005).