

JARED GARRISON

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PROFILE

Senior Research Assistant at The Swiss Institute of Technology (ETH) Zürich focusing on transmission and dispatch models of the electric power system, integration of renewable energy, and interdisciplinary macro-energy system modeling frameworks. Knowledgeable in electricity market operation and economic dispatch optimization. Possess vast leadership experience through student and professional organizations including extensive community service and K-12 outreach.

EDUCATION

The University of Texas at Austin

Doctor of Philosophy in Mechanical Engineering

January 2009 – December 2014

Overall GPA: 3.90

Advisor: Dr. Michael Webber

Dissertation: “A Grid-Level Unit Commitment Assessment of High Wind Penetration and Utilization of Compressed Air Energy Storage in ERCOT”

Master of Science in Mechanical Engineering

August 2007 – December 2009

Overall GPA: 3.72

Advisor: Dr. Michael Webber

Thesis: “An Integrated Energy Storage Scheme for a Dispatchable Wind and Solar Powered Energy System”

Bachelor of Science in Mechanical Engineering

August 2002 – May 2007

Overall GPA: 3.82

RESEARCH EXPERIENCE

Nexus-e: Integrated Energy Systems Modeling Platform, Supported by the Swiss

September 2017 – Present

Federal Office of Energy (SFOE)

Creation of an interdisciplinary framework of modules that are linked through interfaces to more holistically analyze and understand the impacts of future developments in the energy system.

- Project manager and research contributor,
- Combine top-down and bottom-up energy modeling approaches to represent a much broader scope of the energy-economic system than traditional stand-alone modeling approaches,
- Lead the development of the Electricity Market (eMark) module, which simulates a market-based clearing of electricity and reserves that mimics the actual sequential structures and timing currently employed and applies realistic intra-zonal trading limits (market coupling),
- Evaluate how centralized and decentralized flexibility technologies could be deployed in the Swiss electricity system and how they would impact the traditional operation of the system.

SCCER-FURIES Phase2 Bulk multi-energy grids, Supported by the Swiss

September 2017 – August 2020

Competence Center for Energy Research (SCCER)

Quantitative evaluation of the economic potential for current and enhanced electricity market scenarios: an envisioned roadmap toward modernized market coupling.

- Given the ongoing coordination between countries (i.e., market coupling), the expected future adjustments or new market (i.e., flexibility or capacity markets), and the general increase of intermittent generation, a proper evaluation mechanism is needed to provide a quantitative assessment of the Swiss and European electricity markets,
- Comparison of a co-optimized energy-only and reserve market design with current and possible future zonal ATC or FB coupled market designs,
- Investigate the potential economic benefits of enhanced market coordination mechanisms (i.e., market designs) for future scenarios involving the penetration of renewables, prediction uncertainty, and available control structures.

Assessing Future Electricity Markets (AFEM), Supported by the Swiss National Science Foundation, National Research Program 70 “Energy Turnaround”

March 2015 – January 2019

Development of a modeling framework encompassing short-term reliability concerns, medium-term dispatch and price concerns, and long-term capacity expansion and market design concerns; and evaluation of the wholesale market and reliability impacts of the Swiss electricity system in light of the planned nuclear phase-out and envisaged targets for intermittent renewable energy under several assumptions regarding future market and regulatory conditions.

- Project manager and research contributor,

- Creation of a model for quantifying the increased requirements for system flexibility to balance the uncertainties of added renewable energy resources,
- Creation of a model for assessing the transmission network security and reliability.

SCCER – Heat and Electricity Storage, Supported by the Swiss Competence Center for Energy Research (SCCER)

February 2017 – Present

Determine whether an advance-adiabatic compressed air energy storage (AA-CAES) plant can be operated profitably in Switzerland.

- Extension of existing coupled grid and market model to include the operation of an AA-CAES plant,
- Validation of resulting AA-CAES operational behavior with detailed plant model,
- Initial evaluation of the economic system benefit from inclusion of the AA-CAES plant in the energy market,
- Additional model extensions to include participation of AA-CAES plant in reserve markets and other possible use cases,
- Determination of optimal plant location considering geological limitations and transmission grid benefits,
- Quantification of potential AA-CAES plant profitability for future Swiss scenarios.

Hybrid HVAC/HVDC overhead lines in Switzerland, Supported by the Swiss National Science Foundation, National Research Program 70 “Energy Turnaround”

March 2017 – December 2018

Evaluation of the economic potential for a hybrid AC/DC overhead power line in Switzerland.

- Creation of a realistic model of a DC line and associated converter stations,
- Implementation of the DC line model within the Swiss AC network,
- Use of optimal power flow simulations to evaluate the benefits of a hybrid AC/DC line located along two possible north-south corridors in the Swiss network.

T&DFlex, Supported by the Swiss Federal Office of Energy (SFOE)

January 2019 – Present

Assess the potential benefits achieved through coordination between the TSO and DSOs in Switzerland for improved congestion management, voltage support, and ancillary services.

- Quantify the network and system benefits achievable when coordinated distributed energy assets are allowed to offer their flexibility as a resource to the TSO in the form of ancillary services for balancing energy supply and demand.

SCCER-FURIES Phase1 Bulk multi-energy grids, Supported by the Swiss Competence Center for Energy Research (SCCER)

March 2015 – December 2016

Creation of a realistic technical model of the Swiss energy system, including the transmission network, which can be used for planning, operation, and economic evaluation of future scenarios.

- Combine key aspects of economic dispatch optimization with nonlinear AC power flow to evaluate the reliability and security impacts of adding renewables in Switzerland,
- Use of energy and reserve cooptimized dispatch model and stochastic reserve deployment model to analyze the performance of various reserve dimensioning methodologies and develop suggestions for optimal new reserve dimensioning methods.

20% Wind Project, Sponsored by U.S. Department of Energy

January 2011 – December 2014

Estimating the impact on the ERCOT electric grid of increased wind generation and addition of energy storage.

- Extensive use of two unit commitment and economic dispatch optimization models of ERCOT using PLEXOS and GAMS with resulting data organization in MATLAB and figure creation in MATLAB and R,
- Thorough evaluation of ERCOT market operation and unit-specific generator characteristics,
- Added model capabilities including: better representation of operation for combined heat and power (CHP) plants, separation of lignite and subbituminous coal plants and prices, inclusion of typical plant outages, and improvement of ERCOT unit-specific power plant performance and cost parameters,
- Investigated the impact of future high wind generation scenarios with the potential to incorporate conventional compressed air energy storage (CAES) systems to improve grid reliability and resiliency,
- Analyzed the influence of future wind generation volatility on the generating fleet dispatch.
- Evaluated the economic feasibility and environmental impacts of conventional and adiabatic CAES facilities

Dispatchable Solar Wind Storage System, Sponsored by Austin Energy

August 2008 – January 2011

Optimizing the operation of a conventional and a novel compressed air energy storage (CAES) system

- Developed a MATLAB thermodynamic model of the power generation equipment in a CAES system
- Conducted a levelized cost analysis of the novel CAES system to compare against traditional technologies
- Created a MIP optimization model using GAMS to determine optimum operating schedule for both conventional and novel CAES systems in the ERCOT market

WORK EXPERIENCE

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- Swiss Institute of Technology (ETH) Zurich**, Research Assistant *March 2019 – Present*
• Conduct research on the Swiss and European energy system with an emphasis on the electricity grid
- Swiss Institute of Technology (ETH) Zurich**, Postdoctoral Researcher *March 2015 – March 2019*
• Analyze the integration of renewable energy in the Swiss electricity system
- The University of Texas at Austin**, Graduate Research Assistant *August 2008 – March 2015*
• Conducted research toward completion of my Masters and Ph.D. on the integration of renewable energy and compressed air energy storage in ERCOT
- The University of Texas at Austin**, Graduate Teaching Assistant *August 2007 – August 2008*
• Courses: Thermodynamics (2 terms) & Thermal Fluid Systems (1 term)
- Applied Research Laboratories**, Student Technician *August 2006 – August 2007*
• Utilized SolidWorks to design underwater sonar array and other parts for an Unmanned Underwater Vehicle
- Halliburton**, Design Engineer Co-op Fall '04, Sum '05, Spring '06 *August 2004 – May 2006*
• Used SolidWorks to design parts for Measuring While Drilling tools
• Designed mounting fixtures and assisted with vibration, pressure, fatigue, and qualification testing
- Lufkin Industries**, Design Engineer Intern *May 2004 – August 2004*
• Helped senior engineers design, draft, and develop numerous large gear boxes for industrial applications

SKILLS

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- Proficient in: MATLAB, MATPOWER, MySQL, PLEXOS, GAMS, R, LATEX, GIT, CPLEX and GUROBI
 - Proficient in: Adobe Acrobat, Mendeley, Microsoft Works, Word, Excel, Outlook, and PowerPoint
 - Extensive experience using: eGrid, EIA 860, EIA 923, EPA CEMS, NERC GADS, and ERCOT online databases
 - Experienced in: PYTHON, QGIS, LABVIEW, PSCAD, ENDNOTE, IGOR PRO, MATHEMATICA, and C++
 - Experienced in computer aided drafting using SOLIDWORKS and PRO ENGINEER

PEER-REVIEWED JOURNAL PUBLICATIONS

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- Jan Abrell, Patrick Eser, **Jared B. Garrison**, Jonas Savelsberg, Hannes Weigt, “Integrating economic and engineering models for future electricity market evaluation: a Swiss case study,” in *Energy Strategy Reviews*, vol 25, 86-106, August 2019.
- Thomas A. Deetjen, **Jared B. Garrison**, Joshua D. Rhodes, Michael E. Webber, “Solar PV integration cost variation due to array orientation and geographic location in the Electric Reliability Council of Texas,” in *Applied Energy*, vol. 3,607-616, October, 2016.
- Rebecca A. M. Peer, **Jared B. Garrison**, Craig P. Timms, Kelly T. Sanders, “Spatially and Temporally Resolved Analysis of Environmental Trade-Offs in Electricity Generation,” in *Environmental Science and Technology*, vol. 50(8), 4537-4545, March, 2016.
- Jared B. Garrison**, Michael E. Webber, “An Integrated Energy Storage Scheme for a Dispatchable Solar and Wind Powered Energy System,” in *Journal of Renewable and Sustainable Energy*, vol. 3(4), 043101, July, 2011.

PEER-REVIEWED CONFERENCE PROCEEDINGS

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- Elena Raycheva, **Jared B. Garrison**, Christian Schaffner, Gabriela Hug, “High resolution generation expansion planning considering flexibility needs: the case of Switzerland in 2030,” in *2020 Mediterranean Conference on Power Generation, Transmission, Distribution and Energy Conversion*, November 11, 2020, Paphos, Cyprus.
- Ognjen Stanojev, **Jared B. Garrison**, Sören Hedtke, Christian M. Franck, Turhan Demiray, “Benefit analysis of a hybrid HVAC/HVDC transmission line: a Swiss case study,” in *13th IEEE PES PowerTech Conference*, June 25, 2019, Milano, Italy.
- J. B. Garrison**, J. Abrell, J. Savelsberg, H. Weigt, T. Demiray, and C. Schaffner, “Combining investment, dispatch, and security models – an assessment of future electricity market options for Switzerland,” in *15th International Conference on the European Energy Market*, June 27-29, 2018, Łódź, Poland.
- A. Fuchs, **J. B. Garrison**, and T. Demiray, “A security-constrained multi-period OPF for the locational allocation of automatic reserves,” in *2017 IEEE Manchester PowerTech*, June 18-22, 2017, pp. 1–6, Manchester, UK.
- Colin M. Meehan, Carey W. King, **Jared B. Garrison**, Michael E. Webber, “The Total Impact of Wind Energy Variability on Fossil Fuel Emission Rates in Texas,” in *31st USAEE/IAEE North American Conference*. November 4-7, 2012, Austin, TX, USA.
- Jared B. Garrison**, Michael E. Webber, “Optimization of an Integrated Energy Storage Scheme for a Dispatchable Wind Powered Energy System,” in *ASME 6th International conference on Energy Sustainability*, July 23-26, 2012, San Diego, CA, USA.

- Jared B. Garrison**, Michael E. Webber, “A Dynamic Model of an Energy Storage Scheme for a Dispatchable Solar and Wind Powered Energy System,” Poster presented at *ASME 2011 International Mechanical Engineering Congress and Exposition*, November 11-17, 2011, Denver, CO, USA.
- Jared B. Garrison**, Michael E. Webber, “An Integrated Energy Storage Scheme for a Dispatchable Solar and Wind Powered Energy System and Analysis of Dynamic Parameters,” in *ASME 5th International conference on Energy Sustainability*, August 7-10, 2011, Washington, DC, USA.
- Jared B. Garrison**, Michael E. Webber, “An Integrated Energy Storage Scheme for a Dispatchable Solar and Wind Powered Energy System,” in *ECOS 23rd International Conference on Efficiency, Cost, Optimization, Simulation, and Environmental Impact of Energy Systems*, June 14-17, 2010, Lausanne, Switzerland.
- Jared B. Garrison**, Michael E. Webber, “Simulating the Dynamic and Steady State Response of a Rotor Resistive Controlled 1.5 MW Variable Speed Wind Turbine,” in *ASME 4th International conference on Energy Sustainability*, May 17-22, 2010, Phoenix, AZ, USA.
- Jared B. Garrison**, Mark Kapner, Michael E. Webber, “A First Order Thermodynamic and Economic Analysis for Integrating Thermal and Compressed Air Energy Storage for a Dispatchable Wind and Solar Powered System,” in *ASME 3rd International Conference on Energy Sustainability*. July 19-23. 2009, San Francisco, CA, USA.

MASTERS THESES/PROJECTS ADVISED

- Maxime Libsig, “Modeling of hydro cascade operation in Switzerland considering price uncertainty: from past to future,” Masters semester project, ETH Zurich, 2020.
- Ognjen Stanojev, “Economical and Technical benefits of a Hybrid HVAC/HVDC Line,” Masters semester project, ETH Zürich, 2018.
- Ivo Caduff, “Assessing Hybrid AC-DC Lines in the Swiss Energy System,” Masters semester project, ETH Zürich, 2017.
- Gonca Gürses, “Economic and Operational Assessment of Established and New Reserve Methods and Metrics for Electric Grids with High Shares of Renewables,” Masters thesis, Rheinisch-Westfälische Technische Hochschule (RWTH) Aachen, 2016.

TECHNICAL REPORTS & WORKING PAPERS

- Gonca Gürses, **Jared B. Garrison**, Reinhard Madlener, Turhan Demiray, “Economic and Operational Assessment of Established and New Reserve Methods and Metrics for Electric Grids with High Shares of Renewables,” FCN Working Papers 22/2016, E.ON Energy Research Center, Future Energy Consumer Needs and Behavior (FCN), 2016.
- Ross Baldick, Michael E. Webber, Carey W. King, **Jared B. Garrison**, Stuart M. Cohen, Duehee Lee, “Techno-economic Modeling of the Integration of 20% Wind and Large-scale Energy Storage in ERCOT by 2030,” for US Department of Energy, EE0001385, December, 2012.
- Jared B. Garrison**, Charlie R. Upshaw, Michael E. Webber, “Review of ‘The Preliminary Feasibility Study of Hydrogen Hubs’ authored by the Northwest Hydrogen Alliance,” April 2010 (*confidential*).

CONTRIBUTED PRESENTATIONS AND POSTERS

- Philipp Roos, Giw Zanganeh, Emmanuel Jacquemoud, Philipp Jenny, Martin Scholtysik, Jonathan Roncolato, Maurizio Barbato, **Jared B. Garrison**, Alexander Fuchs, Turhan Demiray, Andreas Haselbacher, “AA-CAES: Investigation of plant configurations and grid integration,” Poster presented at *7th Symposium of SCCER Heat and Electricity Storage (HaE)*, Nov 6, 2018, Rapperswil, Switzerland.
- Renger H. van Nieuwkoop, Philipp Fortenbacher, **Jared B. Garrison**, Blazhe Gjorgiev, and Xuejiao Han, “Nexus Energy System Platform,” Poster presented at *Energy Modelling Platform for Europe (EMP-E) 2018 Conference on Modelling Clean Energy Pathways*, September 25-26, 2018, Brussels, Belgium.
- Gonca Gürses, **Jared B. Garrison**, Turhan Demiray, “Economic and Operational Assessment of Established and New Reserve Methods and Metrics for Electric Grids with High Shares of Renewables,” Poster presented at *Associazione Italiana Economisti dell’Energia (AIEE) 1st Energy Symposium*, Dec 1, 2016, Milan, Italy.
- Jared B. Garrison**, “A Unit Commitment Assessment of Compressed Air Energy Storage in Texas’ Electricity Market,” Presentation at *Frontiers in Energy Research Seminar Series hosted by ETH Zurich Energy Science Center*, Mar 24, 2015, Zurich, Switzerland.
- Jared B. Garrison**, “Overview on CAES Research at UT Austin,” Presentation to *APEX CAES*, Aug 19, 2014, Houston, TX, USA.
- Jared B. Garrison**, Carey W. King “UT-Austin Grid Modeling Research Summary & Example of Refined CHP Definitions,” Presentation at *2014 DNVGL KERMIT Summit: Evaluating Grid Performance with KERMIT*, Aug 19, 2014, Austin, TX, USA.
- Jared B. Garrison**, “Twenty Percent Wind, Energy Storage, and the Texas Grid,” Presentation at *ASME 2013 International Mechanical Engineering Congress and Exposition*, Mar 21, 2014, San Diego, CA, USA.

- Jared B. Garrison**, “Wind Power and Energy Storage in the ERCOT Electricity Market,” Presentation at *International Energy Agency (IEA) Energy Storage Technology Roadmap Stakeholder Engagement Workshop*, February 13-14, 2013, Paris, France.
- Jared B. Garrison**, “Solutions for Integrating Intermittent Resources into the Electric Grid,” Presentation at *Austin Power Lunch Group monthly meeting*, June 12, 2012, Austin, TX, USA.
- Jared B. Garrison**, “Optimization of an Integrated Energy Storage Scheme for a Dispatchable Wind Powered Energy System,” Presentation at *UT Thermal Fluid Systems Seminar*, March 21, 2012, Austin, TX, USA.
- Jared B. Garrison**, Michael E. Webber, “A Dynamic Model of an Energy Storage Scheme for a Dispatchable Solar and Wind Powered Energy System,” Poster presented at *ASME 2011 International Mechanical Engineering Congress and Exposition*, November 11-17, 2011, Denver, CO, USA.
- Jared B. Garrison**, Michael E. Webber, “An Energy Storage Scheme for Creating Dispatchable Wind and Solar Energy,” Poster presented at *2011 University of Texas Energy Forum*, Feb 4, 2011, Austin, TX, USA.
- Jared B. Garrison**, “An Integrated Energy Storage Scheme for a Dispatchable Wind and Solar Powered System,” Presentation at *UT Thermal Fluid Systems Seminar*, January 27, 2010, Austin, TX, USA.

TECHNICAL COMMENTARY, OP-EDS, COLUMNS

- Jared B. Garrison**, Jan Abrell, Jonas Savelsberg, Philipp Fortenbacher, Christian Schaffner, “Bewertung zukünftiger Strommärkte (Assessing Future Electricity Markets),” in *Verband Schweizerischer Elektrizitätsunternehmen (Association of Swiss Electricity Companies) Industry Bulletin*, September, 2017.

OTHER INVITED PRESENTATIONS AND TALKS

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| • Presenter, UT Chancellor’s Council Executive Committee 2013 Winter Meeting | <i>January 24, 2013</i> |
| • Panel Member, ‘M.E. Grad School Info Panel’ hosted by ASME | <i>Spring ’07, ’08, ’10, ’12</i> |
| • Panel Member, ‘Why Coop’ hosted by Kappa Theta Epsilon | <i>Fall 2006 – 2009</i> |

ACCOMPLISHMENTS AND AWARDS

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| • Recipient of 2013 ASME Central Texas Mechanical Engineer of the Year | <i>Feb 2014</i> |
| • Recipient of 2013 ASME Old Guard Early Career Award | <i>Nov 2013</i> |
| • Honorable Mention in ASME IMECE 2011 Research Poster Presentation | <i>Nov 2011</i> |
| • Featured Article in Journal of Renewable and Sustainable Energy | <i>Jul 2011</i> |
| • Recipient of 2011 Cockrell School of Engineering Graduate Student Leadership Award | <i>Feb 2011</i> |
| • Recipient of 2010 ASME Central Texas Young Mechanical Engineer of the Year | <i>Apr 2010</i> |
| • Recipient of 2010 UT ME Department Graduate Recruitment Service Award | <i>May 2010</i> |
| • 1 st Place Winner of ASME Central Texas Student Paper Contest | <i>Apr 2009</i> |
| • Received Thrust 2000 Graduate Fellowship in Engineering | <i>2009 – 2012</i> |
| • Received UT Endowed Graduate Fellowship | <i>2007, 2008, 2013</i> |
| • Received UT Endowed Scholarship in Engineering | <i>2003 – 2006</i> |
| • Engineering Honors (Freshman, Sophomore, Junior and Senior) | <i>2002 – 2007</i> |
| • Valedictorian of Lufkin High School | <i>2002</i> |

LEADERSHIP POSITIONS AND MEMBERSHIPS

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| • Longhorn Engineering Advisory Delegation (UT Austin) – Member | <i>Oct 2016 – Present</i> |
| • Texas Exes Switzerland Chapter – Co-Founder | <i>Mar 2015 – Present</i> |
| • ASME Central Texas Section – Chair, Vice Chair, Secretary, College Relations Chair | <i>Jul 2009 – Jun 2014</i> |
| • Central Texas Discover Engineering – Steering Committee Member | <i>Jul 2012 – Jun 2014</i> |
| • UT Graduate Student Assembly Election Oversight Board – Board Member | <i>Jan 2014 – Aug 2014</i> |
| • ASME National Section – UT Student Section Liaison | <i>Jan 2011 – Dec 2014</i> |
| • Mechanical Engineering Graduate Student Board – Board Member | <i>Apr 2010 – Mar 2015</i> |
| • Engineering Leadership Team at UT Austin – Member | <i>Aug 2007 – Dec 2014</i> |
| • Kappa Theta Epsilon (Engineering Coop Honors Society) UT Student Section – Treasurer, Community Service Officer | <i>2005 – 2013</i> |
| • ASME UT Student Section – President, Vice President, Community Service Officer | <i>Apr 2005 – Apr 2009</i> |
| • Leadershape Texas – Staff Member, Participant | <i>Aug 2008, Jan 2007</i> |
| • Tau Beta Pi (Engineering Honors Society) UT Student Section – Member | <i>2005 – 2015</i> |
| • Pi Tau Sigma (Mechanical Engineering Honors Society) UT Student Section – Member | <i>2005 – 2015</i> |
| • National Society of Collegiate Scholars – Member | <i>2005 – 2015</i> |

ACTIVITIES

- Organizing Member – UT ASME Student Paper Contest (hosted by Central Texas ASME) 2009 – 2015
- Organizing Member – UT ASME Student Scholarship (hosted by Central Texas ASME) 2009 – 2015
- Organizing Member – UT Mechanical Engineering in Austin Job Panel (hosted by ASME UT Student Section and ASME Central Texas Section) 2009 – 2012
- Selection Committee Member – Cockrell School of Engineering Leadership Awards 2012 – 2014
- Selection Committee Member – Joe J. King Professional Engineering Achievement Award Dec 2008

OUTREACH ACTIVITIES

- Coordinator and Volunteer – Walnut Creek Elementary Science Fair Project Advisors 2010 – 2015
- Technical Advisor and Volunteer – Akins High School First Robotics Team 2012 – 2014
- Coordinator – UT Mechanical Engineering Graduate Student BBQ May 2012 – Dec 2013
- Coordinator – UT Mechanical Engineering Faculty, Staff & Graduate Student Picnic Jan 2013 – Jan 2014
- Coordinator and Volunteer – UT ASME Explore UT activity Spring 2006 – 2010
- Coordinator and Volunteer – UT ASME Introduce a Girl to Engineering Day activity Feb 2006 – 2010
- Coordinator and Volunteer – UT ASME Engineering Day at the Museum activity Feb 2009
- Coordinator and Volunteer – UT ASME Engineering Day at the Mall activity Feb 2006 – 2008
- Coordinator and Volunteer – UT ASME Encounter with Engineering activity Feb 2006 – 2010
- Volunteer – UT Engineering Fall Gathering Aug '06-'09, '11-'13
- Volunteer – Explore UT Spring 2013
- Volunteer – Introduce a Girl to Engineering Day Feb '02 – '05, '13
- Volunteer – Keep Austin Beautiful Waller Creek Clean Up 2009
- Volunteer – Student Engineering Council Electronic Waste Drive 2009 – 2010
- Volunteer – Student Engineering Council Recycling Challenge 2009 – 2010
- Volunteer – Student Engineering Council Canned Food Drive 2007 – 2008

RELATED COURSES

Restructured Electricity Markets: Locational Marginal Pricing, Large-Scale System Optimization, Computational Economics, Introduction to Renewable Energy Engineering and Sustainability, Convection Heat Transfer, Modeling and Simulation of Wind Power Plants, Microeconomics of Energy and Mineral Resources, Energy Technology and Policy, Numerical Methods in Petroleum and Geosystems Engineering, Fundamentals of Heat and Mass Transfer, Thermodynamics, Fundamentals of Incompressible Flow, Turbomachinery and Compressible Flow, Thermal Fluid Systems, Propulsion, Electrochemical Energy Systems, Combustion Engine Processes

Employability Status: **US Citizen**