

# Guannan He

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Engineering and Public Policy • Carnegie Mellon University • Pittsburgh • US

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## Research Focus: *Energy Economics and Policy; Power System Operation and Planning*

**Energy Economics and Policy:** Modeling the optimal decisions and analyzing the economics of energy technologies. Designing and assessing electricity market mechanisms and energy policies. Examples include: (i) *Techno-Economic Analysis* on energy storage and water electrolyzer for renewable energy integration; (ii) *Game-Theoretic Modeling* of the strategic behavior of agents in electricity markets and the equilibrium to inform market design.

**Power System Operation and Planning:** Energy dispatch that allows for the optimal economics and reliability to meet energy demand. Power system generation and transmission capacity expansion. Examples include: (i) *Power System Dispatch and Planning with Storage*, both stationary and portable storage; (ii) *Distributed Control*, a robust control method for microgrid and distribution network with high penetrations of distributed resources such as PV, storage, and demand response.

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## Education

Carnegie Mellon University <b>Ph.D. in Engineering and Public Policy</b> Advisor: Prof. Jay F. Whitacre & Prof. Soumya Kar	PITTSBURGH, US 2016 – present
Tsinghua University <b>M.S. in Electrical Engineering</b> Advisor: Prof. Chongqing Kang & Prof. Qixin Chen	BEIJING, CHINA 2014 – 2016
Tsinghua University <b>B.S. in Electrical Engineering</b>	BEIJING, CHINA 2010 – 2014
Tsinghua University <b>B.S. in Economics</b>	BEIJING, CHINA 2012 – 2014

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## Publications

### Journal Articles

1. **G. He**, Q. Chen, P. Moutis, S. Kar, and J. F. Whitacre, "An Intertemporal Decision Framework for Electrochemical Energy Storage Management," *Nature Energy* 3, 404-412 (2018). [PDF](#)
2. **G. He**, Q. Chen, C. Kang, Q. Xia, and K. Poolla, "Cooperation of Wind Power and Battery Storage to Provide Frequency Regulation in Power Markets," *IEEE Transactions on Power System* 32, 3559–3568 (2017). [PDF](#)
3. **G. He**, Q. Chen, C. Kang, P. Pinson, and Q. Xia, "Optimal Bidding Strategy of Battery Storage in Power Markets Considering Performance-Based Regulation and Battery Cycle Life," *IEEE Transactions on Smart Grid* 7, 2359–2367 (2016). [PDF](#)
4. **G. He**, Q. Chen, C. Kang, and Q. Xia, "Optimal Offering Strategy for Concentrating Solar Power Plants in Joint Energy, Reserve and Regulation Markets," *IEEE Transactions on Sustainable Energy* 7, 1245-1254 (2016). [PDF](#)
5. **G. He**, Q. Chen, C. Kang, and Q. Xia, "Optimal Operating Strategy and Revenue Estimates for the Arbitrage of a Vanadium Redox Flow Battery Considering Dynamic Efficiencies and Capacity Loss," *IET Generation, Transmission & Distribution*, 10, 1278-1285 (2016). [PDF](#)
6. P. Zou, Q. Chen, Q. Xia, **G. He**, and C. Kang, "Evaluating the Contribution of Energy Storage to Support Large-Scale Renewable Generation in Joint Energy and Ancillary Service Markets," *IEEE Transactions on Sustainable Energy*, 7, 808-818 (2016). [PDF](#)
7. P. Zou, Q. Chen, Q. Xia, **G. He**, and C. Kang, and A.J. Conejo, "Pool Equilibria Including Strategic Storage Systems," *Applied Energy*, 177, 260-270, (2016). [PDF](#)

### Conference Proceedings

1. P. Zou, Q. Chen, Q. Xia, C. Kang, **G. He**, and X. Chen, "Modeling and Algorithm to Find the Economic Equilibrium for Pool-based Electricity Market with the Changing Generation Mix," in *Power and Energy Society General Meeting, 2015 IEEE*, pp.1-5, July 2015. [PDF](#)
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## Research Projects

### **Intermittent Renewable Electricity to Commodities**

*Apr '18 – Jan '19*

Breakthrough Energy Ventures Project

- Created “black-box” techno-economic models for industrial processes that take renewable electricity as inputs
- Analyzed the necessary conditions for competitive renewable-based production of hydrogen in various business models
- Studied the optimal sizing problems of water electrolyzer and hydrogen storage
- Assessed the economic viability of renewable-based ammonia production technologies, including 1) water electrolysis and Haber-Bosch process; 2) lithium-cycling

### **Agent-Based Coordination Scheme For PV Integration**

*Aug '16 – present*

US DOE SHINES Project

- Developed and demonstrated a distributed, agent-based control system to integrate smart inverters, energy storage, and commercial off-the-shelf home automation controllers and smart thermostats
- Proposed decision models for electrochemical energy storage considering battery degradation

### **Business, Economics, Planning and Policy for Energy Storage in Low-Carbon Futures**

*Mar '14 – Jun '16*

UK-China Collaborative Research Project

- Reviewed the physical characteristics and business models of energy storage, and market mechanisms and policies for energy storage
- Formulated optimal operating models for energy storage in electricity markets
- Analyzed whether and how energy storage could integrate renewable energy economically

### **Reserve Market Design and Simulation for the Northeast China Power Grid**

*Apr '15 – Jun '16*

Northeast China Power Grid Research Project

- Reviewed the reserve market mechanisms in the US and UK
- Designed reserve market mechanisms and rules for the Northeast China Power Grid to accommodate wind energy
- Simulated the reserve market auction and evaluating the values of various types of energy storage based on historical data from the Northeast China Power Grid

### **Technology and Economics for Multi-Application Energy Storage in Power Grid**

*Mar '15 – Jun '16*

China Southern Power Grid Research Project

- Reviewed the applications of energy storage in power grid
- Developed the economic analysis and configuration optimization methods for multi-application energy storage

### **Regulation Market Design and Simulation for the North China Grid**

*Feb '15 – Jun '16*

North China Power Grid Research Project

- Reviewed the regulation market mechanisms in the US and UK

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## Presentations

"What is the degradation cost of Electrochemical Energy Storage," invited talk

2018 Electrochemical Energy Symposium at CMU

*Nov. 2018*

"Portable Large-Scale Energy Storage for Grid Congestion Relief"

2018 CEIC Advisory Committee Meeting

*Oct. 2018*

"Renewable to Hydrogen"

Breakthrough Energy Ventures E2X Workshop

*Sep. 2018*

"An Intertemporal Decision Framework for Electrochemical Energy Storage Management"

2017 CEIC Advisory Committee Meeting

*Oct. 2017*

"Operating Strategy and Economics for Large-Scale Energy Storage in Power Markets," invited talk

Lawrence Berkeley National Laboratory

*Aug. 2015*

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## Professional Services

### Reviewer

IEEE Transactions on Smart Grid  
IEEE Transactions on Sustainable Energy  
Applied Energy  
International Transactions on Electrical Energy Systems  
CSEE Journal of Power and Energy Systems  
IEEE PES General Meeting

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## Teaching Experiences

### Teaching Assistant

19-603 Data Science for Technology, Innovation, and Public Policy, CMU *Fall 2018*

### Student Advising

Himanshu Deshpande, Master in Energy, Science, Technology and Policy, CMU *Dec 2018 - Present*

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## Skills

**Programming:** MATLAB, Python, R, Java, C++

**Languages:** Chinese (*native*), English (*full professional proficiency*)

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