Han Kun Ren

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Email: han.ren@eng.ox.ac.uk Availability: Immediate

Education

University of Oxford, PhD in Engineering Science 10/2020 - Present
Thesis: Optimal energy storage sizing, placement, operation in renewable power systems to minimize system cost.

University of Oxford, MSc in Energy Systems 10/2019 - 9/2020
Dissertation: Sizing lithium battery and solar photovoltaic to reduce the levelized cost of electricity in microgrids.

University of Toronto, BASc in Civil Engineering 9/2014 - 5/2019
Capstone Project: Energy demand modelling and design of a solar home.

Experience

Doctoral Research Assistant, University of Oxford 10/2020 - Present

- Optimized energy storage sizing and placement using optimal power flow to maximize storage utilization and minimize generator costs, while accounting for storage efficiency, self-discharge, energy limits, power limits.
- Benchmarked the novel optimization algorithm in terms of speed and accuracy against Gurobi mathematical optimization and meta-heuristic optimization, using techniques such as linear programming, mixed-integer quadratic programming, elitist genetic algorithm, and particle swarm algorithm.
- Applied the optimization algorithms in case studies using DC OPF, AC OPF, linear storage model, and non-linear storage model to explore their effect on storage sizing and placement.
- The novel method operates without requiring storage costs, which stands in contrast to other methods, where errors in storage cost estimates cause inaccuracies in sizing and placement. The methods can serve as a decision support tool, providing insights into the physical limits of energy storage amidst economic variabilities.

Energy Analyst, EcoSync 4/2021 - 7/2021

- Developed physical models on heating-related energy expenditure, carbon emissions, and heat loss for a real-time room-by-room online tracking system.
- Implemented these models into the tracking system using BitBucket for source control and code review.

Energy Analyst, Energy Systems Catapult 2/2021 - 3/2021

- Utilized machine learning techniques, including linear regression and recurrent neural network, to model and predict electricity demand and solar generation based on weather data. The predicted data was used to optimize battery storage schedules with the aim of reducing peak demand.

Teaching Assistant, University of Oxford 1/2021 - 3/2023

- Assist the teaching of MSc in Energy System, including the Energy Markets module, where concepts such as power market structure, market equilibrium, contingency analysis, and locational marginal pricing were taught.
- Taught optimal energy storage sizing in hybrid renewable systems with solar generation to enhance Oxford Masters students' knowledge on energy storage and renewable energy.
- Assisted professors and guest speakers in both in-person and online lecture delivery. Provided guidance to student assignments. Managed the course webpage for course material distribution and lecture recording.

Engineering and Project Management Assistant, TC Energy 5/2017 - 8/2018

- Created cathodic protection engineering drawings and documentations. Processed funding requests and construction updates. Managed the $250,000 power request project to upgrade grid electrical connections for cathodic protection systems. Oversaw the Management of Change process for documenting project changes.

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- Streamlined the engineering drawing process and improved drawing accuracy, saving 200 hours annually, by semi-automating the mapping of cathodic protection devices according to anode placement designs using VBA.
- Enabled project managers to facilitate concurrent progression in construction and permit application across hundreds of sites by creating an automated tracker that monitors permit status and construction schedules.
- Designed a unified search platform using VBA to efficiently manage the documentation of changes to project scope, schedule, and cost for cathodic protection projects across Canada.

Publications

- **Han Kun Ren**, Masao Ashtine, Malcolm McCulloch, David Wallom. (2023). An analytical method for sizing energy storage in microgrid systems to maximize renewable consumption and minimize unused storage capacity. Journal of Energy Storage, 68, 107735.
- **Han Kun Ren**, Malcolm McCulloch, David Wallom. (2022). Optimal sizing of solar photovoltaic and lithium battery storage to reduce grid electricity reliance in buildings. ECEEE 2022 Summer Study on Energy Efficiency: Agents of Change, 1199-1208.
- **Han Kun Ren**, Malcolm McCulloch, David Wallom. Energy storage capacity sizing and site placement in renewable systems using optimal power flow to minimize generator cost and maximize storage utilization. Applied Energy. (Submitted: December 2023)

Talks

- “Battery Energy Storage Sizing and Placement in Hybrid Renewable Systems,” MSc in Electrical Power Systems, University of Birmingham, 2024.
- “Sizing Energy Storage,” MSc in Energy Systems, University of Oxford, 2023.
- “Optimal sizing of solar photovoltaic and lithium battery storage to reduce grid electricity reliance in buildings,” ECEEE Conference, 2022.

Skills

Software: Python, C, VBA, Microsoft Office.
Visualization: matplotlib, AutoCAD, SketchUp.
Renewables: generation model, capacity sizing.
Optimization: Gurobi, genetic algorithm, particle swarm.
Storage: capacity sizing, site placement, operation strategy.
Power System: load flow analysis, optimal power flow.
Energy Market: locational marginal pricing, contingency analysis.

Awards and Honors

- Research paper on energy storage sizing featured in an Oxford article, University of Oxford, 2023.
- Oriel DPhil Scholarship in Engineering Science, University of Oxford, 2020-2023.
- Top Energy Transition Group Project Award, University of Oxford, 2020.
- Undergraduate Research Fellowship, University of Toronto, 2016.
- Engineering Dean’s Honor List, University of Toronto, 2015-2018.