

# NOMAN BASHIR

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## RESEARCH FOCUS

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Computer Systems, Cloud Computing, Energy Systems, Sustainable Computing, Uncertainty-Aware Decision-Making

## ACADEMIC EXPERIENCE

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### Massachusetts Institute of Technology

📅 2023 – present

Postdoctoral Associate, Computer Science & Artificial Lab. (CSAIL)

**Advisor:** Christina Delimitrou

- Working on power management for modern computing workloads, including LLMs and microservices.
- Working on enabling uncertainty-aware discernable decision-making in sustainable computing.

Computing & Climate Impact Fellow, MIT Climate & Sustainability Consortium (MCSC)

**Advisor:** Elsa Olivetti

- Designed a framework for sustainable development in generative AI in the face of unfettered growth.

### University of Massachusetts Amherst

📅 2016 – 2023

Postdoctoral Associate, College of Information and Computer Sciences (CICS)

**Advisor:** Prashant Shenoy

- Conducted research on using carbon efficiency as a first-class metric for designing sustainable computer systems.
- Mentored 10+ Ph.D. students, several M.S., and undergraduate students.

Graduate Research Assistant, Dept. of Electrical and Computer Engineering (ECE)

**Advisor:** David Irwin

- Improved the programmability of networked energy systems to enhance their reliability, scalability, and efficiency.

## EDUCATION

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### University of Massachusetts Amherst

📅 2016 – 2022

Ph.D. in Computer Engineering

### National University of Science and Technology, Islamabad

📅 2013 – 2016

MS in Energy Systems Engineering

### University of Engineering and Technology, Lahore

📅 2009 – 2013

BS in Electrical Engineering

## HONORS & AWARDS

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🏆 **ACM SIGMETRICS'24 Best Student Paper Award** for the paper “CarbonScaler: Leveraging Cloud Workload Elasticity for Optimizing Carbon-Efficiency”. 📅 Jun 2024

🏆 **IGSC'23 Best Student Paper Award** for the paper “No Free Lunch: Analyzing the Cost of Deep Decarbonizing Residential Heating Systems”. (1 out of 14 papers). 📅 Nov 2023

🏆 **ACM e-Energy'23 Best Reviewer Award**, one of the top three reviewers out of 84 PC members. 📅 Jun 2023

🏆 **Best Paper Runner Up & Finalist Awards at ACM e-Energy 2024, ACM/SPEC ICPE 2023, Super-computing 2020, and ACM BuildSys 2017.** 📅 2017–24

## PUBLICATIONS

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My work has been published at the top computer systems and energy systems venues, including ASPLOS (x2), EuroSys (x2), SIGMETRICS/Performance (x4), SoCC (x4), SC (x1), ICML (x1), e-Energy (x8), BuildSys (x4), and HotCarbon (x4).

### Representative Publications

- [1] **Noman Bashir**, Nan Deng, Krzysztof Rządca, David Irwin, Sree Kodak, and Rohit Jnagal. *Take it to the Limit: Peak Prediction-driven Resource Overcommitment in Datacenters*. In: *European Conference on Computer Systems (EuroSys)*. 2021. **This work has been deployed on all Google datacenters as their default overcommit strategy.**
- [2] **Noman Bashir**, Varun Gohil, Mohammad Shahradd, David Irwin, Anagha Belavadi Subramanya, Elsa Olivetti, and Christina Delimitrou. *The Sunk Carbon Fallacy: Rethinking Carbon Footprint Metrics for Effective Carbon-Aware Scheduling*. In: *ACM Symposium on Cloud Computing (SoCC)*. 2024.

- [3] Abel Souza, **Noman Bashir**, Jorge Murillo, Walid Hanafy, Qianlin Liang, David Irwin, and Prashant Shenoy. *Eco-visor: A Virtual Energy System for Carbon-Efficient Applications*. In: ACM International Conference on Architectural Support for Programming Languages and Operating Systems (**ASPLOS**). 2023.

## CONFERENCE PUBLICATIONS

- [1] **Noman Bashir**, Priya Donti, James Cuff, Sydney Sroka, Marija Ilic, Vivienne Sze, Christina Delimitrou, and Elsa Olivetti. *The Climate and Sustainability Implications of Generative AI*. In: An MIT Exploration of Generative AI: Nature-Inspired Design and Sustainability (**MIT Press**), (2024).
- [2] **Noman Bashir**, Varun Gohil, Mohammad Shahradd, David Irwin, Anagha B. Subramanya, Elsa Olivetti, and Christina Delimitrou. *The Sunk Carbon Fallacy: Rethinking Carbon Footprint Metrics for Effective Carbon-Aware Scheduling*. In: ACM Symposium on Cloud Computing (**SoCC**). 2024.
- [3] Yasra Chandio, **Noman Bashir**, Tian Guo, Elsa Olivetti, and Fatima M. Anwar. *Scoping Sustainable Collaborative Mixed Reality*. In: IEEE International Symposium on Emerging Metaverse (**ISEMV**). 2024.
- [4] Walid Hanafy, Qianlin Liang, **Noman Bashir**, Abel Souza, David Irwin, and Prashant Shenoy. *Going Green for Less Green: Optimizing the Cost of Reducing Cloud Carbon Emissions*. In: ACM International Conference on Architectural Support for Programming Languages and Operating Systems (**ASPLOS**). 2024. **Artifact Available, Artifact Functional, Results Produced**, Repo: <https://github.com/umassos/GAIA>.
- [5] Adam Lechowicz, Nicolas Christianson, Bo Sun, **Noman Bashir**, Mohammad Hajiesmaili, Adam Wierman, and Prashant Shenoy. *Chasing Convex Functions with Long-term Constraints*. In: The International Conference on Machine Learning (**ICML**). 2024.
- [6] Thanathorn Sukprasert, Abel Souza, **Noman Bashir**, David Irwin, and Prashant Shenoy. *On the Limitations of Carbon-Aware Temporal and Spatial Workload Shifting in the Cloud*. In: European Conference on Computer Systems (**EuroSys**). 2024. **Artifact Available, Artifact Functional, Results Produced**.
- [7] Walid A. Hanafy, Qianlin Liang, **Noman Bashir**, David Irwin, and Prashant Shenoy. *CarbonScaler: Leveraging Cloud Workload Elasticity for Optimizing Carbon-Efficiency*. In: ACM SIGMETRICS/IFIP PERFORMANCE Joint International Conference on Measurement and Modeling of Computer Systems (**SIGMETRICS**). 2024. **Best Student Paper Award**.
- [8] Adam Lechowicz, Nicolas Christianson, Bo Sun, **Noman Bashir**, Mohammad Hajiesmaili, Adam Wierman, and Prashant Shenoy. *Online Conversion with Switching Costs: Robust and Learning-Augmented Algorithms*. In: ACM SIGMETRICS/IFIP PERFORMANCE Joint International Conference on Measurement and Modeling of Computer Systems (**SIGMETRICS**). 2024.
- [9] Adam Lechowicz, Nicolas Christianson, Jinhang Zuo, **Noman Bashir**, Mohammad Hajiesmaili, Adam Wierman, and Prashant Shenoy. *The Online Pause and Resume Problem: Optimal Algorithms and An Application to Carbon-Aware Load Shifting*. In: ACM SIGMETRICS/IFIP PERFORMANCE Joint International Conference on Measurement and Modeling of Computer Systems (**SIGMETRICS**). 2024.
- [10] Diptyaroop Maji, **Noman Bashir**, David Irwin, Prashant Shenoy, and Ramesh K Sitaraman. *The Green Mirage: Impact of Location- and Market-based Carbon Intensity Estimation on Carbon Optimization Efficacy*. In: ACM International Conference on Future and Sustainable Energy Systems (**e-Energy**). 2024. **Best Paper Award Finalist**.
- [11] Roozbeh Bostandoost, Adam Lechowicz, Walid A. Hanafy, **Noman Bashir**, Prashant Shenoy, and Mohammad Hajiesmaili. *LACS: Learning-Augmented Algorithms for Carbon-Aware Resource Scaling with Uncertain Demand*. In: ACM International Conference on Future and Sustainable Energy Systems (**e-Energy**). 2024.
- [12] Thanathorn Sukprasert, **Noman Bashir**, Abel Souza, David Irwin, and Prashant Shenoy. *On the Implications of Choosing Average versus Marginal Carbon Intensity Signals on Carbon-aware Optimizations*. In: ACM International Conference on Future and Sustainable Energy Systems (**e-Energy**). 2024. **Best Notes Paper Award Finalist**.
- [13] Mahsa Sahebdel, Ali Zeynali, **Noman Bashir**, Prashant Shenoy, and Mohammad Hajiesmaili. *A Holistic Approach for Equity-aware Carbon Reduction of the Ridesharing Platforms*. In: ACM International Conference on Future and Sustainable Energy Systems (**e-Energy**). 2024.
- [14] Julia Köhlke, Adam Lechowicz, Oluwole Fabikun, **Noman Bashir**, Abel Souza, Prashant Shenoy, and Sebastian Lehnhoff. *Examining the Adoption of Electromobility Concepts Across Social Contexts for Energy Transition*. In: ACM International Conference on Systems for Energy-Efficient Buildings, Cities, and Transportation (**BuildSys**). 2024.
- [15] Abel Souza, **Noman Bashir**, Jorge Murillo, Walid Hanafy, Qianlin Liang, David Irwin, and Prashant Shenoy. *Eco-visor: A Virtual Energy System for Carbon-Efficient Applications*. In: ACM International Conference on Architectural Support for Programming Languages and Operating Systems (**ASPLOS**). 2023.
- [16] John Thiede, **Noman Bashir**, David Irwin, and Prashant Shenoy. *Carbon Containers: A System-level Facility for Managing Application-level Carbon Emissions*. In: ACM Symposium on Cloud Computing (**SoCC**). 2023.

- [17] **Noman Bashir**, Yasra Chandio, David Irwin, Fatima M. Anwar, Jeremy Gummesson, and Prashant Shenoy. *Jointly Managing Electrical and Thermal Energy in Solar- and Battery-powered Computer Systems*. In: ACM International Conference on Future Energy Systems (*e-Energy*). 2023. **This work led to NSF CNS Core: Small award with funding of \$325,965, Award ID: 2230143.**
- [18] Adam Lechowicz, **Noman Bashir**, John Wamburu, Mohammad Hajiesmaili, and Prashant Shenoy. *Equitable Network-Aware Decarbonization of Residential Heating at City Scale*. In: ACM International Conference on Future Energy Systems (*e-Energy*). 2023.
- [19] Priyanka Mary Mammen, **Noman Bashir**, Ramachandra Rao Kolluri, Eun Kung Lee, and Prashant Shenoy. *CUFF: A Configurable Uncertainty-driven Forecasting Framework for Green AI Clusters*. In: ACM International Conference on Future Energy Systems (*e-Energy*). 2023.
- [20] Qianlin Liang, Walid A. Hanafy, **Noman Bashir**, Ahmed Ali-Eldin, David Irwin, and Prashant Shenoy. *Dēlen: Enabling Flexible and Adaptive Model-serving for Multi-tenant Edge AI*. In: ACM/IEEE Conference on Internet of Things Design and Implementation (*IoTDI*). 2023.
- [21] Qianlin Liang, Walid Hanafy, **Noman Bashir**, David Irwin, and Prashant Shenoy. *Energy Time Fairness: Balancing Fair Allocation of Energy and Time for GPU Workloads*. In: IEEE/ACM Symposium on Edge Computing (*SEC*). 2023.
- [22] Xiaoding Guan, **Noman Bashir**, David Irwin, and Prashant Shenoy. *WattScope: Non-intrusive Application-level Power Disaggregation in Datacenters*. In: Performance Evaluation (*PEVA*) and The International Symposium on Computer Performance, Modeling, Measurements and Evaluation (*Performance*) (2023).
- [23] Anupama Sitaraman, **Noman Bashir**, David Irwin, and Prashant Shenoy. *No Free Lunch: Analyzing the Cost of Deep Decarbonizing Residential Heating Systems*. In: International Green & Sustainable Computing Conference (*IGSC*). 2023. **Best Student Paper Award.**
- [24] Talha Mehboob, **Noman Bashir**, Michael Zink, and David Irwin. *Is Sharing Caring? Analyzing the Incentives for Shared Cloud Clusters*. In: ACM/SPEC International Conference on Performance Engineering (*ICPE*). 2023. **Best Paper Award Finalist.**
- [25] John Wamburu, **Noman Bashir**, David Irwin, and Prashant Shenoy. *Data-driven Decarbonization of Residential Heating Systems*. In: ACM International Conference on Systems for Energy-Efficient Buildings, Cities, and Transportation (*BuildSys*). 2022.
- [26] **Noman Bashir**, Nan Deng, Krzysztof Rządca, David Irwin, Sree Kodak, and Rohit Jnagal. *Take it to the Limit: Peak Prediction-driven Resource Overcommitment in Datacenters*. In: European Conference on Computer Systems (*EuroSys*). 2021. **Artifact Available, Artifact Functional, Results Produced.**
- [27] **Noman Bashir**, Tian Guo, Mohammad Hajiesmaili, David Irwin, Prashant Shenoy, Ramesh Sitaraman, Abel Souza, and Adam Wierman. *Enabling Sustainable Clouds: The Case for Virtualizing the Energy System*. In: ACM Symposium on Cloud Computing (*SoCC*). 2021.
- [28] Pradeep Ambati, **Noman Bashir**, David Irwin, and Prashant Shenoy. *Good Things Come to Those Who Wait: Optimizing Job Waiting in the Cloud*. In: ACM Symposium on Cloud Computing (*SoCC*). 2021.
- [29] Pradeep Ambati, **Noman Bashir**, David Irwin, and Prashant Shenoy. *Waiting Game: Optimally Provisioning Fixed Resources for Cloud-Enabled Schedulers*. In: International Conference for High Performance Computing, Networking, Storage and Analysis (*SC*). 2020. **Best Paper Award Finalist and Best Student Paper Award Finalist.**
- [30] **Noman Bashir**, David Irwin, and Prashant Shenoy. *DeepSnow: Modeling the Impact of Snow on Solar Generation*. In: ACM International Conference on Systems for Energy-Efficient Buildings, Cities, and Transportation (*BuildSys*). 2020.
- [31] Santiago Correa, **Noman Bashir**, Andrew Tran, David Irwin, and Jay Taneja. *Extend: A Framework for Increasing Energy Access by Interconnecting Solar Home Systems*. In: ACM SIGCAS Conference on Computing and Sustainable Societies (*COMPASS*). 2020.
- [32] Menghong Feng, **Noman Bashir**, Prashant Shenoy, David Irwin, and Dragoljub Kosanovic. *SunDown: Model-driven Per-Panel Solar Anomaly Detection for Residential Arrays*. In: ACM SIGCAS Conference on Computing and Sustainable Societies (*COMPASS*). 2020.
- [33] Pradeep Ambati, **Noman Bashir**, David Irwin, Mohammad Hajiesmaili, and Prashant Shenoy. *Hedge Your Bets: Optimizing Long-term Cloud Costs by Mixing VM Purchasing Options*. In: IEEE International Conference on Cloud Engineering (*IC2E*). 2020. **Invited Paper.**
- [34] **Noman Bashir**, Dong Chen, David Irwin, and Prashant Shenoy. *Solar-TK: A Data-Driven Toolkit for Solar PV Performance Modeling and Forecasting*. In: IEEE International Conference on Mobile Ad Hoc and Sensor Systems (*MASS*). 2019. **Invited Paper.**
- [35] Santiago Correa, **Noman Bashir**, Jesus Omana Iglesias, Candace Saffery, and Jay Taneja. *Like a Good Neighbor, Solar is There*. In: ACM International Conference on Future Energy Systems (*e-Energy*). 2019.



- [36] **Noman Bashir**, David Irwin, and Prashant Shenoy. *Helios: A Programmable Software-defined Solar Module*. In: ACM International Conference on Systems for Built Environments (**BuildSys**). 2018.
- [37] **Noman Bashir**, David Irwin, Prashant Shenoy, and Jay Taneja. *Enforcing Fair Grid Energy Access for Controllable Distributed Solar Capacity*. In: ACM International Conference on Systems for Energy-Efficient Built Environments (**BuildSys**). 2017. **Best Paper Award Finalist**.
- [38] **Noman Bashir**, Hira Shahzad Sardar, Mashood Nasir, Naveed UI Hassan, and Hassan A. Khan. *Lifetime Maximization of Lead-Acid Batteries in Small Scale UPS and Distributed Generation Systems*. In: IEEE **PowerTech**. 2017.
- [39] **Noman Bashir**, Zohaib Sharani, Khushboo Qayyum, and Affan A. Syed. *Delivering Smart Load-shedding for Highly-stressed Grids*. In: IEEE International Conference on Smart Grid Communications (**SmartGridComm**). 2015.
- [40] Aneeq ur Rehman, **Noman Bashir**, Naveed UI Hassan, and Chau Yuen. *Impact of Home Appliances on the Performance of Narrow-band Power Line Communications for Smart Grid Applications*. In: IEEE Region 10 Conference (**TENCON**). 2016.

#### JOURNAL PUBLICATIONS

- [41] John Wamburu, **Noman Bashir**, David Irwin, and Prashant Shenoy. *Analyzing the Impact of Decarbonizing Residential Heating on the Electric Distribution Grid*. In: SIGENERGY Energy Informatics Review (**EIR**) (2023).
- [42] John Wamburu, **Noman Bashir**, Emma Grazier, David Irwin, Christine Crago, and Prashant Shenoy. *Equity-Aware Decarbonization of Residential Heating Systems*. In: SIGENERGY Energy Informatics Review (**EIR**) (2023).
- [43] **Noman Bashir**, David Irwin, and Prashant Shenoy. *A Probabilistic Approach to Committing Solar Energy in Day-ahead Electricity Markets*. In: Sustainable Computing: Informatics and Systems (**SUSCOM**) (2021).
- [44] Menghong Feng, **Noman Bashir**, Prashant Shenoy, David Irwin, and Beka Kosanovic. *Model-driven Per-panel Solar Anomaly Detection for Residential Arrays*. In: ACM Transaction Cyber-Physical Systems (**TCPS**) (2021).
- [45] Pradeep Ambati, **Noman Bashir**, David Irwin, and Prashant Shenoy. *Modeling and Analyzing Waiting Policies for Cloud-Enabled Schedulers*. In: IEEE Transactions on Parallel and Distributed Systems (**TPDS**) (2021).
- [46] **Noman Bashir**, David Irwin, Prashant Shenoy, and Jay Taneja. *Mechanisms and Policies for Controlling Distributed Solar Capacity*. In: ACM Transactions on Sensor Networks (**TOSN**) (2018).

#### WORKSHOP PUBLICATIONS

- [47] Roozbeh Bostandoost, Walid A. Hanafy, Adam Lechowicz, **Noman Bashir**, Mohammad Hajiesmaili, and Prashant Shenoy. *Data-driven Algorithm Selection for Carbon-Aware Scheduling*. In: SIGENERGY Energy Informatics Review (**EIR**) and Workshop on Sustainable Computer Systems (**HotCarbon**) (2024).
- [48] Diptyaroop Maji, **Noman Bashir**, David Irwin, Prashant Shenoy, and Ramesh K Sitaraman. *Untangling Carbon-free Energy Attribution and Carbon Intensity Estimation for Carbon-aware Computing*. In: ACM e-Energy International Workshop on Energy Data and Analytics (**EDA**). 2024.
- [49] **Noman Bashir**, David Irwin, Prashant Shenoy, and Abel Souza. *Sustainable Computing – Without the Hot Air*. In: SIGENERGY Energy Informatics Review (**EIR**) and Workshop on Sustainable Computer Systems (**HotCarbon**) (2023).
- [50] Walid A. Hanafy, Roozbeh Bostandoost, **Noman Bashir**, David Irwin, Mohammad Hajiesmaili, and Prashant Shenoy. *The War of the Efficiencies: Understanding the Tension between Carbon and Energy Optimization*. In: SIGENERGY Energy Informatics Review (**EIR**) and Workshop on Sustainable Computer Systems (**HotCarbon**) (2023).
- [51] Phuthipong Bovornkeeratiroj, **Noman Bashir**, Vivek Deulkar, Bharathan Balaji, Prashant Shenoy, David Irwin, and Mohammad Hajiesmaili. *Quantifying the Decarbonization Potential of Flexible Load*. In: ACM BuildSys International Workshop on Cyber-Physical-Social Infrastructure Systems (**CPSIS**). 2023.
- [52] **Noman Bashir**, David Irwin, Prashant Shenoy, and Abel Souza. *Sustainable Computing – Without the Hot Air*. In: SIGENERGY Energy Informatics Review (**EIR**) and Workshop on Sustainable Computer Systems (**HotCarbon**) (2022).

#### BOOK CHAPTER

- [1] **Noman Bashir**, Naveed UI Hassan, Chau Yuen, and Wayes Tushar. *Smart Grid Communications and Standard*. In: *Communication, Control and Security Challenges for the Smart Grid*. Ed. by SM Mueeen and Saifur Rahman. Institution of Engineering and Technology, 2017.

#### THESIS

- [1] **Noman Bashir**. *Improving the Programmability of Networked Energy Systems*. PhD Thesis. University of Massachusetts Amherst, 2022.
- [2] **Noman Bashir**. *Using Stressed Grids as a Storage Medium for Renewable Energy*. MS Thesis. National University of Science and Technology, 2016.

## UNDER-REVIEW/IN-PREPARATION

- [1] **Noman Bashir**, Anagha B. Subramanya, Julia Xia, Melissa Zgola, Ajay Gupta, Greg Norris, Elsa Olivetti, and Christina Delimitrou. *Discernible Decision Making under Uncertainty in Sustainable Computing*. In: [submission](#). 2024.
- [2] Varun Gohil, **Noman Bashir**, and Christina Delimitrou. *URJA: Request-Level Power Capping for Microservice*. In: [preparation](#). 2024.
- [3] **Noman Bashir**, Rohan Shenoy, Adam Lechowicz, Mohammad Hajiesmaili, Adam Wierman, and Christina Delimitrou. *Learning Carbon-Aware Scheduling Algorithms for Data Processing Clusters*. In: [preparation](#). 2024.
- [4] Yichen Gao, **Noman Bashir**, Christopher Hill, and Jeremy Gregory. *Enabling Proactive Sustainability Interventions in Datacenters*. In: [submission](#). 2024.
- [5] Xiaoding Guan, **Noman Bashir**, Prashant Shenoy, and David Irwin. *Ahead of the Curve: Leveraging Periodicity to Improve Job Scheduling in Data Centers*. In: [submission](#). 2024.
- [6] Talha Mehboob, **Noman Bashir**, Jesus Omana Iglesias, Michael Zink, and David Irwin. *EcoLearn: Optimizing the Carbon Footprint of Federated Learning*. In: [submission](#). 2024.
- [7] Adam Lechowicz, Nicolas Christianson, Bo Sun, **Noman Bashir**, Mohammad Hajiesmaili, Adam Wierman, and Prashant Shenoy. *CarbonClipper: Optimal Algorithms for Carbon-aware Spatiotemporal Workload Management*. In: [submission](#). 2024.
- [8] Ali Zeynali, Mahsa Sahebdel, **Noman Bashir**, Ramesh Sitaraman, and Mohammad Hajiesmaili. *Near-Optimal Emission-Aware Online Ride Assignment Algorithm for Peak Demand Hours*. In: [submission](#). 2024.
- [9] Cooper Sigrist, Adam Lechowicz, Jovan Champ, **Noman Bashir**, and Mohammad Hajiesmaili. *Lost in Siting: The Hidden Carbon Cost of Inequitable Residential Solar Installations*. In: [submission](#). 2024.
- [10] Adam Lechowicz, Nicolas Christianson, Bo Sun, **Noman Bashir**, Mohammad Hajiesmaili, Adam Wierman, and Prashant Shenoy. *Online Conversion with Switching Costs: Robust and Learning-augmented Algorithms*. In: [submission](#). 2024.
- [11] Mahsa Sahebdel, Ali Zeynali, **Noman Bashir**, Prashant Shenoy, and Mohammad Hajiesmaili. *LEAD: Towards Learning-Based Equity-Aware Decarbonization in Ridesharing Platforms*. In: [submission](#). 2024.
- [12] Anupama Sitaraman, Adam Lechowicz, **Noman Bashir**, Xutong Liu, Prashant Shenoy, and Mohammad Hajiesmaili. *Online Learning of Dynamic Incentive Allocation for City-scale Deep Decarbonization*. In: [submission](#). 2024.

## INVITED TALKS / PANELS



### The Climate and Sustainability Implications of Generative AI

- MIT ILP Sustainability Conference  11/2024
- Conference on the Political Economy of Artificial Intelligence, Harvard Kennedy School  04/2024
- MIT Sloan AI + ML Conference  03/2024


### Systems for Sustainable Computing

- Nokia Bell Labs  02/2024
- Rigorous Systems Research Group (RSRG), Caltech  09/2023
- Climate Change AI  07/2023
- IBM Research  03/2023

### A Holistic View of Societal Decarbonization

- MIT Climate & Sustainability Consortium  01/2024
- Low Carbon and Sustainable Computing (LOCOS) seminar, University of Glasgow.  11/2022

### Benefits and Limitations of Carbon Accounting Paradigms

- NetZero Carbon Computing (NetZero), co-located with HPCA  02/2023


### Peak Prediction-driven Resource Overcommitment in Google Datacenters

- Tracing Summit at Google, UK  11/2022

### Solar-TK: A Data-driven Toolkit for Solar PV Performance Modeling and Forecasting

- Energy Data Analytics Symposium, Duke University.  11/2020

### Panel: Balancing Acts: Climate Mitigation and Adaptation

- Pakistan Student Association, Columbia University.  02/2024







### Panel: Data Centers and Computing

- MIT MCSC and MIT Energy Initiative.  01/2024









## MENTORING EXPERIENCE





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### Massachusetts Institute of Technology



- Ph.D. student Anagha Belavadi Subramanya and M.Eng. student Julia Xia.  Since 10/2023  
Anagha and Julia (with Elsa Olivetti) are developing a model to quantify the uncertainty in embodied carbon estimates for computing hardware.
- Ph.D. student Varun Gohil.  Since 10/2023  
Varun (with Christina Delimitrou) is working on request-level power management for microservices.
- Undergraduate student Yichen Gao.  Since 10/2023  
Yichen (co-advised with Jeremy Gregory, Chris Hill, and James Cuff) is developing a framework to enable proactive sustainability interventions in datacenters. Her work [4] is under-review.
- Undergraduate student Gerson Asifiwe.  Since 06/2024  
Gerson is analyzing the potential for power oversubscription in LLM inference clusters. He plans to work on devising fine-grained power management strategies.
- Undergraduate student Wacuka M. Ngata.  Since 06/2024  
Wacuka is devising a framework to compare the environmental footprint of large-scale datacenters against small distributed datacenters, potentially powered by renewable energy.
- Undergraduate student Pragnya Govinda.  Since 02/2024  
Pragnya is analyzing the fine-grained locational marginal emissions (LMEs) data from PJM. She is exploring the implications of the spatiotemporal variations in LMEs on carbon-aware decision-making.

### University of Massachusetts Amherst

- Ph.D. student Adam Lechowicz.  Since 02/2022  
Adam (with Prashant Shenoy and Mohammad Hajiesmaili) has worked on developing learning-augmented carbon-aware workload scheduling algorithms. Our work has resulted in multiple prestigious conference publications [5, 8, 9, 18] and some of our recent work is under-review [5, 7].
- Ph.D. students Walid A. Hanafy and Qianlin Liang.  02/2022 – 10/2023  
Walid and Qianlin (with Prashant Shenoy and David Irwin) worked on developing systems for sustainable cloud computing [4, 50, 7, 15] and energy-efficient multi-tenant edge computing systems [20, 21]. **Qianlin has since joined Amazon as a Research Scientist.**
- Ph.D. student John Wamburu.  02/2022 – 10/2023  
John (with Prashant Shenoy) worked on enabling equity-aware decarbonization of residential homes by transitioning from gas-based heating to electric air-source heat pumps. Our work resulted in multiple publications [41, 42, 25]. **John has since joined IBM Research Kenya as a Research Scientist.**
- Ph.D. student Thanathorn Sukprasert.  02/2022 – 10/2023  
Tammy (with Prashant Shenoy and David Irwin) worked on understanding the potential and limitations of carbon-aware workload migrations. She also explored how the choice of carbon intensity signals impacts the outcomes of carbon-aware scheduling. Our work was published at EuroSys'24 [6] and e-Energy'24 [12].
- Ph.D. student Talha Mehboob.  02/2022 – 10/2023  
Talha (with David Irwin and Michael Zink) worked on understanding the potential and incentives for a shared cloud cluster across the users of an organization [24]. In his recent project, he has worked on carbon-aware client selection in federated learning, which is currently under review [6].
- Ph.D. student Xiaoding Guan.  02/2022 – 10/2023  
Rebecca (with David Irwin and Prashant Shenoy) worked on non-intrusive power monitoring in datacenters [22]. She is currently leveraging workloads' periodicity to overcommit CPU resources in datacenters [5].
- Ph.D. student Roozbeh Bostandoost.  02/2022 – 10/2023  
Roozbeh (with Mohammad Hajiesmaili and Prashant Shenoy) worked on data-driven algorithms for carbon-aware execution of computing workloads with uncertain demand [11]. His recent work developed algorithms for selecting among carbon-aware workload execution approaches [47].
- Ph.D. student Mahsa Sahebdel.  02/2022 – 08/2024  
Mahsa (with Mohammad Hajiesmaili and Prashant Shenoy) has worked on reducing the carbon footprint of ridesharing platforms while optimizing the rider's wait time [13]. In her recent work, she has explored the fairness issues from a driver's perspective in carbon-aware ride assignments [11].

- Ph.D. student Diptayroop Maji.  02/2022 – 08/2024  
Dip (with Ramesh Sitaraman and Prashant Shenoy) analyzed various carbon intensity estimation approaches and how they impact the efficacy of carbon-aware workload optimizations [10, 48].
- Ph.D. student John Thiede.  02/2022 – 10/2023  
John (with David Irwin and Prashant Shenoy) developed a system-level facility for managing application-level carbon footprint, called [CarbonContainers](#), which migrates VMs based on carbon intensity and workload variations [16].
- MS student Menghong (Aslan) Feng.  02/2022 – 08/2024  
Aslan (with Prashant Shenoy, David Irwin, and Beka Kosanovic) worked on anomaly detection in solar PV systems [32, 44]. **He has since joined Apple as an Advanced Inspection Engineer.**
- Undergraduate student Anupama Sitaraman.  02/2022 – 08/2024  
Anu (**co-advised** with Prashant Shenoy and Mohammad Hajiesmaili) explored deep decarbonization of residential heating systems by transitioning to electric heating from gas-based heating [23]. Her recent work leveraged online learning for dynamic incentive allocation for deep decarbonization [12]. **She has joined CMU as a Ph.D. student.**


#### Lahore University of Management Sciences

- Undergraduate student Hira Shahzad Sardar.  06/2015 – 03/2017  
Worked on improving the lifetime of battery backups [38]. **Hira joined Dartmouth College for her MS. She later joined MathWorks as a Technical Project Manager.**
- Undergraduate student Aneeq ur Rehman.  06/2015 – 05/2016  
Worked on using powerline communication technology for smart grid applications [40]. **Aneeq joined the University of Sheffield for his MS. He has since joined AstraZeneca as Sr. Data Scientist.**

#### TEACHING EXPERIENCE


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##### Guest Lecturer

 Spring 2022, 2023, 2024

Lecture on “Sustainable Computing Systems and Computing for Sustainability” in COMPSCI677: Distributed and Operating Systems at UMass Amherst.

##### Guest Lecturer

 Summer 2022, 2023, 2024

Lecture on “Unique Source of Energy” in UMass Amherst Turing Summer Program at UMass Amherst.

##### Teaching Assistant, University of Massachusetts Amherst

ECE322 – Systems Programming

 Fall 2020

ECE341 – Introduction to Algorithms

 Spring 2021

##### Teaching Assistant, National University of Computer and Emerging Science, Islamabad, Pakistan

EE522 – Advance Embedded Systems

 Fall 2013, 2014

#### INDUSTRY EXPERIENCE

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##### VMware Research Group


 Summer 2021

Sustainability Research Intern, OCTO

Mentors: Ben Pfaff, Victor Firoiu

- Worked on developing benchmarks to evaluate the sustainability of VMware applications and products.

##### Google, Inc.

 May 2020 – Nov 2020

Research Intern, Borg

Mentors: Nan Deng, Krzysztof Rzdca

- Worked on improving resource overcommitment in Google datacenters managed by Borg.
- Our data-driven dynamic approach is now the default overcommit strategy in Google datacenters.

#### GRANT WRITING EXPERIENCE

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##### “Provisioning and Operating Sustainable Datacenters”

 11/2024 – 08/2025

As a lead person with Prof. Elsa Olivetti. Funded by Nokia Research Awards 2024. The award amount is \$57k.

- **“Managing Electrical and Thermal Energy in Sustainable Computing Systems”** 📅 2022–2025  
Based on my research work on jointly managing electric and thermal energy in computing systems [17]. The project was funded as NSF CNS Core Small and awarded to my advisor and collaborators. Award amount was **\$325K**.
- **“Linking Datacenter Architecture Design to Siting Decisions in an Evolving Energy System”** 📅 2024  
As a lead person with Prof. Christina Delimitrou and Prof. Elsa Olivetti. Under review at the MIT Future Energy Systems Center. Expected funding amount of **\$250K**.

## COMMUNITY SERVICE

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**Conference Program Committees:** USENIX NSDI (2025), ACM SoCC (2022, 2023, 2024), SIGKDD (2024), ACM/IEEE IPSN (2024), ACM e-Energy (2023, 2024, 2025), ACM BuildSys (2023, 2024), IGSC (2023).

**Workshop Program Committees:** HotInfra (2024), DATA (2023), ENSYS (2022), Workshop on Tackling Climate with Machine Learning (ICLR 2023, NeurIPS 2022).

**Journal Reviewer:** Journal of Systems Research, Energy Informatics Review, IEEE Transactions on Parallel and Distributed Systems, Elsevier Sustainable Computing: Informatics and Systems, and Elsevier Applied Energy.

**Grant Reviewer:** Climate Change AI Innovation Grants Program (2023) and MIT Solve Challenge (2024).

**Chair/Co-Chair:** ACM SIGEnergy Workshop on Societal Decarbonization (SoDec) (2022 – present), Ph.D. Symposium Chair at ACM BuildSys (2023), Ph.D. Symposium Chair at IEEE IC2E (2023), and ACM SIGEnergy Graduate Student Talk Series (2022 – 2023).

**Organizer:** NSF Workshop on Water Sustainability and Ecological Diversity at Purdue University (2024), ACM e-Energy Hybrid Hub at UMass Amherst (2022), and UMass Summer Turing Program (2022, 2023).

## REFERENCES

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|--|--------------------------|
| 1. <b>Christina Delimitrou</b> , Massachusetts Institute of Technology | delimitrou@csail.mit.edu |
| 2. <b>David Irwin</b> , University of Massachusetts Amherst            | deirwin@umass.edu        |
| 3. <b>Elsa Olivetti</b> , Massachusetts Institute of Technology        | elsao@mit.edu            |
| 4. <b>Prashant Shenoy</b> , University of Massachusetts Amherst        | shenoy@umass.edu         |
| 5. <b>Adam Wierman</b> , California Institute of Technology            | adamw@caltech.edu        |