

Stephen J. Lee, PhD

Founder, Biospheric AI
Director of Analytics, Energy for Growth Hub

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Summary

I am building Biospheric AI, a geospatial analytics company developing probabilistic AI systems that produce high-resolution forecasts of electricity and heating demand, technology adoption propensity, and infrastructure stress assessments to support energy planning across diverse geographies — from utilities modernizing aging grids in industrialized economies to governments and development institutions extending access in emerging markets. Our patent-pending methods combine deep learning with Bayesian inference for multimodal data fusion, encoding constraints from physics and economics while preserving privacy by training on aggregated or anonymized data. Based at Greentown Labs in Somerville, MA, we collaborate with utilities, universities, intergovernmental organizations, and NGOs to accelerate infrastructure decision-making and improve development and decarbonization outcomes..

Education

- 2018 – 2023 **Ph.D. Electrical Engineering and Computer Science**, *Massachusetts Institute of Technology, Cambridge, MA, USA.*
- Concentrations in Machine Learning and Energy Systems
 - Committee: Prof. Ignacio J. Pérez-Arriaga, Dr. John Fisher III, Dr. Robert Stoner, Prof. Jay Taneja
- 2018-2023 **Ph.D. Minor, Energy Economics**, *MIT Sloan School of Management, Cambridge, MA.*
- 2015-2018 **S.M. Electrical Engineering and Computer Science**, *Massachusetts Institute of Technology, Cambridge, MA.*
- 2015-2018 **S.M. Technology and Policy**, *Massachusetts Institute of Technology, Cambridge, MA.*
- 2009-2013 **B.S. Materials Science & Engineering; Nanotechnology Concentration**, *Johns Hopkins University, Baltimore, MD.*
- 2009-2013 **Second Major in Economics**, *Johns Hopkins University, Baltimore, MD.*

Papers

- 2026 **S.J. Lee**, C. Drouin, Forecasting Residential Heating and Electricity Demand with Scalable, High-Resolution, Open-Source Models, *Energy and AI (Accepted)*
- 2026 X.J. Ji, Q. Li, **S.J. Lee**, M. Luke, F. Mavrothalassitis, Cleaner bills, cleaner air: The environmental co-benefits of stringent renewable portfolio standards policy design, *Energy Economics*
- 2025 **S.J. Lee**, J. Taneja, Tracking Multi-Tier Framework Progress at the National Level with Open Energy Maps, *Energy for Growth Hub*
- 2024 **S.J. Lee**, Open Energy Maps: Electricity Access and Demand Layers, *Open Energy Maps*
- 2024 D. Edeme, M. Kueppers, **S.J. Lee**, D. Wetzal, Africa's electricity access planners turn to geospatial mapping, *IEA Commentaries*
- 2024 **S.J. Lee**, J. Taneja, Tracking the Modern Energy Minimum using the Open Energy Maps machine learning platform, *Energy for Growth Hub*

- 2023 **S.J. Lee**, Multimodal Data Fusion for Estimating Electricity Access and Demand, *Doctoral Thesis, Massachusetts Institute of Technology*
- 2023 H. Doran, **S.J. Lee**, D. Merino-Garcia, GeoMap Beta User Handbook and Reference Materials, *Project InnerSpace*
- 2022 A. González-García, P. Ciller, **S.J. Lee**, R. Palacios, F. de Cuadra, I.J. Pérez-Arriaga, A Rising Role for Decentralized Solar Minigrids in Integrated Rural Electrification Planning? Large-Scale, Least-Cost, and Customer-Wise Design of Grid and Off-Grid Supply Systems in Uganda, *Energies*
- 2021 **S.J. Lee**, D. Suri, P. Somani, C. Dean, J. Pacheco, R. Stoner, I.J. Pérez-Arriaga, J. Fisher, J. Taneja, How probabilistic electricity demand forecasts can expedite universal access to reliable electricity, *Energy for Economic Growth*
- 2021 M. Luke, P. Somani, T. Cotterman, D. Suri, **S.J. Lee**, No COVID-19 Climate "Silver Lining" in the U.S. Power Sector: CO₂ Emissions Reductions Not Statistically Significant, Additional Risk to Coal Generators is Minimal, *Nature Communications*
- 2021 J. Shekhar, D. Suri, P. Somani, **S.J. Lee**, M. Arora, Reduced renewable energy stability in India following COVID-19: Insights and key policy recommendations, *Renewable & Sustainable Energy Reviews*
- 2020 C. Dean, **S.J. Lee**, J. Pacheco, J. Fisher, Learning to Count: Lightweight Data Fusion with Deep Conjugate Mappings, *arXiv preprint arXiv:2011.10607*
- 2019 **S.J. Lee**, E. Sánchez, A. González-García, P. Ciller, P. Duenas, J. Taneja, F. de Cuadra, J. Lumberras, H. Daly, R. Stoner, I.J. Pérez-Arriaga, Investigating the Necessity of Demand Characterization and Stimulation for Geospatial Electrification Planning in Developing Countries, *MIT Center for Energy and Environmental Policy Research Working Papers*
- 2019 A. González-García, P. Ciller, **S.J. Lee**, T. Cotterman, R. Amatya, R. Stoner, I.J. Pérez-Arriaga, Promotion of mini-grids for rural electrification in Uganda, *Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH*
- 2019 P. Ciller, D. Ellman, C. Vergara, A. González-García, **S.J. Lee**, C. Drouin, M. Brusnahan, Y. Borofsky, C. Mateo, R. Amatya, R. Stoner, F. de Cuadra, I.J. Pérez-Arriaga, Optimal Electrification Planning Incorporating On- and Off-Grid Technologies: The Reference Electrification Model (REM), *Proceedings of the IEEE*
- 2018 **S.J. Lee**, Adaptive Electricity Access Planning, *Master's thesis, Massachusetts Institute of Technology*
- 2018 R. Amatya, M. Barbar, M. Brusnahan, P. Ciller, T. Cotterman, F. de Cuadra, P. Dueñas, D. Ellman, A. González-García, **S.J. Lee**, C. Mateo, R. Palacios, I.J. Pérez-Arriaga, R.J. Stoner, C.R. Vergara, Computer-aided electrification planning in developing countries: The Reference Electrification Model (REM), *Working Papers IIT No. WP-IIT-18-112A*
- 2018 I.J. Pérez-Arriaga, R. Stoner, R. Rahnama, **S.J. Lee**, G. Jacquot, A. González-García, and P. Dueñas. A utility approach to accelerate universal electricity access in less developed countries: A regulatory proposal, *Economics of Energy & Environmental Policy*
- 2018 M. Luke, **S.J. Lee**, Z. Pekarek, and A. Dimitrova, Blockchain in Electricity: a Critical Review of Progress to Date, *eurelectric*
- 2013 J. Sinha, **S.J. Lee**, H. Kong, T. Swift, and H.E. Katz, Tetrathiafulvalene-functionalized Thiophene Copolymerized with 3, 3''-Didodecylquaterthiophene: Synthesis, Response to Trinitrotoluene, and Thermoelectric Behavior, *Macromolecules*
- 2013 J. Sinha, R. Ireland, **S.J. Lee**, and H.E. Katz, Synergistic Thermoelectric Power Factor Increase in Films Incorporating Tellurium and Thiophene-based Semiconductors, *Materials Research Society Communications*

Book Contributions

- 2024 The Future of Geothermal Energy, *IEA*, Paris, <https://www.iea.org/reports/the-future-of-geothermal-energy>.

- 2018 Sunny-side up: electricity for clean cooking, *World Energy Outlook 2018*, IEA, Paris, <https://doi.org/10.1787/weo-2018-en>.
- 2018 Enlightened thinking: the value of high-resolution electrification planning for achieving universal electricity access, *World Energy Outlook 2018*, IEA, Paris, <https://doi.org/10.1787/weo-2018-en>.

Short Articles

- 2024 **S.J. Lee**, J. Taneja, Tracking the Modern Energy Minimum using the Open Energy Maps machine learning platform, *Energy for Growth Hub*
- 2022 **S.J. Lee**, J. Taneja, Long-tailed distributions and electrification planning: why we need to model the 'long tail' of large consumers, *Energy for Growth Hub*
- 2022 **S.J. Lee**, I.J. Pérez-Arriaga, Imagining the 'Google' of electrification: how digital twins and computational systems for continuous planning can reinvent century-old practices, *Energy for Growth Hub*
- 2021 **S.J. Lee**, Z. Shah, B. Min, J. Taneja, Nighttime Lights Satellite Imagery: Challenges and Opportunities, *Energy for Growth Hub*
- 2021 **S.J. Lee**, A planner's guide to acquiring building locations data, *Energy for Growth Hub*
- 2020 **S.J. Lee**, R. Stoner, I.J. Pérez-Arriaga, The Integrated Distribution Framework and the Global Commission to End Energy Poverty: Exploring Pathways for Accelerating Universal Access to Modern Energy Services, *Working Paper*, DOI: 10.13140/RG.2.2.23442.20162
- 2020 **S.J. Lee**, L. Aoudi, Opportunities for Mutually Beneficial Public Policy and Machine Learning Climate Solutions, *Working Paper*, DOI: 10.13140/RG.2.2.12575.10401
- 2020 **S.J. Lee**, J. Taneja, Why Demand Demands More Attention, *Energy for Growth Hub*
- 2019 **S.J. Lee**, The Virtuous Cycle of Clean Cooking and Electricity Costs, *Energy for Growth Hub*
- 2018 **S.J. Lee**, Empowered Planning with Models, Satellites, & Machine Learning, *Energy for Growth Hub*
- 2018 M. Luke, **S.J. Lee**, Z. Pekarek, and A. Dimitrova, Blockchain in Electricity: A Call for Policy and Regulatory Foresight, *eurelectric*

Selected Talks and Presentations

- 2023 Presenter, *MIT Energy Initiative Fall Seminar*, Cambridge, MA, USA
- 2022 Presenter, *MIT Energy Initiative Fall Seminar*, Cambridge, MA, USA
- 2021 Webinar Panelist, *Energy Modelling for Better Policymaking*, *Applied Research Programme on Energy and Economic Growth (EEG)*, Oxford, United Kingdom
- 2021 Webinar Presenter, *MITEI-Madhya Pradesh Energy Department Energy Seminar*, Bhopal, Madhya Pradesh, India
- 2020 Webinar Presenter, *Load Research Chapter of the South African Institute of Electrical Engineers (SAIEE)*, Johannesburg, South Africa
- 2019 Presenter, *Asian Development Bank Innovation Speakers' Series*, Manila, Philippines
- 2018 Panelist, *2018 MIT Africa Innovate Conference, Power & Energy*, Cambridge, MA, USA
- 2018 Presenter, *University Program Review*, *NNSA's Office of Defense Nuclear Nonproliferation Research and Development*, Ann Arbor, MI, USA
- 2017 Presenter, *Hack4Climate*, associated with the *2017 United Nations Climate Change Conference (COP23)*, Bonn, Germany
- 2016 Presenter, *Tata India Symposium*, Cambridge, MA, USA
- 2013 Presenter, *Provost's Undergraduate Research Award Recognition Ceremony*, Baltimore, MD, USA

Selected Awards and Honors

- 2021-2022 Graduate Research Fellowship, *Jacobs Social Entrepreneur Fellowship*

- 2021-2022 Graduate Research Fellowship, *Legatum Center for Development & Entrepreneurship*
- 2021 Research Funding Recipient, *International Energy Agency*
- 2020 Research Funding Recipient, *Enel Foundation*
- 2019 Research Funding Recipient, *Energy for Growth Hub*
- 2018 Nominee, Best Master's Thesis Award, *MIT Institute for Data, Systems, and Society*
- 2018 Finalist, NDSEG Fellowship, *U.S. Department of Defense*
- 2015-2017 Graduate Research Fellowship, *MIT Tata Center for Technology and Design*
- 2016 Semifinalist, *MIT Clean Energy Prize*
- 2013 Departmental and University Honors, *Johns Hopkins University*

Professional Certifications

- 2014 Oracle Certified Associate, Java SE 7 Programmer (OCAJP 7)
- 2013 SEMOSS Analytics Certification

Teaching Experience

- 2019 **Teaching Assistant**, 6.041/6.431 Probabilistic Systems Analysis, *Department of Electrical Engineering and Computer Science*.
- 2018 **Teaching Assistant and Guest Lecturer**, 15.017/6.934 Engineering, Economics, and Regulation for Energy Access in Developing Countries, *MIT Sloan School of Management and Department of Electrical Engineering and Computer Science*.
- 2017 **Guest Lecturer**, 15.S02 Planning, Policy, and Technology for Energy Access in Developing Countries, *MIT Sloan School of Management*.

Selected Professional Experience

2018 – Present **Director of Analytics and Fellow**, *Energy for Growth Hub*, Washington, DC.

- Extending electricity demand and access rate estimation algorithms across Africa, South America, and Southeast Asia. Computing estimates of the share of each country that fail to meet the “Modern Energy Minimum” metric as defined by the Energy for Growth Hub.
- Leading ambassador on behalf of the Hub’s “Big Data” team to present on research activities and evaluate partnership opportunities internationally.

2015 – 2024 **Postdoctoral Associate and Graduate Research Fellow**, *MIT Energy Initiative & MIT CEEPR*, Cambridge, MA.

- Designing machine learning models to produce high-resolution geospatial maps of electricity and heating demand across countries and continents, collaborating with intergovernmental organizations, NGOs, governments, utilities, and universities. These maps are being used to improve infrastructure decision-making and affect development and climate outcomes.
- Employed computational energy systems models and conducted analyses to inform large-scale electrification infrastructure planning efforts as part of the Universal Energy Access Group (universalaccess.mit.edu).
- Leading surface heating and electricity demand characterization efforts for international geothermal project evaluation.

2016 – **Consultant**, *Highland Energy Analytics*, Cambridge, MA.

present

- Analytics and software engineering consulting services for top climate NGOs. Developed climate analytics products that appeared in UN Framework Convention on Climate Change (UNFCCC) COP conferences, U.S. congressional reports, and major news outlets.

2015 – 2023 **Researcher**, *MIT Computer Science and Artificial Intelligence Laboratory*, Cambridge, MA.

- Co-developed the Lightweight Data Fusion (LDF) machine learning modeling framework, combining deep learning-based model training with probabilistic graphical models for: (1) improved modeling with sparse data inputs, (2) the ability to combine induction-based models (i.e. learning models *de novo* from unstructured data) with deduction-based models (i.e. human-interpretable models based on theory), and (3) the provision of quantified uncertainty characterizations to power decision theory-based decision-making.
- Designed convolutional neural network architectures for the semantic segmentation of satellite imagery using TensorFlow and Keras. Built a computer vision system to consume imagery, other geospatial vector datasets, and georeference features for large-scale feature extraction on GPU-enabled Amazon EC2 servers. Built a suite of web-based manual image annotation tools and visualization dashboards.

2013 – 2015 **Software Engineering, Full Stack**, *SEMOSS*, Arlington, VA.

- Developed data processing and visualization components of the open source analytics environment, SEMOSS (semoss.org). Led new feature development efforts across the full application stack and refactored client-specific analyses into analytic routines for general-purpose data exploration

2013 – 2015 **Consultant**, *Deloitte Consulting LLP*, Arlington, VA.

- Performed systems and optimization analyses for the National Oceanic and Atmospheric Administration (NOAA) and the Military Health System (MHS) using SEMOSS, Python, and Excel/VBA. Performed network analyses to inform information systems migration efforts towards service-oriented architectures, inform technology investment decisions, and eliminate system redundancies.
- Led a business case analysis for the Defense Logistics Agency (DLA) Energy Sustainment, Restoration and Modernization (SRM) Office with projected cost savings of over \$90 million in five years and prepared figures that were presented to Congress.
- Codeveloped web-based dashboards for comparative financial analytics in the Power and Utilities, Retail, and Technology sectors with Deloitte's Global Benchmarking Center. Dashboards allow executives to assess performance relative to competitors by business segment and identify high-priority areas for improvement.