

KARAN BHUWALKA

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EDUCATION

Massachusetts Institute of Technology

Ph.D, Mechanical Engineering (GPA: 5/5) Feb '24
• Thesis: A model to evaluate the availability and cost of metals critical for renewable energy technology
• Advisor: Elsa Olivetti

M.S., Computer Science (GPA: 5/5) Feb '21

M.S., Technology and Policy Program (GPA: 5/5) Feb '21
• **Best Masters Thesis:** "Assessing the socio-economic risks in materials supply chain for electric vehicles"

Indian Institute of Technology, Bombay

B.Tech, Materials Science & Engineering (GPA 8.8/10; Rank 3/120) May '18

RESEARCH AND WORK EXPERIENCE

Stanford University, Staff Research Scientist 02/'24 - present
Energy Science & Engineering; Group PIs: Sally Benson, William Chueh

- Techno-economic modeling of graphite processing and supply chains to guide policy on diversifying supply
- Estimating learning rates and costs of various battery chemistries
- Organized 2 workshops with over 100 companies and government leaders on scaling-up energy technology and supply chains (focused on Sodium-ion batteries and Graphite Processing respectively)

MIT Materials Systems Lab, Graduate Researcher 08/'18 - 02/'24

- Dynamic market modeling of critical minerals price and supply in various demand and policy scenarios
- Identifying policies to increase plastic recycling via waste supply chain model
- Quantifying materials use in vehicles and automakers' vulnerability to supply risk
- Bayesian hierarchical regression modeling to reduce uncertainty in material demand and flows

Dow Chemicals, ESG Intern with Global Purchasing Sustainability Director May '23 - Aug '23

- Developed a method for quantifying downstream emissions for over 100 product groups across regions.
- Measured Dow's downstream Scope 3.10 emissions for setting emissions targets and reporting to CDP

Columbia Center for Sustainable Investment, Research Affiliate May '20 - Aug '20

- Policy memo on how carbon pricing can spur mining sector investments in Africa [published by UN](#)
- Estimated variability in mining emission factors estimates by country and process

PUBLICATIONS

- [14] E.A. Moore, **K. Bhuwalka**, A. Zhu, P. Tang, Y. Chen, J. Russel, R. Kirchain, and R. Roth, "A Game Theory Strategy to Decarbonize the Mining Industry" (in preparation)
- [13] **K. Bhuwalka**, M.Ziegler, E.Olivetti and R. Roth, "Dynamic minerals price and availability for modeled energy scenarios" (in preparation)
- [12] **K. Bhuwalka**, B. Ravi, E.A. Moore, I. Diersen, R. Malik, E. Young, R. Billy, R. Roth, R. Stoner, D. Muller, and E.A. Olivetti, "Navigating sustainable pathways for future nickel demand," *Joule* (under review)
- [11] I.Diersen, **K. Bhuwalka**, E.Olivetti, "The opportunity for utilizing end-of-life scrap to meet growing copper demand" *Journal of Advanced Manufacturing and Processing* (Accepted)
- [10] B. Ravi, **K. Bhuwalka**, R. Roth, and E.A. Olivetti, "Meeting policy-driven demand for PET bottle recycling," *J. of Industrial Ecology* (2024)
- [9] J. Ryter, **K. Bhuwalka**, M. O'Rourke, L. Montanelli, D. Cohen-Tanugi, R. Roth, and E.A. Olivetti, "Understanding key mineral supply chain dynamics using economics-informed material flow analysis and Bayesian optimization," *J. of Industrial Ecology* (Accepted)
- [8] **K. Bhuwalka**, R.E. Kirchain, E.A. Olivetti, and R. Roth, "Quantifying the drivers of long-term prices in materials supply chains," *J. of Industrial Ecology*, vol. 27, no. 141-154, (2023).
- [7] **K. Bhuwalka**, E. Choi, E.A. Moore, R. Roth, R.E. Kirchain, and E.A. Olivetti, "A hierarchical Bayesian regression model that reduces uncertainty in material demand predictions," *J. of Industrial Ecology*, vol. 27, no. 43-55 (2023).
- Selected as the 'Editor's Choice' article for Sep '23. Nominated for **Best Paper Award**.
- [6] **K. Bhuwalka**, J. Sonner, L. Lin, and A.E. Hosoi, "When is it profitable to make a product sustainable? Insight from a decision-support tool," in *Technology Innovation for the Circular Economy: Recycling, Remanufacturing, Design, Systems Analysis, and Logistics*, N. Nasr, Ed. Massachusetts: Scrivener Publishing, pp.75-94, (2023).
- [5] B. Ravi, **K. Bhuwalka**, E.A. Moore, R.E. Kirchain, "An overview of recycled plastics supply and demand: Identifying the critical market bottlenecks for closing the loop," in *Recycled Plastics in Infrastructure: Current Practices, Understanding, and Opportunities*, National Academies of Science Engineering and Medicine, Ed: Washington, DC: The National Academies Press. pp. 219-253 , (2023).
- **White paper commissioned by NAS** to inform a report delivered to Congress, DoT and EPA
- [4] J. O'Connor, **K. Bhuwalka**, A. Randall, R. Roth, E.A. Olivetti, K. Whitefoot, "Energy and Critical Materials Summary," in *Securing America's Future; A Framework for Critical Technology Assessment*, National Network for Critical Technologies Assessment, pp. 70-89, (2023)
- [3] J. Ryter, X. Fu, **K. Bhuwalka**, R. Roth, E.A. Olivetti, "Assessing recycling, displacement, and environmental impacts using an economics-informed material system model" *J. of Industrial Ecology*, vol. 26 (3), no. 1010-1024, (2022)
- [2] J. Ryter, X. Fu, **K. Bhuwalka**, R. Roth, E.A. Olivetti, "Emission impacts of China's solid waste import ban and COVID-19 in the copper supply chain" *Nat Communications*, vol. 12 (1), no. 3753, (2021)
- [1] **K. Bhuwalka**, F.R. Field, R. De Kleine, H.C. Kim, T.J. Wallington, R.E. Kirchain "Characterizing the changes in material use due to vehicle electrification" *Env. Sci. and Tech.*, vol. 55 (14), no. 10097-10107, (2021)
- **Featured in C&EN and 31 other news articles**

PRESENTATIONS

Invited talks

- “A hierarchical Bayesian regression model that reduces uncertainty in material demand predictions”, Journal of Industrial Ecology Webinar Series, Jun 2024 (Invited as the first presenter for new webinar series)
- “Can the US forge a path to anode self-sufficiency?” Fastmarkets Lithium Supply & Battery Raw Materials Conference, Jun 2024 (Panel)
- “How Critical are Minerals to our Energy Security?”, TechConnect World Summit, Jun 2024 (Panel)
- “Techno-economic learning for Na-ion and Li-ion batteries”, Stanford Energy Research Showcase, May 2024
- “Nickel Market Dynamics and the Security of the Battery Supply Chain”, Critical Minerals and the Clean Energy Transition workshop, UT Austin, 2024
- “Sustainably Scaling Up Critical Minerals Production”, Columbia Earth and Environmental Engineering Fall Seminar, 2023
- “Repurposing Plastics Waste in Infrastructure Paper Session”, National Academy of Sciences, 2023
- “Materials Requirements for the Energy Transition”, Center for Energy Economics and Policy Research (CEEPR) Workshop at MIT, 2023

Conference Presentations

- “Investigating the impact of environmental policy on material availability”; Industrial Ecology Conference, Leiden 2023
- “When is it profitable to make a product sustainable? Insight from a decision-support tool” REMADE Conference 2023 (National Academy of Science, Washington DC)
- “How to reduce materials costs in clean technologies?”; International Symposium on Sustainable Systems and Technology, Pittsburgh 2022

TEACHING AND MENTORSHIP

Lecturer in ‘Industrial Ecology of Materials’, MIT

Aug ‘23 – Dec ‘23

- Conceptualized and taught module on resource economics and how markets impact life-cycle impacts
- Overall student evaluation ratings of 6.6/7

Teaching Assistant for ‘Exploring Sustainability at Different Scales’

Aug ‘22 – Dec ‘22

- Interdepartmental grad course. Developed assignments and material, taught recitations, held office hours
- Overall student evaluation ratings of 6.8/7

The Critical Minerals Research Lab

05/24-present

- Launched a virtual interdisciplinary lab for students working on critical minerals In collaboration with *Resources for the Future* and professors from Carnegie Mellon University and Colorado School of Mines
- Currently accepting applications from PhD students. Kick-off in Fall 2024.

Advising graduate and undergraduate students

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| • Julia Frohmann, PhD Student, Stanford Energy Science and Engineering | 08/23-present |
| • Hari Ramachandran, PhD Candidate, Stanford Materials Science and Engineering | 08/23-present |
| • Isabel Diersen, PhD Student, MIT Department of Materials Science and Engineering | 08/23-present |
| • Ruiyi Wang, M.Eng, Department of Computer Science | 08/23- 02/24 |
| • Anne Liu, MS, MIT Technology and Policy Program | 08/21-05/23 |

SERVICE

- Guest Editor, Special Issue on “Establishing Sustainable Supply Chain of Critical Materials for Low-carbon Transition”, *Resources, Conservation, and Recycling*
- Reviewer, *Joule*
- Reviewer, *Journal of Industrial Ecology*
- Reviewer, *International Symposium on Sustainable Systems and Tech.*
- Member of GradSAGE, a Graduate Student Advisory Group that meets directly with MIT’s Dean of Engineering to recommend improvements to graduate education and experience
- Member of Career committee for the Industrial Ecology Society, providing mentorship to young students