

Hadi Arbabi

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🔗 ci1hea.github.io

Hadi's work and research interests sit at the interface of data-driven urban analytics and planning. Hadi's overall body of research focuses on the challenges relating to resource consumption and productivity in urban systems often in the context of planetary resource capacity and extreme climate change. Their previous work has focused on a spatially multi-scale examination of urban systems and the extent to which their performance is influenced by their embedded physical infrastructure. Hadi's broader research activity and interests include but are not limited to practical uses of **urban scaling** and **allometry**, city morphology, infrastructure planning for **agglomeration**, **network analysis** of intra- and inter-city urban flows, and building stocks and **urban metabolism**. As of November 2023, Hadi has over 160 citations and an *h*-index of 7 on Google Scholar.

Academic Positions

The University of Sheffield

Lecturer in Built Environment August 2020 – Present
Resources, Infrastructure Systems, & built-Environments Research Group

Research Associate April 2019 – July 2020
Digital Urban Characterization [EP/S016627/1, EP/V012053/1]

Part-Time Research Associate November 2018 – February 2019
Engineering Complexity Resilience Network Plus [EP/N010019/1]

Professional Memberships

Fellow of AdvanceHE (no. PR273991)
Regional Studies Association (no. 15429)
Regional Sciences Association International (no. RSAI08605)
The OR Society (no. 031935)

Education

The University of Sheffield

PhD 2015 – 2019
Resources, Infrastructure Systems, & built-Environments,

– Thesis Title:
*Urban Productivity & Spatial Patterns Across Scales–
A Multi-Scale Exploration of Urban Networks and Their Hierarchical Configurations*

MEng 2011 – 2015
Architectural Engineering (First-Class Honors),

– Dissertation Title:
Influence of Anthropic and Spatial Characteristics of Cities upon Their Energy Metabolism

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| Review Activities | Regional Studies; Journal of the Royal Society Interface; Science of the Total Environment; Regional Studies, Regional Science; Journal of Environmental Management; Energies; ISPRS International Journal of Geo-Information; Sustainability; Applied Sciences; Remote Sensing; GIScience & Remote Sensing; Cleaner Production Letters |
| Professional Standing & Awards | <p>Associate Editor 2022 – 2025 <i>Regional Studies, Regional Science</i> – A Journal of the Regional Studies Association</p> <p>‘Real Zero’ in a Hurry, DecarboN8 International Conference Summer 2021 <i>Invited Session Chair for Innovation and Infrastructure Sustainability: Methods, Metrics and Measures</i></p> <p>International Industrial Ecology Day Summer 2021 <i>Session Organizer for Bottom-Up Urban Built Environment MFA: Data, Methods, Challenges and Comparability</i></p> <p>Regional Science Association International, British and Irish Section Summer 2017 <i>The Early Career Prize for Best Presentation</i> – (Paper C6)</p> <p>The University of Sheffield Autumn 2015 – Summer 2019 <i>Faculty scholarship to undertake doctoral research</i></p> <p>The University of Sheffield Summer 2015 <i>Mappin Medal and Premium for Greatest Distinction Shown by a Candidate on a MEng Program</i></p> <p>The Institution of Structural Engineers (IStructE) Spring 2014 – Winter 2015 <i>Young Members’ Panel invited membership</i></p> <p>Chartered Institute of Building Services Engineers (CIBSE), Yorkshire Region Autumn 2013 <i>CIBSE Yorkshire Award for Outstanding Academic Achievement</i></p> <p>Sheffield International College Summer 2011 <i>Progression Scholarship for Academic Achievement</i></p> |
| Selected Research Articles | <p>J17. A Systematic Approach to Climate Resilience Assessment of Infrastructure Networks. <i>IEEE Sytems</i>, (Accepted), with Q. Li, C. Robson, G. Punzo, & M. Mayfield. doi:10.1109/jsyst.2023.3329765</p> <p>J16. Regional Economic Resilience, Trophic Characteristics, and Ecological Analogies. <i>Papers in Regional Science</i>, (Accepted), with G. Punzo. doi:10.1111/pirs.12766</p> <p>J15. Built Environment Stocks in the Context of a Master Planned City: A Case Study of Chandigarh, India. <i>Journal of Industrial Ecology</i>, (Accepted), with W. Mikhelson, S. Hincks, & D. Densley Tingley.</p> <p>J14. Towards an automated workflow for large-scale housing retrofit. <i>Environmental Research Letters</i>, 18, 061006 (2023), with L. M. Tan, W. O. C. Ward, X. Li, D. Densley Tingley, A. Khan, & M. Mayfield. doi:10.1088/1748-9326/acd797</p> <p>J13. Estimating Energy Consumption of Residential Buildings at Scale with Drive-by Image Capture. <i>Building and Environment</i>, 234, 110188 (2023), with W. O. C. Ward, X. Li, Y. Sun, M. Dai, D. Densley Tingley, & M. Mayfield. doi:10.1016/j.buildenv.2023.110188</p> <p>J12. The Intrinsic Cybernetics of Large Complex Systems and How Droughts Turn into Floods. <i>Science of the Total Environment</i>, 859(2), 159979 (2023), with G. Punzo. doi:10.1016/j.scitotenv.2022.159979</p> <p>J11. Scalable Residential Building Geometry Characterisation Using Vehicle-Mounted Camera System. <i>Energies</i>, 15(16), 6090 (2022), with M. Dai, W. O. C. Ward, D. Densley Tingley, & M. Mayfield. doi:10.3390/en15166090</p> |

- J10. Net Zero by 2050: Investigating Carbon-Budget Compliant Retrofit Measures for the English Housing Stock. *Renewable and Sustainable Energy Reviews*, **161**, 112384 (2022), with X. Li, G. Bennett, T. Oreszczyn, & D. Densley Tingley. doi:10.1016/j.rser.2022.112384
- J9. A Scalable Data Collection, Characterization, and Accounting Framework for Urban Material Stocks. *Journal of Industrial Ecology*, **26**(1), 58-71 (2021), with M. Lanau, X. Li, G. Meyers, M. Dai, M. Mayfield, & D. Densley Tingley. doi:10.1111/jiec.13198
- J8. Mapping Resource Effectiveness across Urban Systems. *npj Urban Sustainability*, **1**, 20 (2021), with L. M. Tan, P. Brockway, D. Densley Tingley, & M. Mayfield. doi:10.1038/s42949-020-00009-3
- J7. On the Use of Random Graphs in Analysing Resource Utilization in Urban Systems. *Royal Society Open Science*, **7**, 200087 (2020), with G. Punzo, G. Meyers, L. M. Tan, Q. Li, D. Densley Tingley, & M. Mayfield. doi:10.1098/rsos.200087
- J6. Productivity, Infrastructure, and Urban Density – an Allometric Comparison of Three European City-Regions across Scales. *Journal of the Royal Statistical Society: Series A (Statistics in Society)*, **183**(1), 211-228 (2020), with M. Mayfield & P. McCann. doi:10.1111/rssa.12490
- J5. On Development Logic of City-Regions: Inter- Versus Intra-City Mobility in England and Wales. *Spatial Economic Analysis*, **14**(3), 301-320 (2019), with M. Mayfield & P. McCann. doi:10.1080/17421772.2019.1569762
- J4. Urban Performance at Different Boundaries in England and Wales through the Settlement Scaling Theory. *Regional Studies*, **53**(6), 887-899 (2019), with M. Mayfield & G. Dabinett. doi:10.1080/00343404.2018.1490501
- J3. An Ecological Thermodynamic Approach in Urban Metabolism: Measuring Resource Utilization with Open System Network Effectiveness Analysis. *Applied Energy*, **254**, 113618 (2019), with L. M. Tan, P. E. Brockway, D. Densley Tingley, & M. Mayfield. doi:10.1016/j.apenergy.2019.113618
- J2. Ecological Network Analysis on Intra-city Metabolism of Functional Urban Areas in England and Wales. *Resources, Conservation & Recycling*, **138**, 172-182 (2018), with L. M. Tan, Q. Li, Y. Sheng, D. Densley Tingley, M. Mayfield, & D. Coca. doi:10.1016/j.resconrec.2018.06.010
- J1. Urban and Rural – Population and Energy Consumption Dynamics in Local Authorities within England and Wales. *Buildings*, **6**(3), 34 (2016), with M. Mayfield. doi:10.3390/buildings6030034
- Chapters & Reports
- R2. Resource Effectiveness in and across Urban Systems. In R. C. Brears (Ed.) *The Palgrave Encyclopedia of Urban and Regional Futures*, Cham: Palgrave Macmillan, (2021), with L. M. Tan. doi:10.1007/978-3-030-51812-7_202-1
- R1. Quantifying Agglomeration Productivity Potential in Long-Term Infrastructure Planning (PIN – Productivity Projects Fund). *Productivity Insights Network*, (2020), with J. Pannell, S. Hincks, & G. Punzo. doi: available here
- Others
- O2. Comments on Bettignies et al., ‘The Scale-Dependent Behaviour of Cities: A Cross-Cities Multiscale Driver Analysis of Urban Energy Use’ Sustainability 2019, 11, 3246. *Sustainability*, **14**, 4230 (2022), with G. Meyers, L. M. Tan, & M. Mayfield. doi:10.3390/su14074230
- O1. Comments on ‘A Multi-Level Framework for Metabolism in Urban Energy Systems from an Ecological Perspective’ by Barrera et al. (2018). *Resources, Conservation & Recycling*, **136**, 463-465 (2018), with L. M. Tan & M. Mayfield. doi:10.1016/j.resconrec.2018.04.028

Invited Talks

- T4. Regions at Risk: Extreme Climate Change, Population & Displacement. In *Adapting to climate change: Local, national and international perspectives*. Grantham Centre for Sustainable Futures: Annual Symposium 2023, UK: 11 October 2023.
- T3. Urban Densification: Is This the Future for Our Cities? In *Festival of Debate*. Opus Independents, UK: 10 May 2023.
- T2. The Tensions between Density, Mobility, & Economic Output in Long-Term Mobility Planning. In *Northern Evidence Academic Forums*. Transport for the North, UK: 12 May 2021.
- T1. On the Development Logic of City-Regions. In *Connect to Collaborate: Accelerating Infrastructure Transitions towards Connected Places*. The University of Bristol, UK: 23 May 2019. (An ESRC co-funded workshop through the Productivity Insights Network)

Conferences

- C16. Extreme Climate Change Impacts on Urban Infrastructure and Support Systems. In *the EGU General Assembly 2023*. Vienna: 2023, with T. Wood, & M. Mayfield.
- C15. Regional Economic Resilience, Trophic Coherence, and Ecological Analogies. In *Regional Sciences Association International-British and Irish Section 48th Annual Conference*. Stirling: 2022, with G. Punzo.
- C14. Demolish or Reuse? - The Balance between Operational and Embodied Emissions in the Retrofit of Commercial Buildings. In *Sustainable Built Environment D-A-CH Conference*. Berlin: 2022, with D. Abbey, C., Gillot, W. O. C. Ward, & D. Densley Tingley. doi:10.1088/1755-1315/1078/1/012016
- C13. Deep Learning Based Residential Energy Prediction Using EPC and GSV. In *Sustainable Built Environment D-A-CH Conference*. Berlin: 2022, with Y. Sheng, M. Mayfield, M. Álvarez, & W. O. C. Ward. doi:10.1088/1755-1315/1078/1/012038
- C12. Measuring the Cityscape: A Pipeline from Street-Level Capture to Urban Quantification. In *Sustainable Built Environment D-A-CH Conference*. Berlin: 2022, with W. O. C. Ward, M. Dai, Y. Sun, D. Densley Tingley, & M. Mayfield. doi:10.1088/1755-1315/1078/1/012036
- C11. Spatial Consistency and Patterns in Agglomeration Elasticities within and across European Urban Systems. In *Regional Science Association International-British and Irish Section 47th Annual Conference*. Cambridge, UK: 2019.
- C10. Limiting Factors in Achieving Overall Circular Economic Effectiveness: an Analytical Assessment. In *1st International Conference on Construction Circular Economy*. Manchester, UK: 2019, with G. Punzo, G. Meyers, L. M. Tan, Q. Li, D. Densley Tingley, & M. Mayfield.
- C9. Finding Northern Powerhouse, or How to Grow Your Own City Regions. In *Regional Studies Association Winter Conference*. London, UK: 2017, with M. Mayfield & P. McCann.
- C8. Ecological Network Analysis on Intra-city Metabolism of Functional Urban Areas in England and Wales. In *Spaces & Flows: Eighth International Conference on Urban and ExtraUrban Studies*. Hull, UK: 2017, with L. M. Tan, Q. Li, Y. Sheng, N. Stanton, T. J. Valentine, & E. B. Fraser.
- C7. Ecological Network Analysis of Inter-city Metabolism of Functional Urban Areas in England and Wales. In *Proceedings of the Department of Civil and Structural Engineering*. Sheffield, UK: 2017, with L. M. Tan, N. Stanton, T. J. Valentine, Q. Li, Y. Sheng, & E. B. Fraser.
- C6. A Look at Urban Performance Balance across Different Boundaries in England and Wales. In *Regional Science Association International-British and Irish Section 46th Annual Conference*. Harrogate, UK: 2017, with M. Mayfield, & G. Dabinett.
- C5. The Importance of Understanding the Material Metabolism of the Built Environment. In *World Sustainable Built Environment Conference*. Hong Kong: 2017, with D. Densley Tingley & M. Durkin.
- C4. Too Large and Too Sparse, or Why the UK Northern Powerhouse Does Not Perform to a London Standard. In *Regional Studies Association Student & Early Career Conference 2016*. Newcastle, UK: 2016, with M. Mayfield & G. Dabinett.

- C3. Avoiding Reductionism in Disaster Prevention and the Role of Complexity. In *Vestnick of Almaty University of Power Engineering and Telecommunications Special Issue 2016*, 14–22. Almaty, Kazakhstan: 2016, with G. Punzo & M. Mayfield.
- C2. Urban and Rural – An Exploratory Look at Population and Energy Consumption in Local Authorities within England and Wales. In *Regional Urbanism in the Era of Globalisation*. Huddersfield, UK: 2016, with M. Mayfield.
- C1. Renewable Energy Technologies in Campus-Sized Developments: A Spatial Study. In *CIBSE Technical Symposium 2015*. London, UK: 2015, with B. R. Lazarov & M. Mayfield.

**Recent
Funding**
(£269k apportioned)

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| QR Policy Support Fund | October 2023 |
| £36k – Principal-investigator for award to support Transfort for the North investigating the changing profile of climate related transport infrastructure failure in the North. | |
| Rochdale Boroughwide Housing | January 2023 |
| £12k – Co-investigator for research commission on new build versus retrofit for housing in Rochdale. | |
| MAKE Architects | July 2022 |
| £20k – Co-investigator for research commission on new build versus retrofit office development. | |
| Community Renewal Fund | June 2022 |
| £42k – Institutional principal-investigator for research commission awarded by the Doncaster Metropolitan Borough Council on residential retrofit planning. | |
| RE Development Fund | January 2022 |
| £4m – Co-investigator for the housing and infrastructure theme of the South Yorkshire Sustainability Centre funded by RE. | |
| ATI Towards Turing 2.0 | October 2021 |
| £755k – Co-investigator for the energy modelling digital twin of the Digital Twins for High-Value Engineering Applications program. | |
| ESRC Impact Acceleration Account | October 2021 |
| £19k – Co-investigator for award allocated by the ESRC-funded IAA to support unlocking productivity in the Sheffield City Region through changes to the mobility network | |
| RE Higher Education Innovation Fund | April 2021 |
| £36k – Co-investigator for award allocated by the Research England-funded HEIF to support decarbonization through knowledge exchange partnership with Barnsley Metropolitan Borough Council and South Yorkshire Mayoral Combined Authority | |
| RE Higher Education Innovation Fund | January 2021 |
| £37k – Co-investigator for award allocated by the Research England-funded HEIF to support the development of a regional emissions accounting and budgeting framework in partnership with the South Yorkshire Mayoral Combined Authority | |
| EPSRC Impact Acceleration Account | January 2021 |
| £9k – Principal investigator and project lead for award allocated by the EPSRC-funded IAA to support the trial of an automated residential retrofit assessment in partnership with Barnsley Metropolitan Borough Council | |
| Productivity Insights Network Productivity Project Funding | March 2020 |
| £9k – Principal investigator and project lead for award allocated by the ESRC-funded Productivity Insights Network to support new and ambitious interdisciplinary directions in productivity research across the social sciences that engage partners and deliver impact on Quantifying Agglomeration Productivity Potential in Long-Term Infrastructure Planning – (Report R1) | |

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| Doctoral Supervision | The University of Sheffield | |
| | P6. Ben Johnstone Bray (FT), Primary Supervisor. <i>Extreme Climate Change Compatible Residential Energy Retrofit</i> | 2023 – Present |
| | P5. Ioana Jelea (FT), Second Supervisor. Primary Supervisor: Giuliano Punzo <i>Complexity and Urban Systems</i> | 2023 – Present |
| | P4. Marcel Fehr (PT), Primary Supervisor. <i>Climate Change and Credit Risk for Mortgage Portfolios</i> | 2021 – Present |
| | P3. Danielle Abbey (FT), Second Supervisor. Primary Supervisor: Danielle Densley Tingley <i>Energy Retrofit for Non-Residential Buildings</i> | 2021 – Present |
| | P2. Yulan Sheng (FT), Third Supervisor. Primary Supervisor: Martin Mayfield <i>Deep Learning for Urban Thermal Energy Analysis</i> | 2020 – Present |
| | P1. Will Mikhelson (FT), Second Supervisor. Primary Supervisor: Danielle Densley Tingley <i>Understanding the Relationship Between Resource Consumption and Development Levels</i> | 2019 – 2023 |
| Teaching Activities | Program Coordinator, the University of Sheffield MEng Architectural Engineering | 2022 – Present |
| | Module Lead, the University of Sheffield CIV201/204 – Sustainable Buildings | 2023 – Present |
| | CIV4017/6017 – Computational Fluid Dynamics | 2020 – Present |
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