

Hadi Arbabi

☎ +44 (0) 114 222 5751

✉ h.arbabi@sheffield.ac.uk

🔗 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 August 2024, Hadi has over 220 citations and an h-index of 9 on Google Scholars.

Academic Positions

The University of Sheffield

Lecturer in the 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

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; Transportation Research Interdisciplinary Perspectives	
Professional Standing & Awards	Associate Editor <i>Regional Studies, Regional Science</i> – A Journal of the Regional Studies Association	2022 – 2025
	‘Real Zero’ in a Hurry, DecarboN8 International Conference <i>Invited Session Chair for Innovation and Infrastructure Sustainability: Methods, Metrics and Measures</i>	Summer 2021
	International Industrial Ecology Day <i>Session Organizer for Bottom-Up Urban Built Environment MFA: Data, Methods, Challenges and Comparability</i>	Summer 2021
	Regional Science Association International, British and Irish Section <i>The Early Career Prize for Best Presentation</i> – (Paper C6)	Summer 2017
	The University of Sheffield <i>Faculty scholarship to undertake doctoral research</i>	Autumn 2015 – Summer 2019
	The University of Sheffield <i>Mappin Medal and Premium for Greatest Distinction Shown by a Candidate on a MEng Program</i>	Summer 2015
	The Institution of Structural Engineers (IStructE) <i>Young Members’ Panel invited membership</i>	Spring 2014 – Winter 2015
	Chartered Institute of Building Services Engineers (CIBSE), Yorkshire Region <i>CIBSE Yorkshire Award for Outstanding Academic Achievement</i>	Autumn 2013
	Sheffield International College <i>Progression Scholarship for Academic Achievement</i>	Summer 2011
Selected Research Articles	J18. Built Environment Stocks in the Context of a Master Planned City: A Case Study of Chandigarh, India. <i>Journal of Industrial Ecology</i> , 28 , 573-588 (2024), with W. Mihkelson, S. Hincks, & D. Densley Tingley. doi:10.1111/jiec.13466	
	J17. Component-Level Residential Building Material Stock Characterization Using Computer Vision Techniques. <i>Environment Science & Technology</i> , 58 (7), 3224-3234 (2024), with M. Dai, J. Jurczyk, R. Mao, W. O. C. Ward, M. Mayfield, G. Liu, & D. Densley Tingley. doi:10.1021/acs.est.3c09207	
	J16. A Systematic Approach to Climate Resilience Assessment of Infrastructure Networks. <i>IEEE Systems Journal</i> , 18 (1), 24-35 (2024), with Q. Li, C. Robson, G. Punzo, & M. Mayfield. doi:10.1109/jsyst.2023.3329765	
	J15. Regional Economic Resilience, Trophic Characteristics, and Ecological Analogies. <i>Papers in Regional Science</i> , 102 (6), 1127-1145 (2023), with G. Punzo. doi:10.1111/pirs.12766	
	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	
	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	

- J12. The Intrinsic Cybernetics of Large Complex Systems and How Droughts Turn into Floods. *Science of the Total Environment*, **859**(2), 159979 (2023), with G. Punzo. doi:10.1016/j.scitotenv.2022.159979
- J11. Scalable Residential Building Geometry Characterisation Using Vehicle-Mounted Camera System. *Energies*, **15**(16), 6090 (2022), with M. Dai, W. O. C. Ward, D. Densley Tingley, & M. Mayfield. doi:10.3390/en15166090
- 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

- O4. Government Resilience: Extreme Weather, Written Evidence Submitted to the Public Accounts Committee. *UK Parliament*, (2024), with T. Wood, S. Sadati, G. Punzo, & M. Mayfield. doi: available here
- O3. Heating Our Homes, Written Evidence Submitted to the Energy Security and Net Zero Committee. *UK Parliament*, (2023), with R. Macrorie, M. Zune, D. Witherley, R. Sulley, W. Eadson, & D. Densley Tingley. doi: available here
- 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

- C17. Fabric Energy Efficiency in Housing Retrofit: The Role of Whole-life Operational and Embodied Carbon Emissions. In *37th Passive and Low Energy Architecture Conference: (Re)thinking Resilience*. Wrocław: 2024, with M. Zune, & D. Densley Tingley.
- 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**
(£315k apportioned)

EPSRC	June 2024
£6m – Co-investigator for BuildZero: transforming the UK’s buildings for zero material extraction, zero carbon and zero waste – EP/Y530578/1.	
British Academy	March 2024
£10k – Principal-investigator for Pump Priming Collaboration between UK and EU Partners – PPHE2400399.	
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
<i>£755k – Co-investigator for the energy modelling digital twin of the Digital Twins for High-Value Engineering Applications program.</i>	
ESRC Impact Acceleration Account	October 2021
<i>£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</i>	
RE Higher Education Innovation Fund	April 2021
<i>£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</i>	
RE Higher Education Innovation Fund	January 2021
<i>£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</i>	
EPSRC Impact Acceleration Account	January 2021
<i>£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</i>	
Productivity Insights Network Productivity Project Funding	March 2020
<i>£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)</i>	
Productivity Insights Network Early Career Seed Funding	November 2019
<i>£500 – Award allocated by the ESRC-funded Productivity Insights Network to further develop a research idea presented at the network's early career sandpit event</i>	

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

CIV4025 – Thermodynamics for Buildings
CIV4017 – Computational Fluid Dynamics
CIV201 – Sustainable Buildings
CIV204 – Sustainable Buildings

2020 – 2021
2020 – Present
2022 – Present
2023 – Present

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