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 September 2024, Hadi has over 230 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; Scientific Reports; Journal of Environmental Management; Energies; ISPRS International Journal of Geo-Information; Sustainability; Applied Sciences; Transportation Research Interdisciplinary Perspectives; Energy Research & Social Science; Remote Sensing; GIScience & Remote Sensing; Cleaner Production Letters

Professional Standing & Awards

Associate Editor 2022 – 2025
Regional Studies, Regional Science – A Journal of the Regional Studies Association

'Real Zero' in a Hurry, DecarboN8 International Conference Summer 2021
Invited Session Chair for Innovation and Infrastructure Sustainability: Methods, Metrics and Measures

International Industrial Ecology Day Summer 2021
Session Organizer for Bottom-Up Urban Built Environment MFA: Data, Methods, Challenges and Comparability

The University of Sheffield Summer 2015
Mappin Medal and Premium for Greatest Distinction Shown by a Candidate on a MEng Program

Selected Research Articles

J18. Built Environment Stocks in the Context of a Master Planned City: A Case Study of Chandigarh, India. *Journal of Industrial Ecology*, **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. *Environment Science & Technology*, **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. *IEEE Sytems Journal*, **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. *Papers in Regional Science*, **102**(6), 1127-1145 (2023), with G. Punzo. doi:10.1111/pirs.12766

J14. Towards an automated workflow for large-scale housing retrofit. *Environmental Research Letters*, **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. *Building and Environment*, **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

Others

O2. 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

O1. 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

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)

Recent Conferences

C5. 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.

C4. Deviations from Agglomeration Expectations: Accessibility, Density, and Local Characteristics. In *Regional Sciences Association International-British and Irish Section 50th Annual Conference.* Bristol: 2024, with G. Punzo.

C3. Extreme Climate Change Impacts on Urban Infrastructure and Support Systems. In *the EGU General Assembly 2023.* Vienna: 2023, with T. Wood, & M. Mayfield.

C2. 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.

C1. 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

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.*

£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*

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