Hadi Arbabi

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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

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

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

Regional Science Association International, British and Irish Section Summer 2017
The Early Career Prize for Best Presentation — (Paper C6)

The University of Sheffield Autumn 2015 – Summer 2019
Faculty scholarship to undertake doctoral research

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

The Institution of Structural Engineers (IStructE) Spring 2014 – Winter 2015
Young Members' Panel invited membership

Chartered Institute of Building Services Engineers (CIBSE), Yorkshire Region Autumn 2013
CIBSE Yorkshire Award for Outstanding Academic Achievement

Sheffield International College Summer 2011
Progression Scholarship for Academic Achievement

Selected Research Articles

J17. A Systematic Approach to Climate Resilience Assessment of Infrastructure Networks. *IEEE Sytems*, (Accepted), with Q. Li, C. Robson, G. Punzo, & M. Mayfield. doi:10.1109/jsyst.2023.3329765

J16. Regional Economic Resilience, Trophic Characteristics, and Ecological Analogies. *Papers in Regional Science*, (Accepted), with G. Punzo. doi:10.1111/pirs.12766

J15. Built Environment Stocks in the Context of a Master Planned City: A Case Study of Chandigarh, India. *Journal of Industrial Ecology*, (Accepted), with W. Mihkelson, S. Hincks, & D. Densley Tingley. doi:10.1111/jiec.13466

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

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. Àlvarez, & 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)

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)

Productivity Insights Network Early Career Seed Funding November 2019
£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*

Doctoral Supervision

The University of Sheffield

P6. Ben Johnstone Bray (FT), Primary Supervisor. 2023 – Present
Extreme Climate Change Compatible Residential Energy Retrofit

P5. Ioana Jelea (FT), Second Supervisor. 2023 – Present
Primary Supervisor: Giuliano Punzo
Complexity and Urban Systems

P4. Marcel Fehr (PT), Primary Supervisor. 2021 – Present
Climate Change and Credit Risk for Mortgage Portfolios

P3. Danielle Abbey (FT), Second Supervisor. 2021 – Present
Primary Supervisor: Danielle Densley Tingley
Energy Retrofit for Non-Residential Buildings

P2. Yulan Sheng (FT), Third Supervisor. 2020 – Present
Primary Supervisor: Martin Mayfield
Deep Learning for Urban Thermal Energy Analysis

P1. Will Mihkelson (FT), Second Supervisor. 2019 – 2023
Primary Supervisor: Danielle Densley Tingley
Understanding the Relationship Between Resource Consumption and Development Levels

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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