

Jethro Browell

(formerly Jethro Dowell)

Curriculum Vitae

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Positions

University of Glasgow, UK

Aug 2021 *Senior Lecturer, School of Mathematics and Statistics*

- Research in mathematical and statistical methodology for probabilistic forecasting and associated decision-making problems
- Principal and Co-Investigator roles on research and knowledge exchange projects, grant writing, managing and developing research staff
- Teaching and supervision at BSc, MSc and PhD level

University of Strathclyde, Glasgow, UK

2020–2021 *Lecturer & Chancellor's Fellow/Senior Lecturer (May 2021)*

Dept. Electronic and Electrical Engineering

2015–2020 *Research Associate/Fellow (2017), Dept. Electronic and Electrical Engineering*

- EPSRC Innovation Fellowship 2018–2021
- Research in mathematical and statistical modelling for energy systems, primarily energy analytics, forecasting and associated decision-making problems
- Founding leader of Energy Forecasting Group
- Principal and Co-Investigator roles on research and knowledge exchange projects, grant writing, managing and developing research staff
- Teaching and supervision at BSc, MSc and PhD level
- EPSRC Doctoral Prize 2015

Education

Degrees

2011–2015 *University of Strathclyde, Glasgow, UK*

PhD: *“Spatio-temporal Prediction of Wind Fields”*

Supervisors: Dr Stephan Weiss and Prof David Infield

Structure: ‘1+3’ EPSRC Centre for Doctoral Training

Three months as a visiting researcher at the Technical University of Denmark

2007–2011 *University of St Andrews, UK.*

MPhys (Hons), 2:1, Mathematics and Theoretical Physics

Master's Research Project: *“Magnetic Fields Containing Two Null Points and a Separator”*

Cedric Thorpe Davie Award for contribution to University musical life

Additional/CPD

- 2021** *Induction Course for New Lecturers in the Mathematical Sciences, IMA*
Two-day training course run by the Institute of Mathematics and its Applications (IMA) and hosted by the Isaac Newton Institute for Mathematical Sciences, Cambridge, 8–9 Sep 2021
- 2019** *Leading Research Programme, University of Strathclyde*
I have completed this three-day course delivered by *My Consultants* developing skills in research management and leadership.
- 2018–2019** *Supervisor Development Programme, University of Strathclyde*
I have completed training courses in research supervision making me eligible to supervise PhD students at the University of Strathclyde.
- 2016–2017** *PGCert: Academic Practice, University of Strathclyde*
I have completed courses in Teaching and Learning, Knowledge Exchange and Researcher Development which comprise a PGCert accredited by the higher education academy. Delivered by the University of Strathclyde’s Organisational and Staff Development Unit.

Publications

Metrics [Google Scholar](#): Citations 722, h-index: 13
[Scopus](#): Citations (excluding self-cite): 418, h-index: 10
[jethrobrowell.com](#): >600 unique visitors per-month

In prep List of working papers and pre-prints is available at www.jethrobrowell.com.

- Journal**
- J. Browell** and M. Fasiolo, “Probabilistic Forecasting of regional net-load with conditional extremes and gridded NWP,” *IEEE Transactions on Smart Grid*, accepted/published online, DOI: [10.1109/TSG.2021.3107159](https://doi.org/10.1109/TSG.2021.3107159)
 - E. Medina-Lopez, D. McMillan, J. Lazic, E. Hart, S. Zen, A. Angeloudis, E. Bannon, **J. Browell**, S. Dorling, R.M. Dorrell, R. Foster, C. Old, G.S. Payne, G. Porter, A.S. Rabaenda, B. Sellar, E. Tapoglou, N. Trifonova, I.H. Woodhouse, and A. Zampollo, “Satellite data for the offshore renewable Energy sector: synergies and innovation opportunities,” *Remote Sensing of Environment*, Vol. 264, 112588, DOI: [10.1016/j.rse.2021.112588](https://doi.org/10.1016/j.rse.2021.112588), 2021
 - H.C. Bloomfield, P.L.M. Gonzalez, J.K. Lundquist, L.P. Laurens, **J. Browell**, R. Dargaville, M. De Felice, K. Gruber, A. Hilbers, A. Kies, M. Panteli, H.E. Thornton, J. Wohland, M. Zeyringer and D.J. Brayshaw, “The importance of weather and climate to energy systems: A workshop on Next Generation Challenges in Energy-Climate Modelling”, *Bulletin of the American Meteorological Society (BAMS)*, 102(1), E159-E167, DOI: [10.1175/BAMS-D-20-0256.1](https://doi.org/10.1175/BAMS-D-20-0256.1), 2021
 - R. Telford, B. Stephen, **J. Browell** and S. Haben, “Dirichlet Sampled Capacity and Loss Estimation for LV Distribution Networks with Partial Observability,” *IEEE Transaction on Power Delivery*, vol. 36, no. 5, pp. 2676–2686, DOI: [10.1109/TPWRD.2020.3025125](https://doi.org/10.1109/TPWRD.2020.3025125), 2021
 - C. Gilbert, **J. Browell** and D. McMillan, “Probabilistic Access Forecasting for Improved Offshore Operations,” *International Journal of Forecasting*, vol. 37, no. 1, pp. 134–150, DOI: [10.1016/j.ijforecast.2020.03.007](https://doi.org/10.1016/j.ijforecast.2020.03.007), 2021
 - R. Tawn, **J. Browell**, and I.A. Dinwoodie, “Missing Data in Wind Farm Time Series: Properties and Effect on Forecasts,” *Electric Power Systems Research (PSCC 2020 Special Issue)*, vol. 189, December 2020, 106640, DOI: [10.1016/j.epsr.2020.106640](https://doi.org/10.1016/j.epsr.2020.106640), 2020.
 - J.W. Messner, P. Pinson, **J. Browell**, M.B. Bjerregard and I. Schicker “Evaluation of Wind Power Forecasts — An up-to-date view,” *Wind Energy*, 23:1461–1481, DOI: [10.1002/we.2497](https://doi.org/10.1002/we.2497), 2020.
 - M. Nedd, **J. Browell**, K. Bell and C. Booth, “Containing Loss Risk in a Low Inertia GB Power System,” *IEEE Transactions on Industry Applications*, vol. 6, no. 2, 1031–1039, DOI: [10.1109/TIA.2019.2959996](https://doi.org/10.1109/TIA.2019.2959996), 2020.
 - C. Sweeney, R.J. Bessa, **J. Browell**, P. Pinson, “The Future of Forecasting for Renewable Energy,” *WIREs Energy and Environment*, vol. 9, no. 2, DOI: [10.1002/wene.365](https://doi.org/10.1002/wene.365), 2020.
 - C. Gilbert, **J. Browell** and D. McMillan, “Leveraging Turbine-level Data for Improved Probabilistic Wind Power Forecasting,” *IEEE Transactions on Sustainable Energy*, vol. 11, no. 3, pp. 1152–1160, DOI: [10.1109/TSTE.2019.2920085](https://doi.org/10.1109/TSTE.2019.2920085), 2020.

11. C. Edmunds, S.M. Martinez, **J. Browell**, E. Gómez-Lázaro, S. Galloway, “The evolution of wind power participation in reserve and response markets in Great Britain and Spain,” *Renewable and Sustainable Energy Reviews*, vol. 115, DOI: [10.1016/j.rser.2019.109360](https://doi.org/10.1016/j.rser.2019.109360), 2019.
 12. **J. Browell**, D. R. Drew and K. Philippopoulos, “Improved Very-short-term Spatio-temporal Wind Forecasting using Atmospheric Regimes,” *Wind Energy*, 21(11), 968–979, DOI: [10.1002/we.2207](https://doi.org/10.1002/we.2207), 2018.
 13. **J. Browell**, “Risk Constrained Trading Strategies for Stochastic Generation with a Single-Price Balancing Market,” *Energies*, 11(6):1345, DOI: [10.3390/en11061345](https://doi.org/10.3390/en11061345), 2018.
 14. R. J. Bessa, C. Möhrle, V. Fundel, M. Siefert, **J. Browell**, S. H. El Gaidi, B-M. S. Hodge, U. Cali, “Towards Improved Understanding of the Applicability of Uncertainty Forecasts in Wind Energy,” *Energies*, 10(9):1402, DOI: [10.3390/en10091402](https://doi.org/10.3390/en10091402), 2017.
 15. A. Malvaldi, S. Weiss, D. Infield, **J. Browell**, P. Leahy, A. Foley, “A spatial and temporal correlation analysis of aggregate wind power in an ideally interconnected Europe,” *Wind Energy*, 20(8), 1315–1329, DOI: [10.1002/we.2095](https://doi.org/10.1002/we.2095), 2017.
 16. L. Cavalcante, R. J. Bessa, M. Reis and **J. Browell**, “Sparse Structures for Very Short-term Wind Power Forecasting,” *Wind Energy*, 20(4), 657–675, DOI: [10.1002/we.2029](https://doi.org/10.1002/we.2029), 2017.
 17. **J. Dowell**, P. Pinson, “Very-short-term Probabilistic Wind Power Forecasts by Sparse Vector Autoregression,” *IEEE Transactions on Smart Grid*, 7(2), pp. 763–770, DOI: [10.1109/TSG.2015.2424078](https://doi.org/10.1109/TSG.2015.2424078), 2016.
 18. V. M. Catterson, D. McMillan, I. Dinwoodie, M. Revie, **J. Dowell**, J. Quigley, K. Wilson, “An economic impact metric for evaluating wave height forecasters for offshore wind maintenance access,” *Wind Energy*, 19(2), pp. 199–212, DOI: [10.1002/we.1826](https://doi.org/10.1002/we.1826), 2015.
 19. **J. Dowell**, S. Weiss, D. Hill, D. Infield, “Short-Term Spatio-Temporal Prediction of Wind Speed and Direction,” *Wind Energy*, 17(12), pp. 1945–1955, DOI: [10.1002/we.1682](https://doi.org/10.1002/we.1682), 2014.
- In Book**
1. R. Bessa, **J. Dowell**, P. Pinson, “Renewable Energy Forecasting,” in *Smart Grid Handbook*, edited by C-C. Liu, S. McArthur and S-J. Lee, Chichester, UK: John Wiley & Sons Ltd, ISBN: [978-1-118-75548-8](https://doi.org/10.1002/9781118755488), 1900 pages, Chapter: 639–659, 2016.
- Other**
1. International Energy Agency — Wind: “Recommended Practices for the Implementation of Wind Power Forecasting Solutions,” Eds: C. Möhrle, J. Zack, J.W. Messner and **J. Browell**, 2019.
- Conference**
1. **J. Browell***, C. Gilbert, R. Tawn, L. May, “Quantile combination for the EEM Wind Power Forecasting Competition”, invited paper, European Energy Market Conference, DOI: [10.1109/EEM49802.2020.9221942](https://doi.org/10.1109/EEM49802.2020.9221942), 2020. **Invited Paper**
 2. **J. Browell*** and C. Gilbert, “ProbCast: Open-source Production, Evaluation and Visualisation of Probabilistic Forecasts,” Probabilistic Methods Applied to Power Systems Conference, DOI: [10.1109/PMAPS47429.2020.9183441](https://doi.org/10.1109/PMAPS47429.2020.9183441), 2020.
 3. C. Gilbert*, **J. Browell**, D. McMillan, “A Data-Driven Vessel Motion Model for Offshore Wind Access Forecasting,” IEEE Oceans, Marseille, France, DOI: [10.1109/OCEANSE.2019.8867176](https://doi.org/10.1109/OCEANSE.2019.8867176), 2019.
 4. C. Gilbert*, **J. Browell**, D. McMillan, “Visualisation of Probabilistic Access Forecasts for Offshore Operations,” WindEurope, Bilabo, Spain, DOI: [10.1088/1742-6596/1222/1/012040](https://doi.org/10.1088/1742-6596/1222/1/012040), 2019.
 5. C. Möhrle*, J. Lerner, J.W. Messner, **J. Browell**, A. Tuohy, J. Zack, C. Collier, G. Giebel, “IEA Wind Recommended Practices for the Implementation of Wind Power Forecasting Solutions Part 2 and 3: Designing and executing forecasting benchmarks and evaluation of forecast solutions,” Wind Integration Workshop, Stockholm, Sweden, 2018.
 6. C. Gilbert*, **J. Browell** and D. McMillan, “A Hierarchical Approach to Probabilistic Wind Power Forecasting,” Probabilistic Methods Applied to Power Systems (PMAPS), Boise, Idaho, DOI: [10.1109/PMAPS.2018.8440571](https://doi.org/10.1109/PMAPS.2018.8440571), 2018.
 7. **J. Browell** and C. Gilbert*, “Cluster-based Regime-switching AR for the EEM Wind Power Forecasting Competition,” 14th International Conference on the European Energy Market (EEM), Dresden, Germany, [post-print available online](#), 2017. **Invited Paper**
 8. **J. Browell***, C. Gilbert and D. McMillan, “Use of Turbine-level Data for Improved Wind Power Forecasting”, IEEE PowerTech, Manchester, UK, [post-print available online](#), 2017.
 9. **J. Dowell***, I. Dinwoodie and D. McMillan, “Forecasting for Offshore Maintenance Scheduling under Uncertainty”, European Safety and Reliability Conference, Glasgow, UK, DOI: [10.1201/9781315374987-171](https://doi.org/10.1201/9781315374987-171) 2016.

10. **J. Dowell***, G. Hawker, K. Bell and S. Gill, "Review of Probabilistic Methods of Defining Reserve Requirements," IEEE PES General Meeting, Boston, MA, DOI: [10.1109/PESGM.2016.7741361](https://doi.org/10.1109/PESGM.2016.7741361), 2016.
11. A. Malvaldi*, **J. Dowell**, S. Weiss, D. Infield, "Short-Term Forecasting of Wind Speed and Direction Exploiting Data Non-Stationarity," International Work-Conference on Time Series, Granada, Spain, 2015
12. **J. Dowell***, S. Weiss, D. Infield, "Kernel Methods for Short-term Spatio-temporal Wind Prediction," IEEE PES General Meeting, Denver, CO, DOI: [10.1109/PESGM.2015.7285965](https://doi.org/10.1109/PESGM.2015.7285965), 2015.
13. **J. Dowell***, S. Weiss, D. Infield, "Spatio-Temporal Prediction of Wind Speed and Direction by Continuous Directional Regime," Probabilistic Methods Applied to Power Systems, Durham, UK, DOI: [10.1109/PMAPS.2014.6960596](https://doi.org/10.1109/PMAPS.2014.6960596), 2014. **Outstanding Student Paper Award**
14. **J. Dowell***, S. Weiss, D. Infield, S. Chandna, "A Widely Linear Multichannel Wiener Filter for Wind Prediction," IEEE Statistical Signal Processing Workshop, Gold Coast, Australia, DOI: [10.1109/SSP.2014.6884567](https://doi.org/10.1109/SSP.2014.6884567), 2014.
15. A. Malvaldi*, **J. Dowell**, S. Weiss, D. Infield, D. Hill, "Wind Prediction Enhancement by Supplementing Measurements with Numerical Weather Prediction Now-Casts," EAWE 10th PhD Seminar on Wind Energy in Europe, 2014.
16. **J. Dowell***, S. Weiss, "Short-Term Prediction Using an Ensemble of Particle Swarm Optimised FIR Filters," IET Conference on Intelligent Signal Processing, London, 2013.
17. **J. Dowell***, A. Zitrou, L. Walls, T. Bedford, D. Infield, "Analysis of Wind and Wave Data to Assess Maintenance Access to Offshore Wind Farms," European Safety and Reliability Association Conference, Amsterdam, ISBN: [9781138001237](https://doi.org/9781138001237), 2013.
18. H. Macdonald*, **J. Dowell**, S. Weiss, D. Infield, D. Hill, "Wind Prediction Enhancement by Environmental Parameters," Proceedings of the 9th PhD Seminar on Wind Energy in Europe, EAWE, 2013.
19. **J. Dowell***, S. Weiss, D. Hill, D. Infield, "A Cyclo-stationary Complex Multichannel Wiener Filter for the Prediction of Wind Speed and Direction," European Signal and Image Processing Conference, Marrakech, E-ISSN: [2076-1465](https://doi.org/2076-1465) 2013.
20. **J. Dowell***, S. Weiss, D. Hill, D. Infield, "Improved Spatial Modelling of Wind Fields," European Wind Energy Association Annual Conference, Vienna, 2013.

* denotes presenting author

Editorial

Member of the Editorial Board: Sustainable Energy, Grids and Networks (2020–present)

Editorial duties for this leading journal responsible for reviewing submissions related to energy forecasting.

Member of the Editorial Board: Renewable and Sustainable Energy Reviews (2019–present)

Editorial duties for this leading journal (top decile, impact factor 10.6) responsible for reviewing wind energy and forecasting related submissions.

Guest Editor: Renewable and Sustainable Energy Reviews (2018–2019)

Guest editor of a special issue of RSER in marine and ocean energy dedicated to the work and memory of Professor Ian Bryden.

Reviews

Regular reviews for:

IEEE Trans. Power Systems, IEEE Trans. Smart Grid, IEEE Trans. Sustainable Energy, IEEE Trans. Industrial Informatics, IEEE Access, International Journal of Forecasting, Renewable & Sustainable Energy Reviews, Meteorological Applications (RMetS), IEEE Power Engineering Letters, Wind Energy, Technological Forecasting and Social Change, Power Systems Computation Conference, Energies (MPDI), European Safety and Reliability Conference, IET Renewable Power Generation, WindEurope Conferences.

Funding and Awards

Current active projects have combined value of £1.6m, approximately half as PI and half as Co-I, and support myself (personal fellowship) and three research associates. I have two project proposals currently under review with the EPSRC with a combined value of £1.9m.

NB: Projects labelled TIC-* refer to those funded by the University of Strathclyde's Technology and Innovation Centre's industry funded Low Carbon Power and Energy Programme.

- Funding** TIC-LCPE (PI, 2020-2021, 12 month, £111k), *“Modelling Wind Power for Probabilistic Transmission System Planning”*
Development of improved methodologies and high-quality dataset for modelling wind power climatologies. For use in probabilistic planning studies by Scottish Transmission and Distribution Network Owners.
-
- TIC-LCPE (Data-02) and EPSRC Supergen Energy Networks Flexfund (PI, 2019-2020, 13 month, £125k), *“Energy Forecasting for Market-led Multi-vector Networks (EnFORMM)”*
Development of forecasting methodology for intraday electricity and gas price forecasting. Partners include SSE, ScottishPower, University of Duisburg-Essen and the Energy Systems Catalyst. Project co-funded by the TIC Low Carbon Power and Energy programme and the EPSRC Supergen Energy Networks Hub.
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- TIC-Networks-06 (Co-I, 2019-2020, 9 month, £150k), *“Operating a Zero Carbon GB Power System in 2025: Frequency and Fault Current”*
Analysis of NGENSO’s target of being able to operating the GB power system with zero carbon generation only by 2025 focusing on frequency response and fault current, and the potential role of SSE and SPR’s generation portfolios.
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- EPSRC Responsive Mode (Co-I, 2019-2021, 24 months, £700k), *“Analytical Middleware for Informed Distribution Networks (AMIDiNe)”*
I lead a work package of this project focused on LV demand forecasting and analytics. AMIDiNe is lead by Strathclyde and in partnership with the University of Oxford, University College London, Drax Power, SSE Networks, Bellrock Technology and CountingLab.
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- TIC-Wind-09 (Co-I, 2019, 1 month, £16k), *“Met-ocean Access Sensor Location Study”*
A study of options for locating sensors within offshore wind farms to measure wave height and other variables to support access decision.
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- TIC-Hydro-04 (PI, 2019, 8 months, £80k), *“Sub-seasonal-to-seasonal Hydro Resource Forecasting”*
I developed and lead this project, supported by a Co-I team in the Dept. of Civil and Environmental Engineering and an RA, which will evaluate and advance forecasting methodologies for extended-range hydro power stations in Scotland utilising state-of-the-art S2S weather forecasts and statistical post-processing techniques.
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- OpenLV IAA (Co-I, 2019, 6 months, £12k), *“OpenLV: Low Voltage Demand Forecasting and Phase Balancing”*
Working with the Network Innovation Competition project *OpenLV* I am part of a team developing software for substation control systems to perform low voltage load forecasting and phase balancing using flexible resources. Funded by the University of Strathclyde’s EPSRC Impact Accelerator Account (IAA)
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- EPSRC-UKRI Innovation Fellowship (PI & Fellow, 2018–2021, £310k), *“System-wide Probabilistic Energy Forecasting.”*
Bold and ambitious project to develop methods for national-scale probabilistic energy forecasting capturing spatial and temporal covariance between large-scale and embedded renewable energy resources and electricity demand, and dependency on large-scale meteorological phenomena.
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- EPSRC Supergen Wind Flexible Funding Special Projects Call (Co-I, 2018, £30k), *“Automated Video Analysis for Accurate Wave Height Measurements in Offshore Wind Farms.”*
Development of automate video processing to derive wave height and other oceanographic variables from CCTV at offshore wind farms for improved access assessment and forecasting.
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TIC-Hydro-01 (PI, 2017–2018, 6 months, £40k), *“Short to Medium Term Hydro Resource Forecasting”*

I developed and now lead this project, supported by a Co-I team in the Dept. of Civil and Environmental Engineering and an RA, which will 1) evaluate and advance forecasting methodologies for hydro power stations operated by ScottishPower and SSE in Scotland, and 2) perform a high-level economic assessment of improved hydro resource forecasts. This is a ‘proof of concept’ project.

Energy Technology Partnership (PI, 2017–2018, 5 months, £20k), *“Dynamic Load Grid Modelling”*

I led this knowledge exchange project to bring state-of-the-art electricity load forecasting closer to commercialisation working with SME software vendor Datalytics Technologies.

The DataLab Industrial PhD Studentship, with Natural Power (PI, 2017–2021, £60k), *“Predictive Analytics for Short-term Wind and Solar Power Forecasting”*

PhD with major wind farm operator Natural Power to develop and operationalise statistical methods for very short-term wind and solar power forecasting.

Knowledge Transfer Partnership, Romax Insight (Co-I, 2017–2019, £240k), *“Advanced wind turbine prognostics using machine learning”*

This KTP will transfer advanced analytical techniques developed at Strathclyde into Romax Insight’s leading commercial prognostic software.

TIC-Wind-03B (Co-I & Researcher, 2017–2018, £145k), *“Commercial Frequency Response from Wind.”*

Following a survey exercise (TIC-Wind-03), I scoped a this project to undertake research into near future commercial opportunities for wind to provide frequency services in GB. The scope included demand for different types of frequency response in for a range of future generation mix scenarios and market arrangements, the technical capability of wind turbines to deliver frequency services, and the impact of them doing so on asset health. As Co-I I managed one Research Assistant in addition to my own time as Researcher-Co-I, and secured additional funding to expand the project when the need to do so was identified.

TIC-Wind-03, (Co-I & Researcher, 2016, £20k), *“Ancillary Services from Wind: Initial Survey of possible Technical and Economic Opportunities.”*

Following identification of ancillary services from wind as an area of interest by industrial partners I produced the scope for this survey project and managed its development with feedback from academics (PI and Co-Is) and industry partners. I delivered the project to positive feed-back which led to a larger follow-on project TIC-Wind-03B

EPSRC Doctoral Prize, (Prize Winner & Researcher, 2015–2017, £100k), *“Optimal Operation of Wind Power Plant Informed by Probabilistic Forecasts.”*

I developed a one-year plan for independent research into applications of probabilistic forecasting, specifically participation in the GB electricity market and vessel dispatch for offshore maintenance. The award was made following an internal (to Strathclyde) review process and interview. This project was supported by two industrial partners, RES and SSE, who provided data and time in-kind. To date, I have produced two journal papers as first author, one as co-author, and four conference papers as part of this project, and geared this funding with 4 CDT summer projects and one PhD student.

Awards *Second Place: EEM Wind Power Forecasting Competition 2020*

Wind power forecasting competition run by an international conference, in a team with Ciaran Gilbert, Rosemary Twan and Leo May.

Runner-up: Fuellers Future Energy Conference Research Presentation Competition 2019

As a team with James Carroll, I was runner-up in this presentation competition collecting a cash prize and networking support with venture capital and angel investors.

Runner-up: Offshore Renewable Energy Catapult Hackathon 2019

As a team with Ciaran Gilbert, Leo May and Adam Stock, I was runner-up in this hackathon, the aim of which was to develop algorithms for producing accurate ‘power available signals’ for wind farms. The event was run by OREC and sponsored by Scottish Power Renewables and National Grid ESO.

Winner of the EEM 2017 Wind Power Forecasting Competition

As a team with Ciaran Gilbert, I won this forecasting competition beating international teams from both academia in industry. Our method, based on regime-switching autoregression, was presented at the EEM conference and in an invited paper. This success was reported in national press and has boosted my profile within the energy forecasting community.

Glasgow Research Partnership in Engineering (PI, 2017, £4k): “Probabilistic Solar Power Forecasting.”

I secured funding for a 6 week postdoctoral researcher exchange to the National Renewable Energy Laboratory, Golden, CO, to collaborate with Bri-Mathias Hodage on aspects of IEA Wind Task 36 and to develop novel techniques for solar power forecasting, May–June 2017.

International Institute of Forecasters Travel Award Grant (2016, US\$1k)

Support to attend International Symposium on Forecasting and present a paper on forecasting for participation in electricity markets.

Glasgow Research Partnership in Engineering, (PI, 2016, £2k), “Production and Use of Probabilistic Wind Power Forecasts.”

I won funding post doctoral exchanges to visit international collaborators Ricardo Bessa (INESC-Tech, Porto), and Pierre Pinson (DTU, Copenhagen) to undertake research into to production and use of wind power forecasts. With Ricardo Bessa, I studied scenario forecasting and co-authored a paper on very-short-term forecasting with him and his colleagues. With Pierre Pinson, I studied game theoretic aspects of single-price balancing markets along with Athanasios Papakonstantinou, we are currently writing a paper on this subject together.

Finalist: Scottish Renewables Young Professionals Green Energy Awards, Academic Category, 2015.

I was nominated by my peers for an award administered by the Scottish Renewables, the renewables trade body in Scotland.

Outstanding student paper award, PMAPS Conference, 2014.

For a paper titled “Spatio-temporal prediction of wind speed and direction by continuous directional regime.”

COST Action ES1002 WIRE: Scientific Mission, Visit to DTU/Prof Pierre Pinson (PI, 2013, £2k), “Spatio-temporal Aspects of Probabilistic Wind Power Forecasting.”

I was awarded funding for a 3 month PhD exchange visit Pierre Pinson (DTU, Copenhagen) to undertake research into to production of probabilistic wind power forecasts. During this trip I developed a sparse VAR method for very-short-term wind power forecasting which was the first work addressing large-scale challenges in wind power forecasting to be published internationally.

Research Supervision and Management

I presently lead the seven-person Energy Forecasting Group including line-management of three research associates and supervision of two PhD students. These roles include supporting professional development, performance reviews, financial management and other forms of support.

- PDRA** Ciaran Gilbert (2020–2021), Electricity demand forecasting
 Thomas Alexander (2020–2021), Electricity price forecasting
 Robert Graham (2020–2021), Meteorology, S2S hydropower forecasting
 Susan Brush (2020, 3 months), GB ancillary services
 Fulin Fan (2018, 5 months), Hydropower forecasting
 David Murray (2017–2018, 5 months), Electricity demand forecasting
 Euan MacMahon (2017–2018, 4 months), Ancillary services
 Marcel Nedd (2017–2018, 9 months), Ancillary services
 David Hamilton, (2017, 2 months), Consultancy
- PhD** Leo May (First Supervisor, 2018–...), *“Forecasting and Analytics for Offering Frequency Response from Wind,”* Wind & Marine Energy CDT
 Rosemary Tawn (First Supervisor, 2018–...), *“Predictive Analytics for Short-term Wind and Solar Power Forecasting,”* industry sponsored PhD with Natural Power and The DataLab
 Ciaran Gilbert (First supervisor, 2016–2020), *“Topics in High Dimensional Energy Forecasting,”* Wind & Marine Energy CDT
 Joanna Sobon (Second Supervisor, 2019–...), *“Operation of Energy Storage in Micro-grids”*
 Alice Malvaldi (Mentor, 2014–...), *“Spatio-Temporal Prediction of Wind Based on Wind Velocity and Related Parameters,”* Wind Energy Systems CDT
- MSc** Kevin Kawal (2020), *“Change point detection for modelling and predicting electricity demand”*
 Krishnadas Valsan (2020), *“Multi-region Solar Power Forecasting”*
 Pablo Benavides López (Visiting Strathclyde from Technical University of Denmark, 2018), *“Probabilistic Electricity Price Forecasting”*
- MRes** Leo May (Wind & Marine CDT, 2018), *“Very short-term power forecasting at Horns Rev 1”* with Vattenfall
 Ahmed El-Bozie (Wind & Marine CDT, 2017), *“Probabilistic Forecasting of Maximum Wave Height”*
 Patrick McGuckin (Future Power Networks CDT, 2017), *“Solar Power Forecasting and Operation of Combined Solar and Battery,”* with British Solar Renewables
 Sofia Koukoura (Wind & Marine CDT, 2016), *“Hierarchical Wind Power Forecasting”*
 Ciaran Gilbert (Wind & Marine CDT, 2016), *“Price Forecasting for Participation in Electricity Markets,”* with RES Ltd
 Owain Roberts (Wind & Marine CDT, 2015), *“Evaluation of the benefits for a utility to improve wind power forecast skill for market participation,”* with EDF Energy
 Alice Malvaldi (Wind Energy Systems CDT, 2014), *“Wind Prediction Enhancement by Supplementing Measurements with Numerical Weather Prediction Now-Casts”*
 Hamish Macdonald (Wind Energy Systems CDT, 2013), *“Wind Prediction Enhancement by Environmental Parameters”*
- Viva** *PhD Examination (External Examiner)*
 Carla Gonçalves, University of Porto: *“Renewable Energy Forecasting: Extreme Quantiles, Data Privacy and Monetization”*
PhD Examination (Convenor)
 Haijie Qi, University of Strathclyde, 2020: *“Optimal operation and sizing of a combined heat and power system integrated with demand side response in a smart energy hub”*
PhD Examination (External Examiner)
 M Groch, Stellenbosch University, 2019: *“Modelling and Short-Term Forecasting of High Wind Speed Events at Operational Wind Farms”*

Presentations, Seminars and Conferences

(Not associated with conference publications.)

- Invited**
- “*Data and Renewable Energy*” (panelist), DataTech: #OurPlanet, The DataLab, October, 2021
 - “*Probabilistic forecasting of regional net-load with conditional extremes*,” Extreme Value Analysis, Edinburgh, 2021
 - “*Energy Forecasting for Market-led Multi-vector Energy Networks*,” EPSRC Supergen Energy Networks Hub Webinar, 2020
 - “*Challenges and best practice in energy forecast evaluation*,” Data Science in the electricity industry: Royal Statistical Society Avon Local Group, 2020
 - “*System-wide Probabilistic Energy Forecasting*,” Control and Power Group Seminar, Imperial College London, 2020
 - “*System-wide Probabilistic Energy Forecasting*,” Research Seminar, National Grid ESO, 2020
 - “*Leveraging turbine-level data for improved wind power forecast performance*,” Quarterly Forecasters Forum, Alliance Manchester Business School, University of Manchester, 2020
 - “*Spatio-temporal Aspects of Probabilistic Wind Power Forecasting*,” IEEE Power & Energy Society General Meeting, Special Panel Session, Atlanta, GA, USA, 2019
 - “*Improved very short-term spatio-temporal wind forecasting using atmospheric regimes*,” International Conference on Energy Meteorology, Copenhagen, Denmark, 2019
 - “*IEA Wind Recommended Practices for Selecting Renewable Power Forecasting Solutions Part 3: Evaluation of Forecasts and Forecast Solutions*,” (poster), International Conference on Energy Meteorology, Copenhagen, Denmark, 2019.
 - “*Session Chair and presenter: Energy Forecasting*,” International Symposium on Forecasting, Thessaloniki, Greece, 2019.
 - “*Aspects of High Dimensional Energy Modelling and Forecasting*,” Isaac Newton Institute Programme: Mathematics of Energy Systems, Cambridge, UK, 2019
 - “*Energy Forecasting — Perspective from Europe and Academia*,” IEEE Power & Energy Society General Meeting, Special Panel Session, Portland, OR, USA, 2018
 - “*Temporal Structure in Short-term Solar Power Forecasting*,” University of Lancaster, Lancaster, UK, 2018.
 - “*Regime-switching Spatio-temporal Wind Forecasting using Atmospheric Modes*,” University of Oxford Mathematical Institute, Oxford, UK, 2017
 - “*Improved Very-short-term Wind Forecasting using Atmospheric Classification*,” National Oceanic and Atmospheric Administration, Boulder, CO, USA, 2017
 - “*Probabilistic Energy Forecasting and Applications*,” National Centre for Atmospheric Research, Boulder, CO, USA, 2017
 - “*Probabilistic Energy Forecasting and Applications*,” National Renewable Energy Laboratory, Golden, CO, USA, 2017
 - “*Short-term Wind Power Forecasting*,” National Grid Electricity Transmission, Wokingham, UK, 2017
 - “*Strategic Participation of Stochastic Generators in Single-price Balancing Markets*,” Electricity Markets and Analytics Group, Technical University of Denmark, Copenhagen, Denmark, 2016
 - “*An Introduction to Wind Power Forecasting*,” European Academy of Wind Energy, 10th PhD Seminar on Wind Energy in Europe, Orléans, France, 2014
 - “*Short-term probabilistic Wind Power Forecasting*,” European Energy Research Alliance, Smart Grid Joint Programme, Glasgow, 2014
- Pres.**
- “*Developing a Sub-seasonal Forecasting System for Hydropower Reservoirs in Scotland*,” delivered by Robert Graham, co-authored with Douglas Bertram, and Christopher J. White, EGU, DOI: [10.5194/egusphere-egu21-7252](https://doi.org/10.5194/egusphere-egu21-7252), 2021
 - “*Day-ahead Forecasting of Instantaneous Power at Wind Farms*,” 41st International Symposium on Forecasting, 2021
 - “*Dependency Structures in Regional Net-Electricity Demand Forecasting*,” 40th International Symposium on Forecasting, 2020
 - “*Atmospheric Regimes for Improved Very Short-term Wind Power Forecasting*,” International Conference on Energy Meteorology, Copenhagen, Denmark, 2019

- “*Probabilistic Energy Forecasting and Applications*,” Royal Statistical Society Conference, Glasgow, UK, September, 2017
- “*Short-term O&M Risk Management when using Cranes*,” Wind Energy Science Conference, Copenhagen, Denmark, 26–29 June, 2017
- “*Large-scale Very-short-term Spatio-temporal Forecasting by Sparse Vector Autoregression*,” EWEA Wind Power Forecasting Technology Workshop, Leuven, Belgium, 1-2 October, 2015
- “*Large-scale Very-short-term Spatio-temporal Forecasting by Sparse Vector Autoregression*,” Wind Engineering Society Research Day, Reading, UK, 2015
- “*Spatio-temporal Wind Forecasting*,” (poster), Durham Risk Day, Durham, UK, 2014

Other Research Activity

- 2020** *Heilbronn Visitor in Data Science, University of Bristol, UK.*
- One month as visiting researcher working on generalised additive models and applications in energy forecasting.
 - Hosted by the Statistical Science group at the University of Bristol.
- 2019** *Visiting Fellow, Isaac Newton Institute for Mathematical Sciences, Cambridge, UK.*
- Programme Title: “*Mathematics of Energy Systems*”
 - I was a visiting fellow for 4 weeks of this prestigious research programme.
 - Outputs I am involved with include plans a journal article (in development) and the creation of an energy-related data science competition platform ‘*Rangl*’ to be launched in 2020.
- 2017** *Visiting Researcher, National Renewable Energy Laboratory, USA.*
- Project Title: “*Probabilistic Solar Power Forecasting*.”
 - I secured a £4k travel grant from the Glasgow Research Partnership in Engineering to visit NREL for 2 months to work with Bri-Mathias Hodge on solar power forecasting and contribute to IEA Wind Task 36.

Teaching

- 2021–** *Lecturer, “Time Series” (STATS4037)*
- A 10 credit introductory course on time series covering theory (AR to ARIMA), modelling strategies, and application in R.
- 2021–** *Work Placement Coordinator*
- I coordinate work placements for the degree program “MSci in Statistics with Work Placement,” in which students spend their 4th of 5 years employed in a statistical role at an external organisation.
- 2021–** *Honours Projects in Statistics; BSc, MSci & MSc*
- Supervision and assessment of undergraduate students’ 4th/5th year and MSc group projects. Project I offer typically involve working with large real-world datasets from the energy sector and require students solve industry-relevant problems.
- 2016–2020** *“Wind Waves and Tides in ORE”, Centre for Doctoral Training Core Module*
- I deliver and assess a 10-hour lecture course on wind power forecasting to CDT PhD students, including a practical forecasting exercise of my own design. The course covers aspects of meteorology and statistical methods and comprises 1/3 of a module. Assessment via oral examination.
- 2016–2021** *Tutor, EE107, Electrical Engineering; BSc & MEng*
- I take a weekly small-group tutorial with first-year EEE students and guide them through a range of technical and transferable skills activities.
- 2017–2021** *Electrical Engineering Student Projects; BSc, MEng & MSc*
- Supervision and assessment of undergraduate students’ 4th year and MSc individual projects. Project I offer typically involve working with large real-world datasets from the energy sector and require students solve industry-relevant problems.
- 2018** *EES-UETP: Statistical Learning for Uncertainty Forecasting*

I will give a half-day seminar on statistical learning for probabilistic forecasting as part of a 3-day electric energy systems university enterprise training partnership course aimed at PhD students and postdocs.

2017– *Data Science for Environmental Modelling and Renewables—MOOC*

I am part of a group of academics from the Universities of Glasgow and Strathclyde who have produced a 6 week jassive Open Online Course on data science applications in sustainability in response to a call for such courses from The DataLab (Scottish Innovation Centre). I produced and manage a one-week section on energy forecasting. In it's first year the course ran on [FutureLearn](#) attracted over 1 400 learners.

2016–2017 *Post-graduate Certificate in Academic Practice, accredited by Higher Education Academy*

I have undertaken professional development courses in teaching and learning practices in higher education, including theoretical and practical aspects of teaching, activity design, and course evaluation.

2015–2017 *Guest Lecturer: EE577–977–988; MEng & MSc*

I deliver lectures on wind power forecasting and participation of wind the GB electricity markets to 5th year undergraduates and MSc students.

2012–2017 *Teaching Assistant: EE317, EE577–977–988; BSc, MEng & MSc*

I assist in the delivery of a *GH Bladed* computer lab, contributed to the lab design in 2012 and continue to develop the material. I assist in whole-class tutorials.

2012–2015 *Educational Outreach: Glasgow Schools, Science Centre and Science Festival*

In my role as Public Outreach Coordinator for the Wind CDT, I designed and delivered a range of outreach activities for school visits and installations at the Glasgow Science centre. These including a power system card game and ‘build your own wind turbine.’ I also organised a public debate on the subject of wind energy featuring academics, industry representatives and campaigners as part of the 2014 Glasgow Science Festival.

Knowledge Exchange Activity

Consulting Regular consultancy with UK and European utilities and government departments on forecast improvement, evaluation and participation in GB electricity markets.

TNEI & National Grid ESO (PI, 2020-2021, 12 months, £60k of £400k project), “*Control RE-ACT*”

Demonstration of probabilistic wind and solar power forecasting techniques and economic evaluation of use cases for National Grid ESO, in collaboration with TNEI. Part of the NIA-funded Control REACT project.

ScottishPower Renewables (PI, 2020, 6 month, £20k), “*Performance Analysis of Frequency Response Provision*”

Bespoke analysis to design and apply a performance monitoring procedure for frequency response provision from wind farms.

National Grid ESO (PI, 2019, 4 months, £30k), “*Power Available Signal Accuracy*”

I lead this project to develop a method of assessing the accuracy of power available signals from wind farms and setting a national accuracy standard. This is a key part of developments in the regulatory environment to enable wind farms to participate in ancillary service markets in GB.

Vattenfall (PI, 2018, 3 months, £16k), “*Forecast Improvement*”

Acted as a consultant on an internal forecast improvement project at Vattenfall, a Swedish Utility with over 2.7GW of wind capacity across five countries.

ScottishPower Renewables (PI, 2018, 1 month, £7k), “*Pricing High Frequency Response from Wind*”

Bespoke analysis to support commercial activity in the frequency response market.

ScottishPower Renewables (Co-I, 2018, 6 months, £60k), *“Black Start from Wind”*
I brought together an industrial partner and academic expertise to deliver a study on the possible role wind farms could play in the GB power system’s black start strategy.

ScottishPower Renewables (Co-I & Researcher, 2017, £8k), *“SPR Imbalance Analysis”*
I led this piece of bespoke analysis of ScottishPower Renewables’ portfolio and its exposure to imbalance risk in the GB electricity market, managing one RA.

Partners *National Grid Electricity System Operator*

I am in regular contact with staff at NGESO, including members of the Forecasting Team and control room staff. I have consulted with them on aspects of forecasting methodology, use of forecasts in operational settings, and statistical analysis of energy data in general. NGESO have funded my work directly as a consultant and via the Network Innovation Allowance.

SSE and Scottish Power, Large Utilities, Europe

I regularly interact with the renewables and trading teams at SSE and SP who have supported my research with in-kind data provision and by co-funding research projects. Both organisations plan to deploy forecasting systems I have developed in 2021.

Professional Membership

- IEEE** Senior Member, member of the Power and Energy Society and Working Group on Energy Forecasting and Analytics (Vice-chair 2021–present), session organiser and invited panellist at PES General Meetings.
- RSS** Fellow of the Royal Statistical Society, 2017–present.
- HEA** Fellow of the Higher Education Academy, 2017–present.
- IIF** Member of the International Institute of Forecasters and Secretary of the UK Chapter, 2019–present, and regular organiser of sessions at the ISF conference.
- WEMC** Member of the World Energy Meteorology Council, 2019–present.
- IEA** WP co-lead of International Energy Agency Wind task 36 and active member PVPS task 16
- ONS** Office for National Statistics Accredited Researcher number 34064.

Citizenship

External *Funding reviews*

I am a member of EPSRC Associate Peer Review College (2021–present) and have acted as a reviewer for two international national funding bodies.

Vice-chair, IEEE PES Working Group on Energy Forecasting and Analytics, 2021–present

I am vice-chair of this international working group which coordinates related activity with in PES (journal special issues, standards, conference sessions) and organises external activities including data science competitions.

Secretary, International Institute of Forecasters UK Chapter, 2019–present

I am secretary of this national group which coordinates activities for UK-based researchers and practitioners of forecasting, including organising quarterly seminars.

Events

I periodically organise academic and industry engagement events for organisation including IEA Wind Task 36, the *PowerGlobe* network and the *Quarterly Forecasters Forum*.

IEA Wind: Task 36, 2017–present

I am an active participant in this International Energy Agency task on the production and use of wind power forecasts. In particular, I am an editor of the ‘IEA Recommended Practice’ document on wind power forecasting and contributed to multiple journal articles on wind power forecasting research.

Supergen Energy Networks Hub Markets & Regulation Working Group, 2019–2021

I was a member of this working group contributing to the running of the SEN Hub, which is trying to answer questions such as ‘How markets and regulations should be developed to optimise and coordinate resources across different energy vectors, and deliver decarbonisation and resilience against rapidly changing energy landscapes?’

Event Organisation

I have organised numerous workshops and events including for PowerSwarm, Risk Day (one-day conference) and the Quarterly Forecasters Forum.

Conference Session Organiser/Chair

International Symposium on Forecasting (2016, 2019, 2020), EAWE PhD Seminar (2015).

Internal*Institute Website Committee, 2020–2021*

Wind energy and control group rep responsible for periodic updates to University of Strathclyde Website.

Fellowship Support, 2018–present

Regularly assist prospective fellowship applicants with proposal and interview preparation, supporting my departments aim of securing more individual fellowships.

Public Outreach Coordinator, PETS Committee, 2014–2015

I coordinated a wide range of public outreach events and contributed to the running of the student-led Professional Engineers Training Society.

Member, Futurewind Committee, 2014–2015

I contributed to the organisation and running of the Futurewind conference with a responsibility for managing event registration and communication with attendees, and chairing sessions during the event.