Nicole Ludwig

nicole.ludwig@uni-tuebingen.de

nnludwig https://mlsustainableenergy.com/

Research Experience

07/2022 – current	**Independent Research Group Leader**, Machine Learning in Sustainable Energy System, Cluster of Excellence - Machine Learning for Science, University of Tübingen, Germany *Faculty Member:* International Max Planck Research School for Intelligent Systems
11/2020 – 07/2022	**Early Career Research Group Leader**, Cluster of Excellence - Machine Learning for Science, University of Tübingen, Germany
07/2020 – 10/2020	**PostDoc**, HelmholtzAI, Institute for Automation and Applied Informatics, Karlsruhe Institute of Technology, Germany
06/2019 – 06/2020	**Research Assistant**, Institute for Automation and Applied Informatics, Karlsruhe Institute of Technology, Germany
02/2019 – 05/2019	**Visiting Researcher**, Mathematical Institute, University of Oxford, UK
06/2016 – 05/2019	**Research Assistant**, DFG Research Training Group 2153: Energy Status Data, Karlsruhe Institute of Technology, Germany
11/2012 – 05/2016	**Student Research and Teaching Assistant**, Chair for Information Systems Research, Department of Applied Econometrics & Institute of Economic Theory and Public Finances, University of Freiburg, Germany

Education

12/2016 – 06/2020	**PhD in Computer Science**, Karlsruhe Institute of Technology, Germany, graduated as Dr.rer.nat. with summa cum laude, Title: *Data-Driven Methods for Demand-Side Flexibility in Energy Systems*, Advisor: Veit Hagenmeyer
09/2014 – 08/2016	**MSc in Information Systems and Network Economics**, University of Freiburg, Germany, graduated with honours, Thesis Title: *Machine Learning for Unstructured Data*, Advisor: Dirk Neumann
08/2015 – 12/2015	**Erasmus Exchange Student**, Faculty of Mathematics and Natural Sciences (MSc Robotics and Intelligent Systems) and Faculty of Social Sciences (MSc Economic Theory and Econometrics), University of Oslo, Norway
04/2012 – 08/2014	**BSc in Economics**, University of Freiburg, Germany, Thesis Title: *Predictive Analytics for Electricity Prices using Weather Data*, Advisor: Dirk Neumann
09/2011 – 03/2012	**BA English and American Studies**, with minor Economics, University of Freiburg, Germany

Awards, Talks and Grants

Prizes and Awards

- Fellowship “Young ZiF Bielefeld”, 2021–2025
- KIT Doctoral Award 2019/2020
- Best Paper Award at the Energy Informatics Conference, 2017
- Audience Choice Award: Best Paper at the ACM e-Energy 2018
- DFG Research Training Group Best Paper Award 2018 and 2019.

Invited Talks

- ETH AI Center, Sustainability Seminar Series, 2022
- Keynote Workshop ”Künstliche Intelligenz in der Umweltinformatik”, (online), 2021
- KIT Department of Informatics Symposium, Karlsruhe (online), 2021
- Cluster Colloquium ”Machine Learning”, Tübingen (online), 2021
- Symposium ”Machine Learning in Science”, Tübingen (online), 2020
- Use Case Speaker Topic Energy, Helmholtz AI, Munich, 2020

Outreach & Science Communication

- Jury Member (Fachjury), IdeenLauf BMBF, 2022
- Silbersalz Science and Media Festival, AI Media Lab, 2021
- Panellist Helmholtz HIDA Event “Career Paths of Women in Data Science”
- SDW Data Science Workshop, Karlsruhe, 2019

Grants

- German Federal Ministry of Education and Research (BMBF) AI Research Group (PI), ca. 750,000€, 2022–2025
- Athene Grant of the University of Tübingen (PI), 5,000€/p.a, 2022–2023
- REACT-EU (Co-PI) “Tübingen Machine Learning Cloud 2.0”, hardware funding, 2 Mio €, 2021
- Innovation Fund Network Project (Co-PI), “Modelling and understanding spatiotemporal interactions (MUSTEIN)”, 2021–2024

Academic Services

Program Chair or Co-Organizer

- Workshop on Energy Data and Analytics at ACM e-Energy Conference, 2022
- Summer School on Communication Technology and Data Analytics for Future Energy Systems, 2017

Program Commitee Member

- The 11th DACH+ Conference on Energy Informatics, 2022
- ECML-PKDD, 2022

Memberships

- International Energy Agency (IEA) Wind: Task 51, 2021–present
- DKN Working Group ”Sustainable AI”, 2022–2024

(Meta-) Reviewer

Climate Change AI Innovation Fund, Applied Energy, Journal of Cleaner Production, Renewable & Sustainable Energy Reviews, Energy Economics, Journal of the Operational Research Society, IEEE Transactions on Power Systems.

Self Government

Deputy Academic Member of the Examination Board for the degree courses: Bioinformatics, Computer Science, Media Informatics, Medical Informatics (all BSc & MSc), and Machine Learning (MSc).

Teaching

Lectures/ Seminars

- Machine Learning in Renewable Energy Systems (Seminar Master, ML-4501c), Winter Term 2021 & Summer Term 2022, University of Tübingen
- *as guest lecturer:* Smart Grid Applications, Parts: Data Analytics in Energy Systems I & II (Lecture Master), Winter Term 2018, Karlsruhe Institute of Technology

Teaching Assistant

at University of Freiburg and Karlsruhe Institute of Technology: Econometrics (Lecture Bachelor), Energy Informatics (Seminar Master), Mathematics for Economists (Lecture Bachelor), Microeconomics II: Game Theory (Lecture Bachelor), Optimising Energy in Smart Cities (Seminar Master), Optimization and Simulation (Lecture Bachelor)

PhD Students

- Nina Effenberger (since 2021) “Wind Power Forecasting in the Face of Climate Change”
- Florian Ebmeier (since 2021) “Machine Learning for Solar Thermal Systems”, co-supervised with Volker Franz
- Eric Stefan Miele (2022), Visiting PhD Student, Sapienza University of Rome, supervisor Alessandro Corsini

Supervision

Supervision and Co-supervision of 22 Bachelor’s and Master’s students at Karlsruhe Institute of Technology and University of Tübingen (see individual topics below)

List of Publications

Journals (peer reviewed)

1. **Ludwig, Nicole**, Siddharth Arora, James W Taylor (2022). “Probabilistic Load Forecasting Using Post-Processed Weather Ensemble Predictions”. In: Journal of the Operational Research Society (accepted).
2. Kittel, Thomas, Stephen Haben, **Nicole Ludwig** (2022).“Investigating the effect of weather inputs for hierarchical probabilistic forecasting of electricity demand”. In: International Journal of Forecasting (minor revision).
3. Bauer, Rebecca, Tillmann Mühlpfordt, **Nicole Ludwig**, Veit Hagenmeyer (2022). “Analytical Uncertainty Propagation for Dynamic Stochastic Optimal Power Flow”. In: Sustainable Energy, Grids and Networks (minor revision, also available on arXiv `https://arxiv.org/abs/2204.05883`).
4. Beichter, Maximilian, Kaleb Phipps, Martha Frysztacki, Ralf Mikut, Veit Hagenmeyer, **Nicole Ludwig** (2022). “Net Load Forecasting using Different Aggregation Levels”. In: Energy Informatics (accepted).
5. Effenberger, Nina, **Nicole Ludwig** (2022). “A Collection and Categorization of Open-Source Wind and Wind Power Datasets for Wind Power Forecasting” In: Wind Energy.
6. Karrari, Shahab, **Nicole Ludwig**, Giovanni de Carne, Mathias Noe (2022). “Sizing of Hybrid Energy Storage Systems using Reoccurring Daily Patterns”. In: IEEE Transactions on Smart Grids, vol. 13, no. 4, pp. 3290-3300.
7. Phipps, Kaleb, Sebastian Lerch, Maria Andersson, Ralf Mikut, Veit Hagenmeyer and **Nicole Ludwig** (2022). “Evaluating Ensemble Post-Processing for Wind Power Forecasts”. In: Wind Energy, 25(8), 1379-1405.
8. Heidrich, Benedikt, Andreas Bartschat, Marian Turowski, Oliver Neumann, Kaleb Phipps, Stefan Meisenbacher, Kai Schmieder, **Nicole Ludwig**, Ralf Mikut, and Veit Hagenmeyer (2021). ”pyWATTS: Python Workflow Automation Tool for Time Series.” In: (under review, also available on arXiv `https://arxiv.org/abs/2106.10157`).
9. vom Scheidt, Frederik, Hana Medinova, **Nicole Ludwig**, Bent Richter, Philipp Staudt, and Christof Weinhardt (2020). “Data Analytics in the Electricity Sector – A Quantitative and Qualitative Literature Review” In: Energy and AI, 1, 100009.
10. Barth, Lukas[†], **Nicole Ludwig**[†], Esther Mengelkamp[†], and Philipp Staudt[†] (2018). “A comprehensive modelling framework for demand side flexibility in smart grids”. In: Computer Science - Research and Development 33.13, pp. 1865–2042.
11. González Ordiano, Jorge Ángel, Andreas Bartschat, **Nicole Ludwig**, Eric Braun, Simon Waczowicz, Nicolas Renkamp, Nico Peter, Clemens Düpmeier, Ralf Mikut, and Veit Hagenmeyer (2018). “Concept and benchmark results for Big Data energy forecasting based on Apache Spark”. In: Journal of Big Data 5.1, p. 11.
12. **Ludwig, Nicole**, Stefan Feuerriegel, and Dirk Neumann (2015). “Putting Big Data analytics to work: Feature selection for forecasting electricity prices using the LASSO and random forests”. In: Journal of Decision Systems 24.1, pp. 19–36.

Conference Proceedings (peer reviewed)

1. Heidrich, Benedikt, **Nicole Ludwig**, Marian Turowski, Ralf Mikut, and Veit Hagenmeyer (2022). “Adaptively coping with concept drifts in energy time series forecasting using profiles”. In: Proceedings of the Thirteenth ACM International Conference on Future Energy Systems (e-Energy ’22). Association for Computing Machinery, New York, NY, USA, 459–470.

[†]equal contribution by the authors

2. Bauer, Rebecca, Tillmann Mühlpfordt, **Nicole Ludwig**, and Veit Hagenmeyer (2022). “Analytical uncertainty propagation and storage usage in a high RES Turkish transmission grid scenario.” In: Proceedings of the Thirteenth ACM International Conference on Future Energy Systems (e-Energy ’22). Association for Computing Machinery, New York, NY, USA, 489–495.

3. Heidrich, Benedikt, Marian Turowski, **Nicole Ludwig**, Ralf Mikut, and Veit Hagenmeyer (2020). “Forecasting energy time series with profile neural networks”. In: Proceedings of the Eleventh ACM International Conference on Future Energy Systems (e-Energy ’20). Association for Computing Machinery, New York, NY, USA, 220–230.

4. Karrari, Shahab, **Nicole Ludwig**, Veit Hagenmeyer, and Mathias Noe (2019). “A Method for Sizing Centralised Energy Storage Systems Using Standard Patterns”. In: 2019 IEEE Milan PowerTech. IEEE, pp. 1–6.

5. **Ludwig, Nicole**, Lukas Barth, Dorothea Wagner, and Veit Hagenmeyer (2019). “Industrial Demand-Side Flexibility: A Benchmark Data Set”. In: Proceedings of the Tenth ACM International Conference on Future Energy Systems (e-Energy ’19). Association for Computing Machinery, New York, NY, USA, 460–473.

6. Barth, Lukas†, Veit Hagenmeyer, **Nicole Ludwig**†, and Dorothea Wagner (2018). “How much demand side flexibility do we need? Analyzing where to exploit flexibility in industrial processes”. In: Proceedings of the Ninth International Conference on Future Energy Systems - e-Energy ’18. New York, New York, USA: ACM Press, pp. 43–62.

7. **Ludwig, Nicole**, Ralf Mikut, and Veit Hagenmeyer (2018). “Auction Design to Use Flexibility Potentials in the Energy - Intensive Industry”. In: 2018 15th International Conference on the European Energy Market (EEM), pp. 1–5.

8. **Ludwig, Nicole**, Simon Waczowicz, Ralf Mikut, and Veit Hagenmeyer (2018). “Assessment of Unsupervised Standard Pattern Recognition Methods for Industrial Energy Time Series”. In: Proceedings of the Ninth International Conference on Future Energy Systems - e-Energy ’18. New York, New York, USA: ACM Press, pp. 434–435.

9. Staudt, Philipp, **Nicole Ludwig**, Julian Huber, Veit Hagenmeyer, and Christof Weinhardt (2018). “SCiBER: A new public data set of municipal building consumption”. In: Proceedings of the Ninth International Conference on Future Energy Systems (e-Energy ’18). Association for Computing Machinery, New York, NY, USA, 618–621.

10. Waczowicz, Simon, **Nicole Ludwig**, Jorge Á. G. Ordiano, Ralf Mikut, and Veit Hagenmeyer (2018). “Demand Response clustering: Automatically finding optimal cluster hyper-parameter values”. In: Proceedings of the Ninth International Conference on Future Energy Systems - e-Energy ’18. New York, New York, USA: ACM Press, pp. 429–430.

11. Jakob, Wilfried, Jorge Ángel González Ordiano, **Nicole Ludwig**, Ralf Mikut, and Veit Hagenmeyer (2017). “Towards coding strategies for forecasting-based scheduling in smart grids and the energy lab 2.0”. In: Proceedings of the Genetic and Evolutionary Computation Conference Companion on - GECCO ’17. New York, New York, USA: ACM Press, pp. 1271–1278.

12. **Ludwig, Nicole**, Stefan Feuerriegel, and Dirk Neumann (2016). “Time Series Analysis for Big Data: Evaluating Bayesian Structural Time Series Using Electricity Prices”. In: Multikonferenz Wirtschaftsinformatik (MKWI) 2016. Vol. III. Ilmenau: Universitätsverlag Ilmenau, pp. 1569–1580.

Conference Proceedings (non peer reviewed) and Abstracts

1. Kittel, Thomas, Stephen Haben, **Nicole Ludwig** (2022).“The Effect of Weather on Probabilistic Smart Meter Load Forecasting”. In: 42nd International Symposium on Forecasting, Oxford, UK, July 10-13, 2022.

2. Miele Eric Stefan, Alessandro Corsini, **Nicole Ludwig** (2022).“Multi-horizon wind power forecasting using multi-modal spatiotemporal neural networks”. In: 42nd International Symposium on Forecasting, Oxford, UK, July 10-13, 2022.

3. Neumann, Oliver, **Nicole Ludwig**, Marian Turowski, Benedikt Heidrich, Veit Hagenmeyer, Ralf Mikut (2021).“Smart Data Representations: Impact on the Accuracy of Deep Neural Networks”. In: Proceedings 31. Workshop Computational Intelligence, Berlin.

4. Phipps, Kaleb, **Nicole Ludwig**, Veit Hagenmeyer, and Ralf Mikut (2020). “Potential of Ensemble Copula Coupling for Wind Power Forecasting”. In: Proceedings 30. Workshop Computational Intelligence, Berlin.

5. **Ludwig, Nicole**, Siddharth Arora, and James Taylor (2019). ”Modelling Uncertainty: Probabilistic Load Forecasting Using Weather Ensemble Predictions”. 39th International Symposium on Forecasting, Thessaloniki, Greece, June 16 -19, 2019.

6. **Ludwig, Nicole** (2019). ”Learning to Increase Demand-Side Flexibility in Energy Systems”. 6th Annual Oxbridge Women in Computer Science Conference, Oxford, UK, March 9, 2019.

7. **Ludwig, Nicole**, Simon Waczowicz, Ralf Mikut, and Veit Hagenmeyer (2017). “Mining Flexibility Patterns in Energy Time Series from Industrial Processes”. In: Proceedings. 27. Workshop Computational Intelligence. Karlsruhe: KIT Scientific Publishing, pp. 13–32.

Manuscripts in preparation

1. Miele, Eric Stefan, Alessandro Corsini, **Nicole Ludwig** (2022).“Multi-horizon wind power forecasting using multi-modal spatiotemporal neural networks”.

2. Neumann, Oliver, Marian Turowski, Ralf Mikut, Veit Hagenmeyer, **Nicole Ludwig** “Representation and Types of Weather Information in Energy Time Series Forecasting”.

Supervised Theses

1. L. Bald, “Uncertainty in Reinforcement Learning for Demand Response in Energy Systems”, Master’s Thesis Computer Science, *University of Tübingen*, 2022.

2. G. Hirsch, “Multi-task learning for Forecasting in Energy Systems”, Master’s Thesis Machine Learning, *University of Tübingen*, 2022.

3. R. Högl, “Forecasting Wind Energy under Extreme Weather Conditions”, Master’s Thesis Computer Science, *University of Tübingen*, 2022.

4. I. Kurth, “Machine Learning for clean water prediction using image data”, Bachelor’s Thesis Cognitive Science, *University of Tübingen*, 2022.

5. J. Gauß, “Probabilistic Short-term Wind Power Forecasting”, Bachelor’s Thesis Computer Science, *University of Tübingen*, 2022.

6. T. Kittel, “Hierarchical probabilistic forecasting of smart meter time series using weather input”, Master’s Thesis Machine Learning, *University of Tübingen*, 2021.

7. O. Neumann, “Evaluating Numerical Weather Predictions and Neural Networks for Energy Forecasting”, Master’s Thesis Computer Science, *Karlsruhe Institute of Technology*, 2020.

8. M. Beichter, “Predicting the Mismatch between Energy Demand and Supply”, Bachelor’s Thesis Computer Science, *Karlsruhe Institute of Technology*, 2020.

9. M. Schedel, “New Demand Side Management Strategies using Reinforcement Learning”, Master’s Thesis Computer Science, *Karlsruhe Institute of Technology*, 2020.

10. K. Schmieder, “Meta-Learning for Anomaly Detection in Energy Time Series”, Master’s Thesis Information Systems, *Karlsruhe Institute of Technology*, 2020.

11. Y. Tanner, “Probabilistic Deep Learning for Energy Time Series”, Master’s Thesis Computer Science, *Karlsruhe Institute of Technology*, 2020.

12. M. Herm,“Evaluating the benefit of grid-based weather information in energy forecasting”, Bachelor’s Thesis Computer Science, *Karlsruhe Institute of Technology*, 2019.

13. B. Heidrich, “A new Deep Learning Architecture to Forecast Energy Demand in Buildings”, Master’s Thesis Computer Science, *Karlsruhe Institute of Technology*, 2019.

14. K. Phipps, “Probabilistic Forecasting and the Integration of Wind Power into the Swedish Electrical Grid”, Master’s Thesis Industrial Economics, *Karlsruhe Institute of Technology*, 2019.

15. T. Buchner, ”Deep Learning in Energy Time Series Forecasting”, Master’s Thesis Industrial Economics, *Karlsruhe Institute of Technology*, 2019.

16. L. Engler, “Impact of Time Resolution on the Analysis of High-Frequency Energy Data”, Bachelor’s Thesis Mechanical Engineering, *Karlsruhe Institute of Technology*, 2018.

17. L. Faller, “Finding Patterns in Time Series - A Comparison of Unsupervised Learning Methods”, Bachelor’s Thesis Computer Science, *Karlsruhe Institute of Technology*, 2018.

18. G. Keppler, “The Impact of Preprocessing on Energy Time Series Analysis”, Bachelor’s Thesis Mechanical Engineering, *Karlsruhe Institute of Technology*, 2018.

19. A. Misuracu, “Expert Knowledge for Unsupervised Machine Learning in Energy Time Series”, Master’s Thesis Computer Science, *Politecnico di Turion & Karlsruhe Institute of Technology*, 2018.

20. M. Pichon, “Agent-based Simulation of Flexibility in Industrial Energy Systems”, Bachelor’s Thesis Computer Science, *INSA & KIT*, 2018.

21. D. Chang, “Data Analytics: What’s the Influence of Preprocessing?”, Master’s Thesis Mechanical Engineering, *Karlsruhe Institute of Technology*, 2018.

22. M. Meza Martinez, “Developing a Forecasting Tool for Industrial Energy Time Series”, Master’s Thesis Industrial Economics, *Karlsruhe Institute of Technology*, 2017.