Iegor Riepin

Personal Information

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I am a research scientist with expertise in energy economics, energy policy, operations research, and related programmable matter. I am particularly interested in mathematical models, their applications to real world problems, their limitations, and the role in decision making.

It is these interests that bring me to my current role as a postdoc researcher at the Energy Systems group @ TU Berlin. The overarching goal of our work is to find cost-effective opportunities for climate neutrality.

Aside from my research, I enjoy astrophotography, reading about space exploration, related discoveries and just good sci-fi books. I truly believe in the value of open science, and I try to contribute by sharing my code, data and teaching materials.

Education

PhD in energy economics (2015-2022)
University: Brandenburg Technical University C-S, Germany
PhD advisors: Prof. Felix Müsgens and Prof. Luis Baringo
My cumulative thesis is titled *"Modeling challenges of modern energy markets: studies on uncertainty, complexity, and constant change"* and is published in open access.
Grade: Summa cum laude (1.0)

Master degree in Power Engineering (2012-2014)
University: Brandenburg Technical University C-S, Germany
Honours degree based on the overall performance (1.2)

Bachelor degree in Heat Power Engineering (2008-2012)
University: ZSEA, Ukraine
Honours degree based on the overall performance (4.98/5)

Work experiences

2022 March→ Postdoctoral researcher | Energy system modeler @ ENSYS

We use methods from operations research and mathematical optimisation researching the most cost-effective pathways to reduce greenhouse gas emissions in energy systems. Our group also maintains the PyPSA ecosystem - an open-source python environment for state-of-the-art energy system modelling.

I lead the modelling work for the 24/7 Carbon-Free Energy by 2030 project that is a research collaboration with Google. Details are at the project page 247cfe.github.io and at GitHub github.com/PyPSA/247-cfe

Since Q2 2024, I work on the RESILIENT research project, financed by public funds. The project aims to improve our abilities to plan energy infrastructure in a resilient way.

2021 September → 2022 February Research fellow | Energy Systems Modelling lead @ Chair of Energy Economics at BTU C-S

I was leading a team of researchers working on modelling of energy markets, acquisition and implementation of third-party research projects with energy industry and government stakeholders. My job in leading the team included managing ongoing research activities, modelling workflow and making sure we do the right things.

2014 November → 2021 August Research fellow @ Chair of Energy Economics at BTU C-S

I have carried out research on energy economics and energy systems modeling. The topics included infrastructure investments, decisions under uncertainty, robust planning of energy systems, risk-aversion, sector coupling and energy auctions. In this period, my PhD supervisor and I developed an "Energy systems modelling" study course at BTU C-S. The class focuses on the intersection of energy economics, operations research and systems modelling. The course gets usually very warm feedback from students. Apart from that, I was teaching "Power System Economics 101/102" classes.

Other experiences

2024 → Freelance consultant | Research scientist @ Green Deal Ukra□na

Aside my research, I support the Green Deal Ukra□na project that aims to set up a Think Tank that will provide modelling-based guidance for Ukrainian government, policymakers, and society in rebuilding the Ukrainian economy and energy sector during and after this terrible war.

Academic research visits

2023 August → 2023 September I had a research visit to a Scalable Systems Laboratory headed by Prof. Victor Zavala at University of Wisconsin-Madison, USA. My work there focused on optimization problems for space-time load shifting by data centers.

2019 September → 2019 October I had a research stay in a Sustainable Energy Systems Integration & Transitions Group headed by Prof. McPherson at UVIC, Victoria BC, Canada. My work there focused on robust optimization algorithms applied to electricity system expansion problems. Victoria BC is simply a fantastic place.

Third-party funded projects

2024 April → @TUB – RESILIENT. Funding: BMWK (CETpartnership project). Project webpage: https://resilient-project.github.io/

2022 March → @TUB – 24/7 Carbon-Free Energy by 2030. Funding: Google. Project webpage: https://irieo.github.io/247cfe.github.io/ Background: Google sustainability

2021 → 2022 @BTU – TransHyDE (System analysis of transport solutions for green hydrogen). Funding: BMBF (Federal Ministry of Education and Research). Cooperation: >30 partners. Project webpage: wasserstoff-leitprojekte.de

2017 @BTU – Design of auctions for market premia for onshore wind generation: theoretical and experimental testing. Cooperation: CERGE-EI. Summary

2016 @BTU – Strategy 2020: modelling of forward prices for natural gas in European gas markets. Funding: industry partner. Cooperation: r2b energy consulting GmbH.

2014 → **2016** @BTU – Fundamental gas market analysis in a context of the German energy transition process. Funding: gas trading utility. Cooperation: r2b energy consulting GmbH. Summary

Peer-reviewed journal articles

in review: Modelling the High-Voltage Grid Using Open Data for Europe and Beyond
Xiong B., Fioriti D., Neumann F., Riepin I., Brown T.
Working paper: https://arxiv.org/abs/2408.17178
The code to replicate the workflow and dataset is a part of PyPSA-Eur and released as free software under the MIT licence: https://github.com/pypsa/pypsa-eur

in review: Mitigating Ukraine's Looming Electricity Crisis
Zachmann G., Meissner F., Riepin I.
Working paper: https://ssrn.com/abstract=4930511

in review: Price formation without fuel costs—the interaction of elastic demand with storage bidding
Brown T., Neumann F., Riepin I.
Working paper: https://arxiv.org/abs/2407.21409
Code: https://github.com/fneum/price-formation

Advances in Applied Energy (2025): Spatio-temporal load shifting for truly clean computing
Riepin I., Brown T., Zavala V.
DOI: 10.1016/j.adapen.2024.100202
Working paper: https://arxiv.org/abs/2405.00036
Code: https://github.com/Irieo/space-time-optimization

Applied Energy (2025): Power System Benefits of Simultaneous Domestic Transport and Heating Flexibility in Great Britain's Energy Transition
Franken et al.
DOI: 10.1016/j.apenergy.2024.124522
Working paper: https://zenodo.org/records/10781213
Blog post @ Centre for Net Zero

Energy Strategy Reviews (2024): On the means, costs, and system-level impacts of 24/7 carbon-free energy procurement
Riepin I., Brown T.
DOI: 10.1016/j.esr.2024.101488
Working paper: https://arxiv.org/abs/2403.07876
Code: https://github.com/Irieo/247-procurement-paper

Environmental research letters (2024): Temporal regulation of renewable supply for electrolytic hydrogen
Zeyen E., Riepin I., Brown T.

DOI: 10.1088/1748-9326/ad2239
Working paper: https://zenodo.org/records/8324521
Code: https://zenodo.org/record/7457441

Energy Economics (2023): Risk aversion and flexibility options in electricity markets
Möbius T., Riepin I., Müsgens F., van der Weijde A. H.
DOI: doi.org/10.1016/j.eneco.2023.106767
Working paper:https://arxiv.org/abs/2110.04088
Code: https://github.com/BTU-EnerEcon/RiskAv

Applied Energy (2022): Adaptive robust optimization for European strategic gas infrastructure planning
Riepin I., Schmidt M., Baringo L., Müsgens F.,
DOI: doi.org/10.1016/j.apenergy.2022.119686
Code: https://github.com/Irieo/ARO-GasInfrastructure
Working paper: www.optimization-online.org/DB_HTML/2021/10/8654.html

Energy Policy (2022): Policy choices and outcomes for the global competitive procurement of offshore wind
Jansen M., Beiter P., Riepin I., Müsgens F. Juarez Guajardo-Fajardo V., Staffell I., Bulder B., Kitzing L.
DOI: 10.1016/j.enpol.2022.113000
Data: https://zenodo.org/record/6524754
Working paper: https://arxiv.org/abs/2202.12548

Applied Energy (2021): Modelling uncertainty in coupled electricity and gas systems—Is it worth the effort?
Riepin I., Möbius T., Müsgens F.
DOI: 10.1016/j.apenergy.2020.116363
Code: https://github.com/Irieo/IntEG
Working paper: https://arxiv.org/abs/2008.07221

Nature Energy (2020): Offshore wind competitiveness in mature markets without subsidy
Jansen M., Staffell I., Kitzing L., Quoilin S., Wiggelinkhuizen E., Bulder B., Riepin I., Müsgens F.
DOI: https://www.nature.com/articles/s41560-020-0661-2
Code: https://zenodo.org/record/3906565
Supplementary data: https://zenodo.org/record/3906325
Nature Energy News & Views: Leaving the competition in its wake
Media coverage: 125 news stories

Energy Journal (2019): Seasonal flexibility in the European natural gas market
Riepin I., Müsgens F.
URL: http://www.iaee.org/en/publications/ejarticle.aspx?id=3779
Code: https://github.com/Irieo/SeasonalFlex
Cambridge Working Papers Series:
DOI: doi.org/10.17863/CAM.43923 | Abstract | Non-Technical Summary

Conference papers

IEEE EEM (2022): Modeling of Extreme Weather Events—Towards Resilient Transmission Expansion Planning
Bernecker M., Riepin I., Müsgens F.
DOI: 10.1109/EEM54602.2022.9921145

IEEE EEM (2020): Regret analysis of investment decisions under uncertainty in an integrated energy system
Möbius T., Riepin I.
DOI: 10.1109/EEM49802.2020.9221935

IEEE EEM (2018): Integrated electricity and gas market modeling—effects of gas demand uncertainty.
Riepin I., Möbius T., Müsgens F.
DOI: 10.1109/EEM.2018.8469790

IEEE EEM (2018): Is offshore already competitive? Analyzing German offshore wind auctions.
Müsgens F., Riepin I.
DOI: 10.1109/EEM.2018.8469851 | Preprint | Video

IEEE EEM (2016): Modelling of world LNG market development: focus on US investments and supplies.
Montenegro R., Riepin I., Hauser P.
DOI: 10.1109/EEM.2016.7521361

ZSEA (2011): Usage of solar energy for heating service and domestic water heating. Riepin I. VII all-Ukrainian scientific conference. Vol. 2, pp. 78 - 83.

ZSEA (2011): Ukrainian market prospects in the field of alternative energy sources.
Riepin I. The annual conference for graduate students. pp. 186 - 192.

Other publications

Project study (2023): The value of space-time load-shifting flexibility for 24/7 carbon-free electricity procurement
Riepin I. and Brown T.
DOI: https://zenodo.org/records/8185850

Project study (2022): System-level impacts of 24/7 carbon-free electricity procurement in Europe
Riepin I. and Brown T.
DOI: https://zenodo.org/record/7180098

SSRN paper (2021): Grok it and use it: Teaching energy systems modeling
Riepin I., Sgarciu S., Bernecker M., Möbius T., Müsgens F.
DOI: https://dx.doi.org/10.2139/ssrn.4320978

Working paper (2015): A note on climate policy negotiations at the threshold of COP-21 in Paris
Müsgens F., Poudineh R., Riepin I.
A note by Oxford Institute for Energy Studies & BTU CS

Science explainers & media appearances

I am not a media person, but occasionally I happen to be in the media to talk about my research in a way that is understandable and interesting to a broader audience.

- Introduction to flexibility in a renewables-based energy system and 24/7 carbon free energy matching
  Youtube @ A training series for European civil society by RGI, December 2024
- The Week in Green Software: Modeling Carbon Aware Software
  Podcast @ Environment Variables (November 2023)
- On space-time load-shifting flexibility for 24/7 carbon-free electricity procurement
  Panel discussion @ Linux Foundation Energy summit Paris, June 2023
- The era of 'negative-subsidy' offshore wind power has almost arrived
  Guest post @ CarbonBrief (2020)
- Offshore-Windenergie - subventionsfrei?
  Guest post @ e|m|w.trends (2020)

Public talks and scientific outreach

An up-to-date list of my talks can likely be on https://iriepin.com/

- Insights from model based studies on 24/7 CFE procurement and green hydrogen regulation.
  Slides @ DTU, Workshop on the policy context and emissions impact of hydrogen and PPA regulation, July 2024
  Code: Space-time load shifting optimizaiton paper
  Code: Green hydrogen regulation paper
- Three Pillars of Hourly Matching—A Tour From Model Land to Real World
  Slides @ EURO 2024. A joint talk with Elisabeth Zeyen, July 2024
- On the role of 24/7 CFE in accelerating advanced clean electricity technologies
  Slides @ Eurelectric 24/7 CFE Hub workshop, May 2024
  Code: https://github.com/PyPSA/247-cfe
- Signals for spatio-temporal load shifting in 24/7 clean computing
  Slides @ DTU Cool Data project final workshop, February 2024
  Code: https://github.com/Irieo/space-time-optimization
- On space-time load-shifting flexibility for 24/7 carbon-free electricity procurement
  Slides @ Eurelectric 24/7 CFE Hub, October 2023
  Code: https://github.com/PyPSA/247-cfe/tree/v0.3
- System-level impacts of 24/7 carbon-free electricity procurement in Europe
  Slides @ EWI Cologne research seminar, November 2022
  Code: https://zenodo.org/record/7181236
- 24/7 - A new paradigm for power procurement?
  Slides @ ENERDAY Conference, May 2023
  Slides @ European Climate and Energy Modelling Platform, October 2022
  Code: https://github.com/PyPSA/247-cfe/tree/v0.2

- European Natural Gas Infrastructure Expansion Planning: An Adaptive Robust Optimization Approach
  Slides @ EWI Cologne guest talk, July 2021
  Slides @ European Conference on Operational Research, Athens, 2021
  Code: `https://github.com/Irieo/ARO-GasInfrastructure`
- On the costs of ignoring uncertainty and the value of perfect information: a toy model.
  Slides | Code @ Doctoral seminar, BTU CS, 2019
- Robust optimization of electricity system expansion
  Slides | Code @ University of Victoria seminar, 2019
- Economic impacts of uncertainty in integrated electricity and gas markets
  Slides @ 30th European Conference on Operational Research, Dublin, 2019
- Integrated electricity and gas market modelling—effects of gas demand uncertainty
  Slides @ EEM2018 Conference, Lodz, 2018
  Slides @ PhD seminar Cottbus-Leipzig-Dresden, 2018
- Integration of electricity and gas market models
  Slides @ Energy modelling seminar, IER, Universität Stuttgart, 2018
- Application of non-linear and complementarity problems for natural gas market modelling
  Slides @ Research seminar on mathematical economics, BTU CS, 2017
- Natural Gas Storages in Competition with Alternative Flexibility Sources
  Slides @ 39th IAEE International Conference, Bergen, 2016
  Slides @ PhD seminar Cottbus-Leipzig-Dresden, 2016
- Mathematical modelling of natural gas markets
  Slides @ BTU research seminar, Cottbus, 2016
  Slides @ Mathematical modelling workshop, Frankfurt, 2015
- Prospects for Shale Gas Exploration in Europe: Ongoing Experience
  Slides @ 38th IAEE International Conference, Antalya, 2015

Teaching experience

2014 → Teaching and supervising graduate students on topics related to energy economics and energy systems modeling.

2017 → **2020** "Energy Systems Modeling" (course development, selected lectures, tutorials, supervision of student projects)
Lecture: Prof. Dr. Felix Müsgens
Some materials are available at github.com/Irieo/ESM

2014 → **2018** "Power System Economics 101" (Winter terms | tutorials) and "Power System Economics 102" (Summer terms | tutorials)
Prof. Dr. Felix Müsgens and Prof. Dr. Stefan Zundel

Scholarships & awards

I am grateful for the following scholarships and awards that supported me during my studies:

- *Promotionsstipendium des Landes Brandenburg, GradV*, Postgraduate scholarship 2017-2019
- *Rheinstahl foundation study scholarship*, Master degree 2014

- *STIBET study scholarship, DAAD*, Master degree 2013
- *Zaporizhia city administration scholarship*, Bachelor degree 2010

COMPUTER SKILLS

Programming, scripting and markup languages Python and data science stack (daily), Git (daily), Snakemake (daily), LaTeX(daily), GAMS (many years of project-related use, research and teaching).

Languages My mother tongue is Ukrainian and Russian, but almost everything I do in private and in scientific work is in English. I also speak German when needed.

FOLLOW THE STARS

I do enjoy astrophotography and even have a small blog page about it. When I am done with science, I will be a space cowboy.

FUN FACT

My wonderful wife holds a PhD in Energy Economics and is also an energy modeller & research scientist by profession. I wish one of us would have chosen to be a doctor.

Berlin, January 2025