

Energy Markets Design

Prof. Dr. Oliver Ruhnau

University of Cologne

oliver.ruhnau@uni-koeln.de

Course overview

Energy market design aims at achieving environmental, economic, and security-of-supply goals. In the beginning of the course, we will get a short overview on how future energy systems that fulfill these goals may look like. On that basis, we will discuss market mechanisms and policy interventions to help such a system materialize. Put differently, after briefly discussing the destination, this course focuses on organizing the travel toward a beneficial future energy system.

This course addresses several topics which are currently discussed in academia and practice. After an introduction on future energy systems, we focus on the following topics:

- 1) Climate policy and renewable support schemes
- 2) Economics of energy storage and policy implications
- 3) Forward markets and capacity remuneration mechanisms
- 4) Consumer tariffs and demand response

For each topic, this course combines input from the lecturer with student group presentations and in-class discussions. The focus will be on the most recent research publications related to each topic. In the end, each student should submit a research proposal. Each student group is required to provide feedback on one other group's presentation and each student is required to provide feedback on one other student's report. As such, this course is as much about interesting content as it is about learning how to do research and provide constructive feedback. In the best case, research proposals may be further developed and used for a master thesis.

Please refer to the second page of this syllabus for a more detailed overview of topics and readings.

Course organization

Class hours & venues

- Wednesdays, 14:00 – 17:00
- 827 Seminarraum (KFR1), Alte Wagenfabrik, Vogelsanger Str. 321a

Office hours are offered on request.

Please **register for this course** via KLIPS.

Previous knowledge from the course “Energy Markets and Regulation” is recommended but not required.

This course features a **combined examination**:

- Group work (2–3 students per group)
 - o Presentation as a group, followed by a discussion (35% of points)
 - o Feedback on another group’s presentation (10% of points)
- Individual work
 - o Draft research proposal (35% of points)
 - o Feedback on another participant’s proposal (10% of points)
 - o Final research proposal (10% of points)

The group presentation should be 20–30 minutes long (10 minutes per student), followed by about 30 minutes for feedback and discussion. The presentations will be integrated in the sessions 3 to 6 (see dates below).

The research proposal should be about 1,500 words long, and the written feedback on another’s proposal should include about 300 words. Students are expected to revise their proposals based on feedback from each other and from the lecturer.

Further information and course material will be distributed via the **ILIAS platform**.

For **questions**, please do not hesitate to reach out to:

- Content: Oliver Ruhnau (ruhnau@wiso.uni-koeln.de)
- Administration: Monika Räthe (monika.raethe@uni-koeln.de)

Course schedule

The following schedule is tentative and may be subject to changes, which we would communicate via ILIAS.

Date	Type	Event
10 Apr 24, 14:00 – 17:00	Session 1	Introduction
By 17 Apr 24, 23:59		Deadline to register for examination
24 Apr 24, 14:00 – 17:00	Session 2	Skill session & topic allocation
By 1 May 24, 23:59		Possibility to withdraw from examination
15 May 24, 14:00 – 17:00	Session 3	Climate and renewable policies
29 May 24, 14:00 – 17:00	Session 4	Economics of energy storage
19 Jun 24, 14:00 – 17:00	Session 5	Forward and capacity markets
03 Jul 24, 14:00 – 17:00	Session 6	Tariffs and consumer response
17 Jul 24, 14:00 – 17:00		Buffer
By 31 Jul 24, 23:59		Deadline for draft proposal submission
By 14 Aug 24, 23:59		Deadline for feedback submission
By 28 Aug 24, 23:59		Deadline for final proposal submission

Topics and readings

1a) Climate policy in energy markets

- Borenstein and Kellogg 2023. Carbon Pricing, Clean Electricity Standards, and Clean Electricity Subsidies on the Path to Zero Emissions. Environmental and Energy Policy and Economy
- Dimanchev and Knittel 2023. Designing climate policy mixes: Analytical and energy system modeling approaches. Energy Economics
- Fischer and Newell 2008. Environmental and technology policies for climate mitigation. Journal of Environmental Economics and Management

1b) Designing renewable support schemes

- Beiter et al. 2023. The enduring role of contracts for difference in risk management and market creation for renewables. Nature Energy
- Schlecht et al. 2023. Financial contracts for differences. Working Paper
- Fabra and Montero 2022. Technology-neutral versus technology-specific procurement. The Economic Journal
- Greve and Pollitt 2017. Determining the optimal length of regulatory guarantee: a length-of-contract auction. Economic Journal

2a) The economics of energy storage

- Schmidt and Staffell 2023. Monetizing Energy Storage. Oxford University Press (see also: Schmidt et al. 2019. Projecting the future levelized cost of electricity storage technologies. Joule)
- Junge et al. 2022. Energy Storage Investment and Operation in Efficient Electric Power Systems. The Energy Journal
- Ruhnau and Qvist 2022. Storage requirements in a 100% renewable electricity system: Extreme events and inter-annual variability. Environmental Research Letters

2b) Policy for energy storage

- Billimoria and Simshauser 2023. Contract design for storage in hybrid electricity markets. Joule
- Helm and Mier 2021. Steering the energy transition in a world of intermittent electricity supply: Optimal subsidies and taxes for renewables and storage. Journal of Environmental Economics and Management
- Abrell et al. 2019. Buffering volatility: Storage investments and technology-specific renewable energy support. Energy Economics

3a) Forward electricity markets

- Cramton et al. 2024. A forward energy market to improve resiliency. Working Paper
- Deletombe et al. 2023. The insurance value of renewable energies. Working Paper
- Dimanchev et al. 2023. Consequences of the missing risk market problem for power system emissions. Working Paper
- Bonaldo et al. 2022. The relationship between day-ahead and future prices in electricity markets. Energy Economics
- Mays et al. 2022. Private risk and social resilience in liberalized electricity markets. Joule

3b) Capacity remuneration mechanisms

- Rodilla et al. 2023. The Challenge of Integrating Demand Response: Providing a Comprehensive Theoretical Framework. IEEE Power and Energy Magazine
- Brito-Pereira et al. 2022. Self-fulfilling or self-destroying prophecy? The relevance of de-rating factors in modern capacity mechanisms. Applied Energy
- Wang et al. 2022. Crediting Variable Renewable Energy and Energy Storage in Capacity Markets: Effects of Unit Commitment and Storage Operation. IEEE Transactions on the Power Sector
- Bublitz et al. 2019. A survey on electricity market design: Insights from theory and real-world implementations of capacity remuneration mechanisms. Energy Economics

4a) Tariff design

- Ito et al. 2023. Selection on welfare gains: experimental evidence from electricity plan choice. American Economic Review
- Schittekatte et al. 2023. Reforming retail electricity rates to facilitate economy-wide decarbonization. Joule
- Farrell 2021. The increasing cost of ignoring Coase: Inefficient electricity tariffs, welfare loss and welfare-reducing technological change. Energy Economics
- Schittekatte et al. 2018. Future-proof tariff design: recovering sunk grid costs in a world where consumers are pushing back. Energy Economics

4b) Consumer response

- Bobbio et al. 2023. Resilient electricity requires consumer engagement. Working Paper
- Khanna T.M. et. al 2023. Effects of electricity pricing schemes on household energy consumption. A meta-analysis of academic and non-academic literature
- Stumpe and Götte 2022. Do Households Shift Electricity Consumption? Evidence from a Real-Time Pricing Tariff. Dissertation Chapter
- Fabra et al. 2021. Estimating the elasticity to real-time pricing: evidence from the Spanish electricity market. AEA Papers and Proceedings