UNIVERSITÄT ZU KÖLN

Energy Market Modeling

Prof. Dr. Oliver Ruhnau
University of Cologne
oliver.ruhnau@uni-koeln.de

Course contents

Energy markets are undergoing fundamental changes, and numerical models can be used to analyze the potential impact of these changes on market outcomes. For this reason, energy market models are widely used to inform private firms and policy makers as well as to conduct research academia.

This course focuses on the fundamental modeling of electricity markets, which play a central role in the energy sector already today and even more so in the future. We start with an introduction into the General Algebraic Modeling Software (GAMS). On this basis, we model:

1) Power plant dispatch
2) Power plant investment
3) Storage dispatch and investment
4) Electricity trade

To address these different aspects, this course provides you with a step-by-step guide to building your own stylized partial equilibrium model of the electricity market: first, we develop a basic understanding of how electricity markets work; second, we formalize market mechanisms into mathematical equations; third, we implement these equations in software code; fourth, we interpret the results and discuss model limitations.

The course sessions will be complemented by guest lectures on how energy market models are used in academia and in the energy industry. In addition, we offer an (optional) excursion to the combined heat and power plant "Heizkraftwerk Niehl" of the energy supplier RheinEnergie (limited seats will be allocated in the beginning of the course).

At the end of the course, students should form groups to (further) develop an energy market model and apply it to a case study of their choice. The results should be presented in class and submitted as a short report.

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

Course organization

Class hours & venues:

- Fridays, 09:00 – 12:00
- 827 Seminarraum x.EG.03 (KFR1), Alte Wagenfabrik, Vogelsanger Str. 321a, 50827 Köln

The **excursion** takes place on Friday, 18 Oct 24, 09:30 – 12:30.

Office hours are offered on request.

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

Prior or parallel participation in the course "Energy Markets and Regulation" is recommended but not required (course contents and schedules are designed to match well).

This course features a **combined examination**:

- Presentation (30% of points)
- Report (70% of points)

The project should be conducted in groups of 2-3 students. The presentation should be 16–24 minutes long (8 minutes per student). The report should comprise around 2,500 words.

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

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

- On content, please contact Maximilian Walde (walde_maximilian@wiso.uni-koeln.de)
- On administration, please contact Monika Räthe (monika.raethe@uni-koeln.de)

Course schedule

The following schedule is tentative. Potential changes would be communicated via ILIAS.

Date	Type	Topic
11 Oct 24	Session 1	Intro to the course, optimization, and GAMS
18 Oct 24	Excursion	Visit of Rheinenergie's "Heizkraftwerk Niehl"
25 Oct 24	Session 2	Modeling power plant dispatch
08 Nov 24	Session 3	Modeling power plant investment Guest lecture: models in academia (EWI)
22 Nov 24	Session 4	Modeling storage Guest lecture: models in the industry (tbd)
By 29 Nov 24, 23:59		*Deadline to register for examination*
06 Dec 24	Session 5	Modeling trade Project Kick-Off
13 Dec 24	Buffer	
By 20 Dec 24, 23:59		*Possibility to withdraw from examination*
23 Dec 24 – 3 Jan 25	Winter break	
10 Jan 25	Session 6	Individual project check-ins
31 Jan 25	Session 7	Project presentations
By 28 Feb 25, 23:59		*Deadline for project report submission*