

Seminar Summer Semester 2026

Seminar Energy Economics I: A Real-Time Day-Ahead Energy Time Series Forecasting Challenge

Research Group “Energy Demand & Mobility”

This seminar introduces students to the theory and practice of probabilistic time series forecasting in the context of the German energy system. Inspired by “*Learning to Forecast: The Probabilistic Time Series Forecasting Challenge*” (Bracher et al., 2023), students take part in an internal real-time forecasting competition while documenting their approach in a seminar paper.

Motivation

Forecasting electricity prices, load, and renewable generation is central to energy economics, market operations, and renewable integration, as these quantities jointly determine market outcomes, system balancing requirements, and trading decisions. With rising renewable penetration and increasing volatility in European power systems, reliable day-ahead forecasts of prices, demand, and wind and solar generation have become indispensable for system operators, utilities, traders, and analysts. The seminar mirrors this professional environment: students develop operational forecasting models and submit day-ahead predictions under real-time conditions, replicating the constraints and decision context faced in practice.

Course Structure

This seminar starts with a kick-off meeting in which students are introduced to the framework conditions of the forecasting challenges (forecasting period, metrics, submission guidelines), the seminar events, and the final seminar paper. At the core of the seminar is an operational forecasting phase in which students develop automated models and submit day-ahead forecasts for electricity prices, load, and renewable generation via the submission interface of energy-arena.org. Submissions are evaluated under real-time conditions and performance is tracked on a public leaderboard using standardized metrics.

The seminar unfolds in four phases:

1. Introduction & Background → energy time series, code development guidelines, submission framework conditions (energy-arena.org)
2. Literature Review & Methods → econometric, machine learning, and hybrid approaches
3. Forecasting Challenge
4. Seminar Paper & Presentation → seminar paper (introduction, literature, methods, results, conclusion) and final workshop presentation.

Learning Outcomes

- Understand real-world challenges of energy time series forecasting.
- Gain hands-on experience in developing and evaluating probabilistic models.
- Learn to handle real-time forecasting constraints.
- Write and present a research paper in applied forecasting.

Grades are based on (1) quality and timeliness of forecasts, (2) the seminar paper, and (3) active participation.

Forecasting Challenges (3 participants per track)

1. Day-Ahead Electricity Prices (3 participants)

Participants develop operational day-ahead forecasting models for wholesale electricity prices of a selected bidding zone. The objective is to generate accurate point or probabilistic forecasts under real-time conditions and compete on rolling-horizon performance metrics.

2. Day-Ahead Electricity Load (3 participants)

Participants build forecasting models for day-ahead electricity demand based on publicly available system load and fundamental data. The challenge focuses on capturing seasonality, weather effects, and structural demand patterns in an operational forecasting setup.

3. Day-Ahead Wind Power Generation (3 participants)

Participants design models to forecast aggregated wind power generation using publicly available meteorological and system data. The task emphasizes handling high volatility, nonlinear dynamics, and weather-driven uncertainty in real-time forecasting.

4. Day-Ahead Solar Power Generation (3 participants)

Participants develop models for day-ahead solar generation forecasting at system level. The challenge requires capturing diurnal patterns, cloud-driven variability, and seasonal effects within an automated operational pipeline.

Dates

Seminar Kickoff: Wed, 15 Apr 2026, 10:00–12:00 (on site: Seminar Room 017, IIP)

Midterm Presentation: Wed, 20 May 2026, 10:00–12:00 (on site: Seminar Room 017, IIP)

Final Presentation: Wed, 08 Jul 2026, 09:00–12:00 (on site: Seminar Room 103, IIP)

Attendance at all dates is mandatory.

Online registration must be completed before **23 March 2026, 00:00** via <https://portal.wiwi.kit.edu>. Confirmation of a seminar place is only valid once final registration has been made in the student portal (<https://campus.studium.kit.edu/exams/registration.php>).

Important: Please check your emails regularly after submitting your application in order to respond promptly to a seminar place offer! If you do not reply within the deadline, the place will be reassigned to other applicants.

Application Documents

- Current transcript of records (Bachelor and, if applicable, Master)
- Short CV including relevant prior knowledge (please do not submit a motivation letter)

Contact:

Max Kleinebrahm (max.kleinebrahm@kit.edu)