Significant outcomes
of our project FEAT

Project targets

Simulations of the energy markets become increasingly complex: More fluctuating renewables and less conventional power plants lead to stronger market dynamics. Increasing amount of flexibility options (FO), e.g., pumped-hydro storage, or batteries lead to more competition. To be profitable, FO require smart bidding strategies that are based on precise price predictions. The project FEAT aims at developing new machine-learning (ML) algorithms that can provide such high-quality predictions. The applicability of such algorithms is then tested in combination with the sophisticated electricity market simulation model AMIRIS.

Main results

In FEAT, *new ML algorithms* were developed that can robustly predict electricity prices in complex energy markets – also from parameter regions *not seen during training*. To this end, networks based on *Temporal-Fusion-Transformer* and *Masked-Autoencoder architectures* were employed. It was shown that the *uncertainty* of their outputs can be *properly calibrated*. These algorithms can be integrated efficiently in electricity market simulations. Obtained price predictions have *reasonable precision* and can be used to dispatch *competing storage units*.

AMIRIS was significantly enhanced during the project. It can now employ ML-based forecasts by using a two-stage architecture shown in Figure 1: one for the price forecasting, and one for the electricity market modelling. By keeping those two layers separate, both can be used and evolve independently. This strengthens the cross-applicability of the tools and methods developed in FEAT for third parties from the research and industry domains.

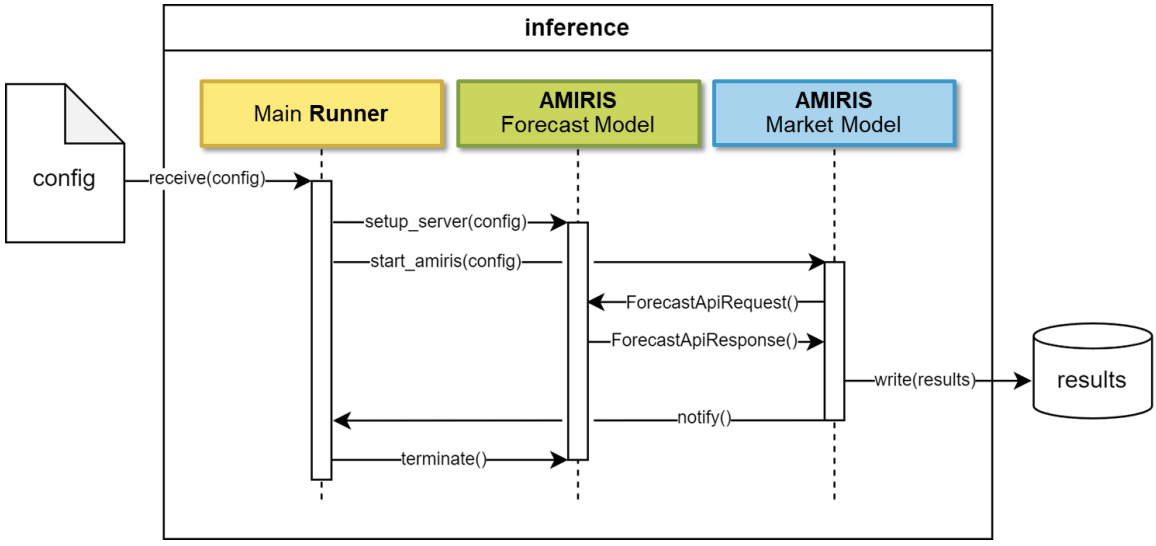


***Figure 1**: Separated layers of forecast and market modelling, connected by a REST API, and loosely joint by a runner script.*

Scientific papers

In the FEAT project, a *scenario generator* for AMIRIS was developed and published open source. Based on this generator, thousands of training scenarios could be created to train and test the ML models. The open electricity market model AMIRIS was enhanced to enable integrating ML forecasts. These changes were publicly released with AMIRIS v3.4. AMIRIS-PriceForecast, a wrapper architecture for providing ML forecasts using a REST interface, was developed and released openly. A Temporal-Fusion-Transformer architecture was employed by DLR to demonstrate the applicability of the method for price forecasting. Corresponding results were published in Energy Reports. This enabled a profitability assessment of flexibility options with AMIRIS. These results were published in Advances in Applied Energy. Figure 2 shows the workflow developed in FEAT to enable ML-based electricity price forecasts in AMIRIS.

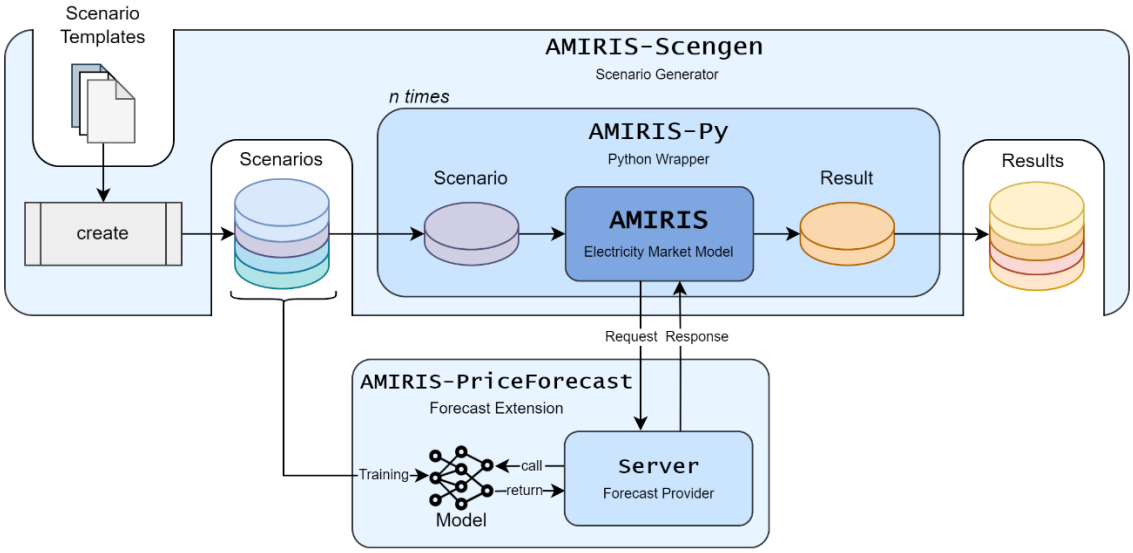


***Figure 2**: Workflow of the tools developed in FEAT to enable ML-based electricity price forecasts in AMIRIS*

Public communications

Which insights or results have been transferred to the public and how?

Project results were communicated to the interested public via a *symposium* dedicated to stakeholders from *science and industry*. The one-day symposium was held in Frankfurt on December 1st, 2025 and attracted *32 external participants*, including not only slides on project outcomes but also featuring two hands-on sessions allowing the participants to apply the openly published project tools on their own. All of DLR's project results are accessible on Zenodo. Also, all developed software modules are freely available on GitLab.

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