



1 With FENIA, the future utilization of conventional power generation can be determined. Photo: Creative Commons Attribution-Share Alike 2.5 Generic

## FENIA - THE POWER PLANT MODEL FOR GERMANY

### Advanced System Technology AST

Am Vogelherd 50  
98693 Ilmenau, Germany

#### Department Energy

Dipl.-Wirtsch.-Inf. Oliver Warweg  
Phone +49 3677 461-111  
oliver.warweg@iosb-ast.fraunhofer.de

Dipl.-Math. Steffi Naumann  
Phone +49 3677 461-104  
steffi.naumann@iosb-ast.fraunhofer.de

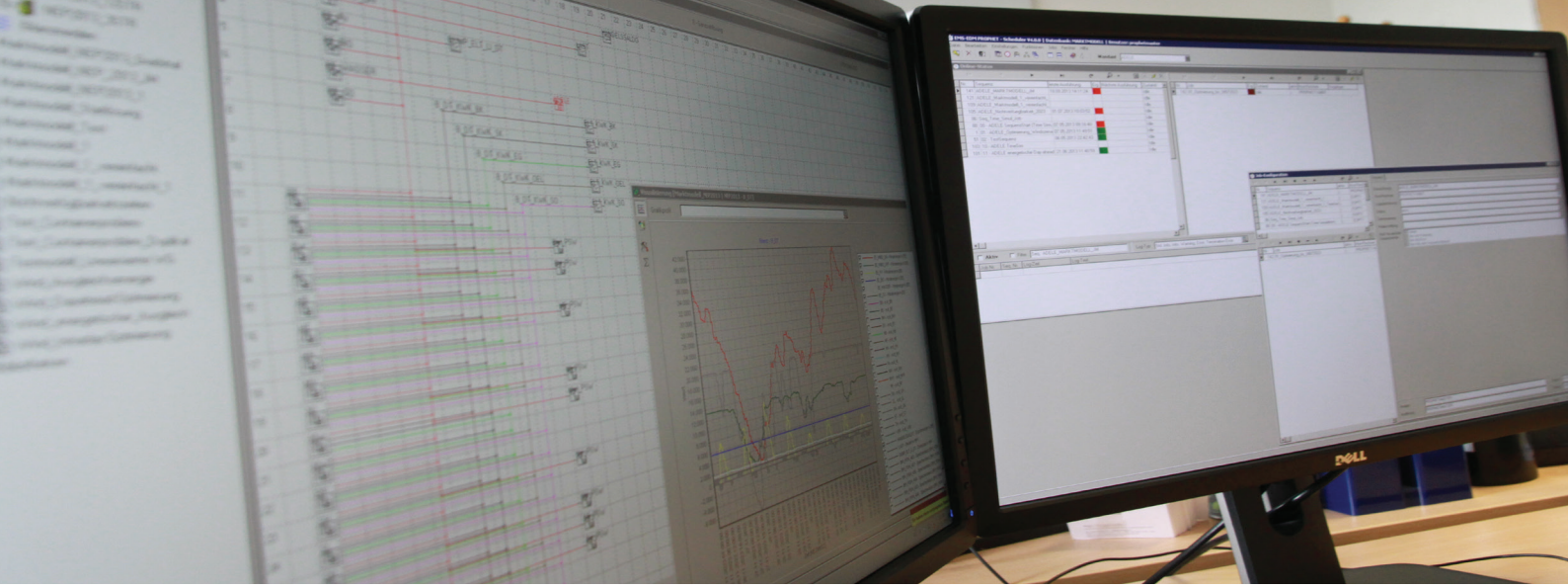
[www.iosb-ast.fraunhofer.de](http://www.iosb-ast.fraunhofer.de)

### Challenge

The rapid expansion of renewable energies – wind and photovoltaic plants with a cumulated output of about 94,000 MW were installed in 2017 alone – causes an increased investment uncertainty in the field of conventional electricity generation. Whether future full load hours, merit order prices or CHP-demands: For the construction and management of adjustable and non-fluctuating power, reliable key figures are needed on the basis of which long-lasting investment decisions can be taken. These data do not only affect conventional electricity generation but, by means of direct marketing, also the electricity generation from renewable energies.

### FENIA

With the fundamental model FENIA (fundamental model of the energy business of Fraunhofer IOSB Advanced System Technology AST), a powerful tool for the simulation of future merit order prices was created. The energy management solution EMS-EDM PROPHET® with its state of the art optimization module RPS forms the basis. In FENIA, all German power plants (broken down by plant unit) as well as the generating capacities from renewable energies and pumped-storage power plants are stored. Both for the past as well as for the future, the utilization schedule broken down by hour and the degree of capacity utilization of power plant technologies, energy storages or new technologies can be determined according to merit order.



### Model characteristics

- Mixed integer linear programming (MILP)
- Target function: Minimization of total system costs
- Time basis: Hour
- Simple modelling with graphical topology editor
- Creation and utilization of scenarios for model variation
- Extensive mathematical functions for the calculation of individual tasks
- Openness for customer-specific processes
- Automation

### System requirements

- Optimization system: EMS-EDM PROPHET®
- Modelling languages: GAMS
- Solver: CPLEX / GUROB

### Features

- Illustration broken down by plant units of all German power plants including renewable energies and pumped storage power plants based, amongst others, on the Federal Network Agency List with a total capacity of more than 180,000 MW
- Illustration of the future electricity generation from renewable energies based on the network development plan 2013 for the years 2023 and 2033
- High correlation of the merit order prices from the model for the EEX Day-Ahead-Price for the base year 2011
- Resolution per hour
- Analysis per state is possible
- Consideration of cross-border capacities and trade balances with European neighboring states

### Fields of application

- Simulation of future merit-order prices
- Increased security for investment decisions and future repair measures
- Determination of future full load hours for conventional electricity generation and energy storages
- Economic considerations of price optimal scanning of today's and future residual loads

