



## RISK MANAGEMENT FOR ENERGY UTILITIES

Energy utilities are subject to a manifold of risks. One of the main challenges is the successful modelling, analyzing, and assessing of these risks. Risk management is therefore at the heart of all operations in any energy utility.

Often, the risk management decisions are based on the complex and confusing calculations in spreadsheets. However, there are several risk management software packages available on the market, but usually these require a transition to the format of the risk controlling software. Hence, these products come at high integration costs and are unlikely to fulfill specific demands of an energy utility.

The Financial Mathematics department of Fraunhofer ITWM has developed a software package for risk management, which can be run independently of the portfolio management (PFM) system and can include data from different sources and of different formats.

This was done in cooperation with practitioners of a big German energy utility and a consultancy company for the energy industry. Therefore, the software has already been tested from different points of view.

The interfaces allow compatibility with the existing trading and PFM software environment. The application is accompanied by an efficient and easy-to-use reporting system.

The computational logic is able to assess complex risk indicators and hedge methods. Furthermore, the software is not bound to the restrictions of spreadsheet risk analysis and profits at this point from the rich experience and expertise in financial mathematical modelling of Fraunhofer ITWM. Standard approaches, such as approximation by normal distributions, do not always adequately describe reality. Fraunhofer ITWM developed a model to represent all observed commodity price phenomena such as jumps or negative prices.

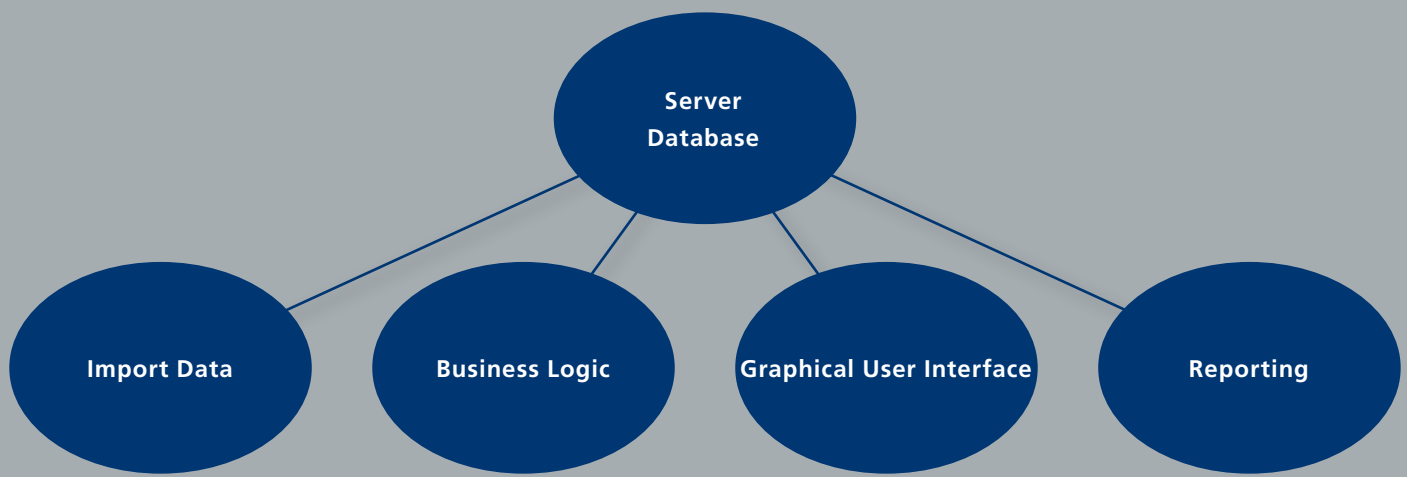
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### Implemented Risk Indicators

The risk management software is able to assess the following risk indicators:

- Mark-to-market
- Open positions
- P&L
- Hedges
- Value-at-risk/Profit-at-risk
- Credit risk
- Liquidity risk
- Temperature and profile risk

Extension of the above methods with utility-specific risk indicators (e. g. excessive rain or draught for hydropower) is possible.

### Applied Methods

The above risk indicators are implemented according to the analytical standard approaches. However, also more complex simulation models using Monte Carlo methods to compute the risk indicators are implemented.

The simulation model is specifically developed by Fraunhofer ITWM for modelling spot and futures prices of commodities such as electricity, gas, and CO<sub>2</sub>. The calibration of the model parameters is also part of the software.

Furthermore, a scenario-based valuation is possible, such that the software is also compatible with simulation methods from third parties. These can be imported through the graphical user interface.

### Software Architecture

The risk management application is designed according to a client-server software architecture, meaning that all computationally expensive jobs (importing data, calculations) are centralized on the server-side, and all other communications (GUI, reporting) are decentralized at the client-side. Furthermore, every component works autonomously and communicates with the other components through clearly defined APIs. The software is developed within the .NET Framework and therefore possible to be installed on all modern windows machines.

- **Server/Database:** A centralized Microsoft SQL server stores and imports all data. All computed risk indicators are also stored in the database, such that historical results can be accessed and compared at any time. User Management with password protection ensures security of the settings and calculations. Calculations can be started automatically (e. g. every night) or manually.
- **Business Logic:** The business logic is the computational heart of the software package. All computational tasks such as computation of risk indicators and simulation of commodity prices are done in the business logic. It is controlled by the server and is, therefore, implemented on the server-side.
- **Graphical User Interface (GUI):** The graphical user interface is main client-side

control. Different books may be combined to form new books relevant for risk analysis. All risk indicators can be computed or scheduled to be computed from the GUI. Furthermore, it is possible to import and export data through the graphical user interface. All user actions on the client-side are logged in the database with a user specified message, their username, and the changes in the data. The previous logs are also visible in the GUI.

- **Reporting:** A Microsoft Excel workbook is used to display the calculation results. All risk indicators can be loaded, together with all the user-logs and the market data. There are several built-in functions to display the results for reporting purposes, but these can be extended easily.

1 Overview of the several software components. The flexible software architecture also allows for the integration of single components