KyPowerFundamentals

KYOS Fundamental Power Market Model

Information document

Last modification date: 10 May 2016

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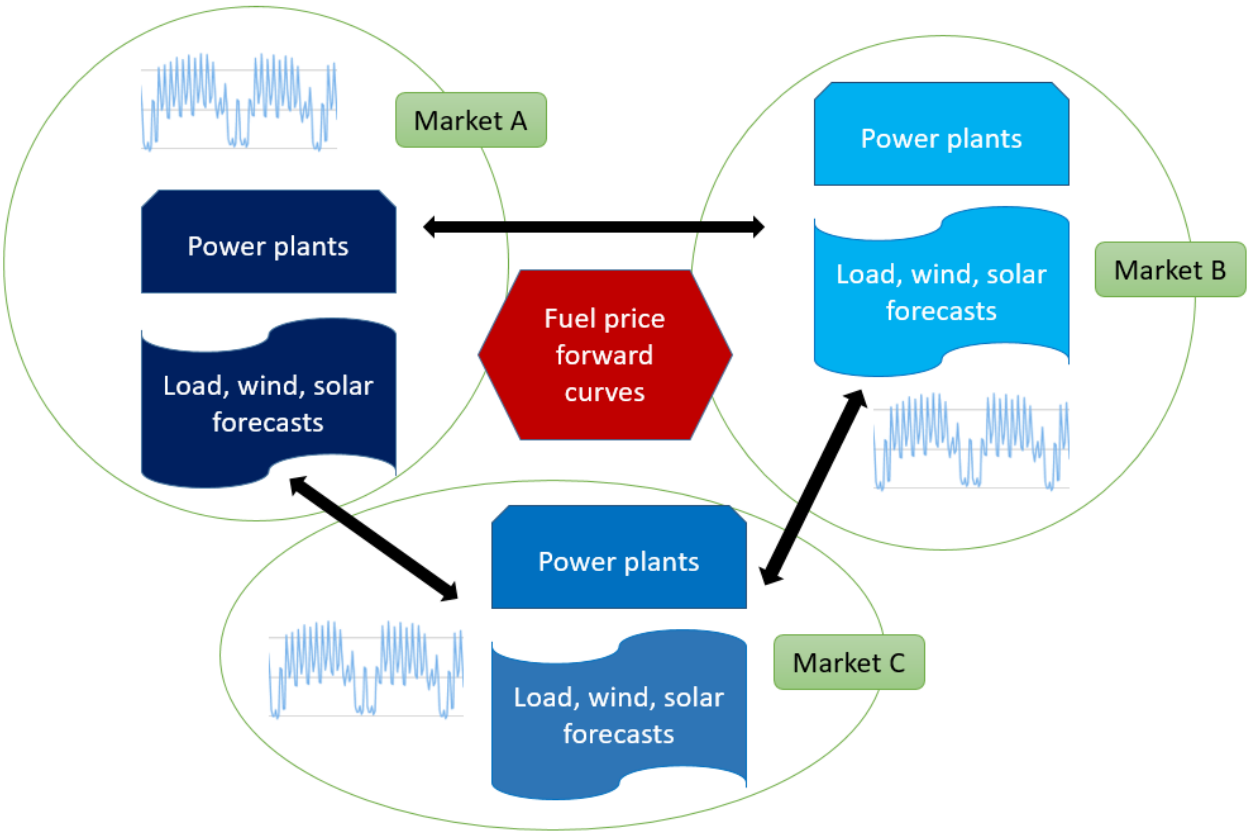
1 Power market scenario analysis

The KYOS Analytical Platform's fundamental market analysis capability offers the flexibility to explore a wide range of power market developments. It is most suitable for making medium- to long-term price assessments, analysing the implications of changes in policies, fuel prices, macro-economic variables, technological developments, and more.

The user is in full control of each scenario, with key drivers such as demand forecasts and growth, wind and solar production, commodity and emission price developments, and new builds and retirements of plants.



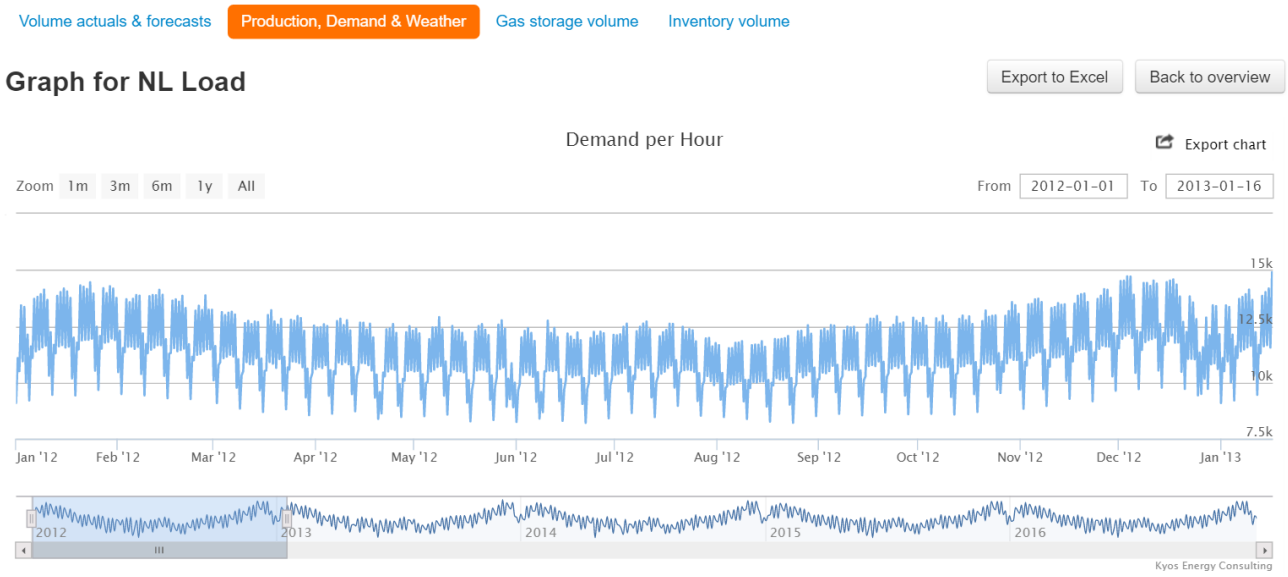
1.1 Key benefits

The KyPowerFundamentals model (KyPF) is the underlying mathematical model for the calculations. It uses advanced techniques to identify the optimal hourly dispatch of all power plants in the market. It has the unique feature of ***integrating true Monte Carlo analysis with fundamental power market modelling***, providing a much broader perspective on potential future developments than in the traditional deterministic fundamental market models. Moreover, it is easy to use with the web-based interface, sharing many features with the other models in the KYOS Analytical Platform.

1.2 Key features

- Optimal economic dispatch of hundreds or even thousands of plants
- Detailed hourly modelling of each individual power plant, including start curves, maintenance periods, minimum up and down time, etcetera
- Multi-market scenarios, including optimization of interconnection flows
- Modular and scalable model architecture, suitable for parallel computing
- Fully integrated in the KYOS Analytical Platform, including web interface and database
- Includes model for forecasting future load, solar and wind production
- Can be combined with advanced Monte Carlo simulations for generating joint simulations of p
- ower prices, fuel prices, emission prices, load, solar and wind production. See explanation at the end.

ID	Name	Commodity	First trading date	Last trading date	Schedule	Automated	Curves	Curve type	
5	EUR_USD	FX EUR USD	2014-10-17	2016-04-14	No	Yes	325	Shaped	View
6	EUR_GBP	FX EUR GBP	2014-11-13	2016-04-14	No	Yes	320	Shaped	View
14	API2 Coal	API2 Coal ARA	2014-11-10	2016-04-14	Yes	Yes	347	Shaped	View
15	NCG	NCG	2014-03-31	2016-04-14	Yes	Yes	481	Shaped	View
17	TTF	TTF	2014-11-05	2016-04-14	No	Yes	354	Shaped	View
18	EUA Carbon	EUA	2014-11-10	2016-04-14	No	Yes	331	Shaped	View
25	NBP Curve	NBP	2014-11-24	2016-04-14	No	Yes	330	Shaped	View
147	Gaspool	Gaspool	2015-07-24	2016-04-14	Yes	Yes	175	Shaped	View
160	Brent	Brent	2015-08-24	2016-04-14	No	Yes	164	Shaped	View



2 Methodology brief

2.1 Equilibrium market prices

The KyPF model employs very fast algorithms for the optimal economic hourly dispatch of power stations. This is combined with a methodology to derive the equilibrium hourly market prices, based on Lagrangian relaxation. The optimization methodology finds the hourly market prices under which the power stations in the market are optimally dispatched until their combined production equals the demand. When multiple markets and interconnection capacities have to be optimized jointly, then the model also allocates hourly transmission flows between the markets.

2.2 The next step: Monte Carlo simulations

A typical fundamental market model generates a single deterministic forecast of the hourly power price. Some of the models furthermore allow the user to analyse various user-defined scenarios. This can either take the form of multiple load and renewable production forecasts, or the form of 'shocks' or sensitivities to fuel price curves or other primary inputs. All of this is fully supported in the KYOS solution.

The next step in fundamental market modelling is the integration of truly stochastic Monte Carlo simulation with fundamental analysis. This has the following potential benefits:

- It can lead to more realistic price forecasts for peak hours (higher prices) and offpeak hours (lower prices). For example for peak hours, suppose that the market price at the average load is 40 €/MWh. In a low load simulation it may go down to 30 €/MWh, whereas in a high load simulation it may go up by comparatively a lot, e.g. to 60 €/MWh, implying an average outcome of 45 €/MWh. Considering this load uncertainty, 45 €/MWh is a better price forecast than 40 €/MWh.
- It can provide a more realistic assessment of flexibility value in the system, in particular of flexible power stations, pump-hydro facilities and batteries. Monte Carlo simulations are required to create realistic variations and unveil the true market value of such assets.

The use of Monte Carlo simulations allows for a much wider and more realistic variety of scenarios. Embedded in the KYOS Analytical Platform is a Monte Carlo simulation model for energy prices, demand and renewable generation. If these simulations are fed into the fundamental market model, the result is a set of Monte Carlo simulations of hourly power prices. This combination of (stochastic) Monte Carlo analysis and fundamental power market modelling provides a hybrid approach to assess the uncertainty in market dynamics.