

RISKS IN ENERGY MANAGEMENT IN POLAND

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Abstract

The article presents an outline of the main problems of risk management to trade in electricity and natural gas on Polish market. The development of energy market deregulation and the crisis caused by the Enron scandal forced the sector companies use advanced methods of financial and risk management systems used previously in mature financial markets. The primary role is played by the introduction of statistical and econometric methods of risk management for the portfolio of contracts for the supply and sale of energy and its volatilities. Deregulation meant that wholesale energy prices are largely shaped by the interplay of market and estimate the risk of the positions and contract management requires preparation of forecasts of prices for each hour.

Keywords

risk, management, energy management, optimization of energy management,

Introduction

Reviewing the literature on the subject, it can be found a wide variety of risk classification, most general division is market risk and specific¹. Specific risk is related to the specifics of individual companies, while the market is expressed by the covariance deviations occurring changes in general economic development².

The electricity market is the market, which brings together different types of risk going through all steps of manufacture, distribution and sale. Analysing the present electricity market risk, it may be noticed that some of them are permanent, they bound inseparably with a competitive market, which at the same time due to the structure and rules. Another part is temporary, due to the process of implementation of the new nature of the market and the conditions that come with the period of operation of a centralized market³.

Production of electricity due to the nature of the market, legal regulations and the specificity of the product, which is electricity, belong to high-risk ventures. The liberalization of energy markets, deregulation of prices and structural changes (consolidation of the industry) increased often poorly known and difficult to assess the risk of the functioning of the energy industry. One of the most important tasks carried out at all levels of government is to mitigate risk and maintain it at a specified (acceptable) level. To the processes associated with risk were

1 Schroeck W.G., *Risk Management and Value Creation in Financial Institution*, Wiley & Sons, New York 2002, s. 2.

2 Zachorowska A., *Ryzyko działalności inwestycyjnej przedsiębiorstw*, PWE Warszawa 2006, s. 59.

3 Zawada M., *Charakterystyka i klasyfikacja ryzyka występującego na rynku energii elektrycznej w Polsce, Ryzyko na rynku energii*, Politechnika Częstochowska, Częstochowa 2014, s. 28–29.

conducted in an efficient manner, it is necessary first to identify potential hazards, risk assessment and then at the end to take steps to reduce it. These activities must be included in the standard procedures and be implemented in a systematic way.

The main hypotheses that should be placed based on the findings⁴:

- Quantum measure of the threat effectively describe the risks in the electricity market,
- Seasonality of electricity affects the choice of methods for estimating the value at risk in the electricity market,
- Derivatives are a useful tool for securing the position on the electricity market,
- Investment strategies, established at the same time taking into account the time horizon, the level of fault tolerance and preferences of investors, are a useful tool in risk management in the electricity market

Energy Economy in Poland

Transmission of electricity in Poland, a network of high voltage is being implemented by the Group Polish Power Grid Company, which owns most of the transmission assets, which consists on the National Transmission System. The system has 11 routes with the systems of neighboring countries including:

- 750 kV one connection with Ukraine,
- 450 kV one connection with Sweden,
- 400 kV connection - two from the Czech Republic, one from Germany and Slovakia,
- 220 kV connections – one from Germany, Ukraine and Belarus, two of the Czech Republic.

Distribution of electricity is carried out by regional distribution companies that perform simultaneously the function of electricity trading. Due to the possessed control over the divided regionally networks of medium and low voltage distribution companies occupy a monopoly position in distribution supported markets⁵.

Polish energy market since 1 May 2004 is part of the European Union energy market. At the time of accession to the EU, Polish energy market was definitely over-regulated market. Formally independent regulator, through administrative determination for all groups of customers purchasing prices of electricity, maintain energy prices at unreasonably low, and in the years 2002–2007 almost unaltered level. This level of energy prices in turn made it impossible to make rational investment decisions primarily in the production of energy. Common energy market of the European Union in accordance with existing regulations is a free and competitive market, where the client has an effective opportunity of choosing from among multiple bidders, with the best offer for him. Polish energy market since Polish accession to the European Union on its competitiveness lost. This occurred primarily as a result of ownership changes carried out by the Treasury, which led to a 4 consolidated groups, including one group of dominant position in the market. Such an administrative structure shaped energy market deepens its inefficiency and thus reduces the competitiveness of the Polish economy. The situation is improving (especially from the point of view of consumers) the actual unbundling

4 Ganczarek A., *Metody statystyczne w analizie i zarządzaniu ryzykiem na polskim rynku energii elektrycznej*, Zastosowanie metod statystycznych w badaniach naukowych III, StatSoft Polska 2008, s. 105.

5 Grabara J., Kurzak L., Lis T., *Systemy informatyczne w energetyce*, Częstochowa 2007, s. 14

of transmission and distribution system that allows real change supplier. Another positive development from the point of view of the evolution of customers is kept by the Transmission System Operator balancing market - from 1 January 2010 is the first element of the energy market in Poland, which is reflected actual cost structure⁶.

Polish electricity market is facing a significant challenge: the construction of new power to replace the existing and meet the growing demand for electricity, a significant reduction in regulatory risk, which effectively prevents or significantly increases the cost of investment decisions, the implementation of new European Union regulations and, above all, the realization climate policy objectives of the Union.

Investment decisions in the power sector have a special feature that analyzed the payback period is very long - up to 40 years. This means that the investment decision on the energy market is crucial to assess risk and generated cash flow. While the level of costs associated with the investment is relatively unchanged.

In the Polish conditions in 2010, we are dealing with virtually every element of regulatory risk, which is crucial to the decision to make the investment:

- EU climate policy (proposal emission reduction of 20%, with a tendency to increase the limit of 30%),
- allocation of CO₂, the key allocation of free permits,
- emissions trading scheme after 2012 regulations for other industrial emissions,
- regulation of energy prices from 2009 below market prices,
- lack of independence of the regulatory body,
- State interventionism: the state is the regulator, the dominant player in the market and administrator energy law and regulations,
- lack of transfer regulations of EU directives into Polish law (eg Directive on energy efficiency, CCS, the third liberalization package, the Directive on the promotion of OZE)⁷.

Input elements causing the risk in terms of power management.

In the production processes we are dealing with a lot of input factors, on the basis of which we can identify potential risks and try to minimize its negative effects. It is known that the risk may also result in a neutral output, or situations that deviate from the goals, but not necessarily, speaking colloquially bad.

In the electricity market, we can observe a number of factors likely to affect the established results, there are, among others quite specific input elements causing risks for this sector of the economy. These elements can be divided into three main groups

In the electricity market, we can observe a number of factors likely to affect the established results, there are, among others quite specific input elements causing risks for this sector of the economy. These elements can be divided into three main groups⁸: related with power generators, related to the trade of electricity, caused by commercial operators.

6 Związek Pracodawców Prywatnych Energetyki, *Analiza trendów rozwoju branży energetycznej*, Janusz Bil, Ewa Gąsiorowska, Wojciech Graczyk, Robert Guzik, Agnieszka Maciuk-Grochowska, Andrzej Malec, Paweł Smoleń, Polska Konfederacja Pracodawców Prywatnych Lewiatan, 2010, s. 4-5.

7 Ibidem.

8 Zawada M., *Charakterystyka i klasyfikacja ryzyka występującego na rynku energii elektrycznej w Polsce, Ryzyko na rynku energii*, Politechnika Częstochowska, Częstochowa 2014, s. 34.

The first mentioned group relates to electricity generators belong to the companies that engaged in electricity generation and those that participate in the marketing or the direction of the balancing system. The main risks with which you can meet in this group are⁹:

- Change in the price of fuel, which are used to produce electricity, the most obvious element of a risk the stability of the company.
- Creation of new generation capacity and sourcing for no capital investment risks.
- Changing the size of the production of electricity, it can cause risks associated with the stability of revenues of the company.
- Technical equipment and their possible failures, causing technical risk in units producing electricity.
- Changes in the prices of electricity, also creates the risk of instability in revenues.
- The pressure of population on the environment, causing increasingly stringent regulations.

Another group primarily concerned with energy companies that are involved in the marketing of electricity. Input elements causing the risk in this case¹⁰:

- Fluctuation in sales volume, also creates the risk that is associated selectable by the customer within national competition and foreign electricity suppliers.
- Turnover energy prices on the wholesale market. It is a very important element because it creates a risk of changes in prices and, consequently changing the size of revenues and profitability of business.
- The responsibility for the provision of transmission services. Liability the transport service, only to be switched off in case of force majeure, a threat to the safety of persons, etc. However, the operator must demonstrate the absence of negligence on his part.
- Establishing regulated prices (tariffs), associated with regulatory risk, there in the retail trade. Arrangements for regulating electricity prices have been maintained, because of the need to monitor the retail market and protect the interests of customers.
- Changes in prices and quality services system, cause risks to the quality of supply and the possibility of failure of operation of power systems.
- The loss of liquidity in the balancing market.
- Liability, the risk of damage caused by third parties.
- The occurrence of failures, network bandwidth, causing technical risk.
- Unscheduled power flows associated with the risk of cross-border electricity trading is related to the concluded contracts of sale, cost of CO₂.

9 Ibidem, s. 34–35.

10 Ibidem, s. 35–37.

The last group includes factors associated with commercial operators¹¹:

- The development of competitiveness, a change for a number of customers, it causes also need to install metering systems.
- Change in electricity prices, depends on energy demand, creates a risk of price change.
- Exchange trading electricity causes transactional and credit risk.
- Errors in the operation of information systems, cause operational risk.
- The change of legislation, this is related to the functioning of the electricity market.

Generally, any risk of the investment is numerically defined as the product of likelihood and financial impact that will have to occur. Then identify possible preventive or shielding, mitigation of its occurrence. The investor takes into consideration a number of risks, which must manage: risk of a decline in demand for your product, the risk of unfavorable changes in the prices of the product sold and purchased fuel, technological risks, loss of competitive advantage, human factors, and the like. However, the Polish regulatory environment to the fore extends risks associated with possible changes in legislation or government policy in the area. Such changes are material, financial impact on the activities of individual companies, entire sectors or markets¹².

Optimization, which is to make good decisions.

Considering the electricity market need to analyze all of the in the last chapter input elements entailing risks, as well as possible to minimize the risk, and that have adverse consequences for it, or optimize.

Analysis of the mathematical aspect of risk is primarily based on probability and statistics, and therefore the following breakdown definitions in the available literature covers this aspect of the measurement capabilities. The risk of being a combination of event and its consequences. Given any product, the quantity of its production, together with information on defective elements can be performed statistical analysis. About how very different from the expected value is dependent on the standard deviation. The greater the deviation, the observed values will be different than expected. Therefore, when the deviation is greater, the less useful it becomes expected value, in the opposite situation, we can accurately predict the actual value. So the risk is very small, because we can accurately predict the future and the level of losses. Therefore, the standard deviation is very accurate way to measure the risk¹³.

Complemented by the standard deviation is the probability, in which using a probability distribution can be much easier to carry out calculations and model risk. However, in this case, there is one drawback, because it must be assumed that examined the phenomenon actually behaves in line with the schedule. Given the aforementioned defective product batches, you can use the binomial distribution to calculate these deficiencies. Then we must assume that the presence of one absent, no relation to the next, but in fact, the situation may look very

11 Ibidem, s. 37–38.

12 Związek Pracodawców Prywatnych Energetyki, *Analiza trendów rozwoju branży energetycznej*, Janusz Bil, Ewa Gąsiorowska, Wojciech Graczyk, Robert Guzik, Agnieszka Maciuk-Grochowska, Andrzej Malec, Paweł Smoleń, Polska Konfederacja Pracodawców Prywatnych Lewiatan, 2010, s. 27.

13 Staniec I., Zawila-Niedźwiecki J., *Zarządzanie ryzykiem operacyjnym*, C.H. Beck Warszawa, 2008, s. 26–27.

different, not least because of the deregulated machine. Other schedules used in the modeling risk much better to check, for example, the Poisson distribution, but still the problem is not completely solved¹⁴.

The study examined two methods of short-term forecasting CRO. Both methods use published by TSO forecasts global demand for energy in the framework of the so-called. the initial plan coordinating daily. Weather OSP is used in the Preliminary stage, a linear predictor for the CRO and the deviation from this prediction is modeled process SARIMA. Methods of different methods to approach multiseasonality data.

The first method, CRO₂₄, eliminates seasonal weekly by varying the number of offset 168, and modeling the rest of the seasonality of the daily uses applied globally process SARIMA $(5,5, d) \times (5,5, D) 24$, the $d, D \in \{0, 1\}$. That is, assuming periodicity 24 and the operators, and autoregressive moving average for both the delay by multiples of one and the delays in multiples of the 24 parameters have a range 5 $d, D \in \{0,1\}$ denote rows of differential operators, respectively increments 1 and 24, and their values are selected on the basis of the information criteria AIC and BIC.

The second method, CRO₇, breaking a series of 24 independent components for each hour. For each component is then used in independent processes SARIMA $(5,5, d) \times (5,5, D) 7$ to the remainder of the seasonal week. This is on the periodicity 7, and the remaining points are covered with those methods CRO₂₄. In both methods the model parameters are estimated for historical data length of 5 weeks. Both methods give comparable results for the four-week test period 03.03.2009 – 30.03.2009, but noticeable drawback is the large computational complexity of the procedures used in parameter estimation models¹⁵.

	CRO ₂₄	CRO ₇
MAPE ^H	7.71	7.86
σ (APE ^H)	10.37	10.40
Computing time	About 2 h	About 2 h

Source: Kozakiewicz M., Kwas M., Prognozowanie cen energii elektrycznej na rynku bilansującym z użyciem ofert bilansujących, opracowanie w ramach badań statutowych IE SGH, 2010.

Table 1. Average hourly forecast errors relative computation times and methods based on models SARIMA for the period 03.03.2009 - 30.03.2009.

¹⁴ Ibidem, s. 28–29

¹⁵ Kwas M., *Zastosowanie Metod Ekonometrycznych Na Konkurencyjnych Rynkach Energii Elektrycznej*, Metody Ilościowe W Badaniach Ekonomicznych Tom XI/2, 2010,

The concept of risk management in the energy company

Risk management is the process in which we have to deal with many factors that need assessment carried out in conjunction with various data and use of expertise. Historical knowledge is required here, but the system of risk management and decisions need to be proactive, that is based on the prediction of future events and limiting their consequences. You can either use methods such as scenario analysis, simulation, modeling. However, this requires advanced knowledge and skills, so often this is used experts both internal and external. Expertise is expensive and not always available. The solution is permanent expert systems allow you to build the knowledge base and making it available indefinitely, while maintaining a reasonable price. Expert systems can turn the information received in the form of input data in knowledge useful, which allow you to improve the quality of decisions¹⁶.

The crises in the financial sector that are repeated in recent years, spread to the whole economy indicate that the current approach to risk management is inadequate to the threats. Currently, the risk is defined in many ways and adopt them according to the methods of risk management. Typically, within one organization there are a few cells which deal with different types of risk. The reason for this is often of a formal risk management perceptions. These risks are defined in terms of regulations and configured enterprise management systems. In the energy sector there are a number of risks, some of discussed in chapter four of this work is closely connected with each other and also one risk may be a special case of the second. Operational risks in the energy company is common and occurs continuously. The concept of universality must be understood so that the risk exists in all places organizations and all the processes, although its nature and the way of materialization may be different. Continuity means that at every moment of its existence, the organization is at risk. There is no break the time at which risk exists, although it may vary depending on the type of activity.

Currently, theorists and practitioners are looking for ways to improve the management of information processing and distribution¹⁷. Develops tools for this purpose “processing of data in the cloud” and mobile technologies. However, this leads to a high complexity of an organization’s structure while improving its maintenance costs and contributing to the emergence of new types of risk¹⁸.

Ultimately, companies should strive to build an integrated risk management system. However, due to the design and deployment best to focus initially only on operational risk. It is the risk present in all businesses regardless of industry, size and other parameters characterizing the organization. Only changes its intensity and in power is particularly high. A risk management system should be functional, flexible, accessible to all levels of management and appropriate to the user’s needs¹⁹.

16 Kapalczyński M., Kryzia D., *System ekspercki jako skuteczne narzędzie zarządzania ryzykiem w przedsiębiorstwie energetycznym*, Zeszyty Naukowe nr. 90, Kraków 2005, s. 119–120.

17 Żebrowski, M. i Waćkowski, K., *Business Inteligence dla MSP jako innowacyjny kierunek zastosowań IT*. [W:] Zintegrowany system wspomagania decyzji. Vizja Press, Warszawa 2011, s. 65–84.

18 Kapalczyński M., Kryzia D., *System ekspercki jako skuteczne narzędzie zarządzania ryzykiem w przedsiębiorstwie energetycznym*, Zeszyty Naukowe nr. 90, Kraków 2005, s. 121–122.

19 Ostrowska, T., *Management information in administration systems in Foundations of management 2*, Warszawa 2009, s. 95–110.

These conditions are satisfied expert software that provides advanced data processing and transforming them into knowledge useful in decision making at all levels of government. The rules contained in the system intelligently make a selection of information and its hierarchy and distribution. And also propose action on the basis of the collected data and rules developed by experts²⁰.

Companies no longer have to protect their monopolistic position in which the costs of their activities could flip on to customers through raising prices. The best energy companies use sophisticated modeling methods to solve key problems such as the formation of prices in the future, volatility and correlations, and then use options and derivatives for risk management. They shall also ensure that their risk management strategies include the whole range of their activities, eg. Production, supply and trade.

Practical recommendations for how to deal with market risk (identification, measurement and reduction of risk) were formulated in the following way:

- embracing risk management strategy, the whole business from production to trade,
- the creation of companies of complex control systems of risk management, including the structure, staff qualifications and procedures (documentation, processing, reporting, etc.),
- focus on the fundamental determinants of prices: analyzing the law of supply and demand (for gas demand is greater and faster impact than supply),
- inventory tracking of gas in storage, the use of weather forecasts, testing and modeling of relationships (correlation) of all these factors, etc.,
- separation gas purchases into smaller batches and spreading them in time: on the basis of the analyzes can be done to optimize purchases instead of using a simple average of the various random days,
- diversification of portfolio purchases by using a combination of physical delivery contracts short- and long-term contracts and paper (futures, options, swaps, etc.) proper care for the collection of income: the fight against the inaccuracy of readings of measuring instruments, with poor organization of toll collection from customers like.

Managing price risk can be reduced to three main boards of the aforementioned²¹: focus on the basic determinants of the price, splitting time purchase and diversification of portfolio purchases²².

Conclusion

The development of the energy market, competition and deregulation are forcing companies to use more and more sophisticated methods of risk management and financial, typical for a developed capital market, such as derivatives and econometric methods of risk management. However, increasing operating efficiency is not only a requirement for competition between energy companies, but also the need to compete with other sectors for access to financial resources for development. The crisis of confidence in the sector forced the company to en-

20 Kapalczyński M., Kryzia D., *System ekspercki jako skuteczne narzędzie zarządzania ryzykiem w przedsiębiorstwie energetycznym*, Zeszyty Naukowe nr. 90, Kraków 2005, s. 122.

21 Corby P., *Combating Price Volatility in the Natural Gas Market*. Power and Gas Marketing, March/April 2002..

22 Jaliński A., Zbigniew Ł., *Problemy zarządzania finansowego i zarządzania ryzykiem w sektorze handlu energią*, POLITYKA ENERGETYCZNA, Tom 9 _ Zeszyt 2 2006, s. 133–134,

sure increase the credibility of financial information and increase liquidity, including through the introduction of clearing systems. Analysing the electricity market can be seen how many factors there That expose companies to the risk of both financial and political, or regulators. In previous chapters they are classified.

Analysing the electricity market can be seen how many there factors that expose companies to the risk of both financial and political, or regulatory. In previous chapters they are classified, but the political risk is a separate element connected with the possibility of armed conflicts, terrorism or economic instability and social.

Instability and unpredictability of regulations and lack of a coherent, long-term government policy, which would involve the authorities in relation to the objectives, means that only the definition of the project baseline scenario for the next few years is very difficult. The consequence of increased regulatory risk is a negative return on investment analyzes. And that's not the non-financial factors (eg. Political) is the only reason for suspension of investment in the manufacturing sector, with which we now have to deal with.

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