Integration of Financial Risk with Efficiency Measurement: Case of Summer 2006 in Electricity Sales Business in Poland

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Abstract

Decisions taken in order to achieve planned targets are always connected with risk that influences the resources of the company—both in positive and negative ways. It should be considered through a capital perspective. That is why it is necessary to state that business decisions always have a financial character, which requires burdening them with costs of risk capital connected with each decision.

Hence, forming the risk capital—the insurance surplus of capital—should support achieving the superior target of the enterprise: maximizing the long-term value of the company. This characteristic of risk implies the consequences of efficiency measurement. There is a necessity to extend the analyses of return on capital by taken risk. That is why the risk profile should be considered and budgeted in the financial planning.

Failure to take into consideration the risk in the process of management control and evaluation of management efficiency leads to inefficient resource allocation in enterprise and reduction of information utility, which is provided to the company's management. It can falsify the real picture of its financial situation. Therefore, the financial analyses should be expanded by risk capital and unrealized results (unrealized PnL) even in the companies that are active in other than financial markets. The efficiency of the risk taken should be a basis for decisions of capital allocation and activities development.

The above-presented approach should be grounds for integration of the risk management with overall economy of enterprises. It defines the target of the paper— the analysis of the influence of risk (that took place during winter and summer 2006) on economic results of utilities selling power to final customers.

The authors believe that integration of the financial sphere in enterprises with risk-controlling techniques should make the process of management and efficiency control more consistent, installing the risk awareness into overall activity of the individuals making decisions. Such a situation improves steering their behaviors in the direction of maximizing the enterprise long-term value for all stakeholders.

1. Introduction

Risk management is seen in many companies as an activity of a small group of people that is isolated from the core activity of enterprise—even as a kind of art having no influence on managers' decisions. It should be changed. However, until the moment when risk management and risk controlling are an integral part of the management process, these activities are a kind of an intellectual exercise of the staff, without any influence on company activity. However, if we describe risk in the below-presented way, it should be considered as a crucial item of overall economic results management:

Financial risk—in this paper—is defined as the value of unplanned change of companies' capital that is caused by discontinuity of trends determining the planned conditions of the companies' actions. That is why risk value should be defined as the capitals necessary to secure both the results of company activity and continuity of its action, constituting the value that can be added or lost during the executions of company plans.

Hence, only the integration of the risk-controlling action with capital allocation and evaluation of decision effects allows motivating managers to achieve targets in the most efficient way from a resources usage perspective.

Chart 1. Comparison of Risk Management and Risk-Controlling Areas in an Enterprise
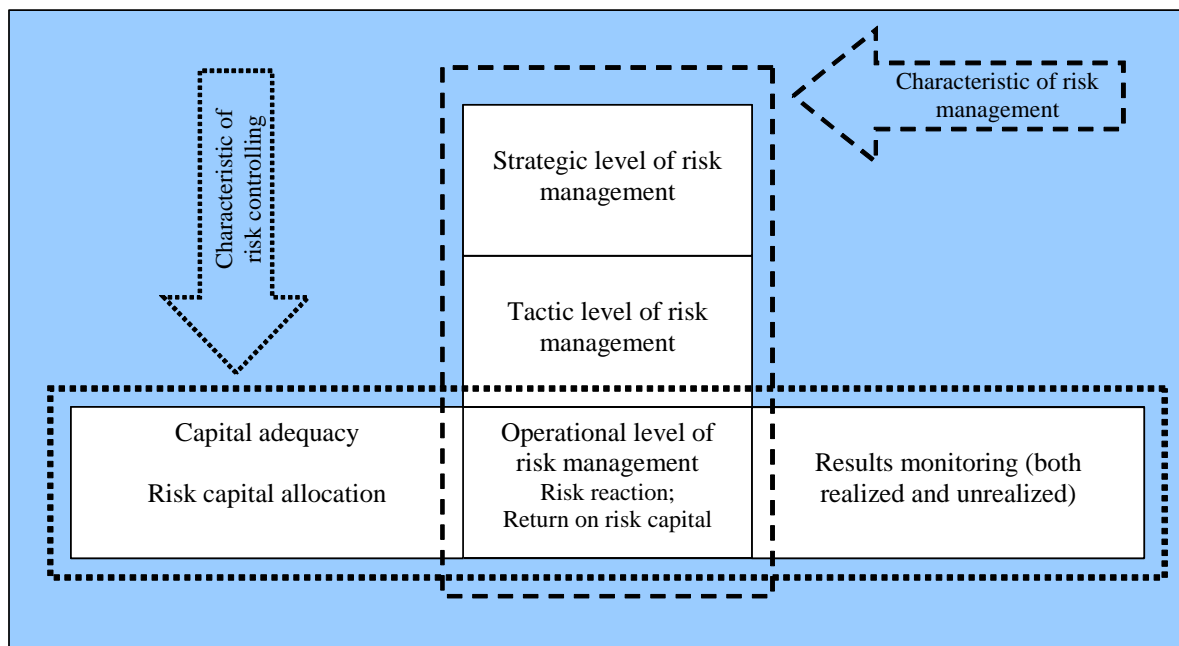
Source: Own study.

Efficient management of risk influence on a company's economic results is based on global analysis of business processes and identification of risk connected with these processes. It should be a basis to create the business model of the company. It should cover all elements of the results volatility, enable the efficient risk measurement, involve capital allocation and report risk-adjusted results in various analytical dimensions.
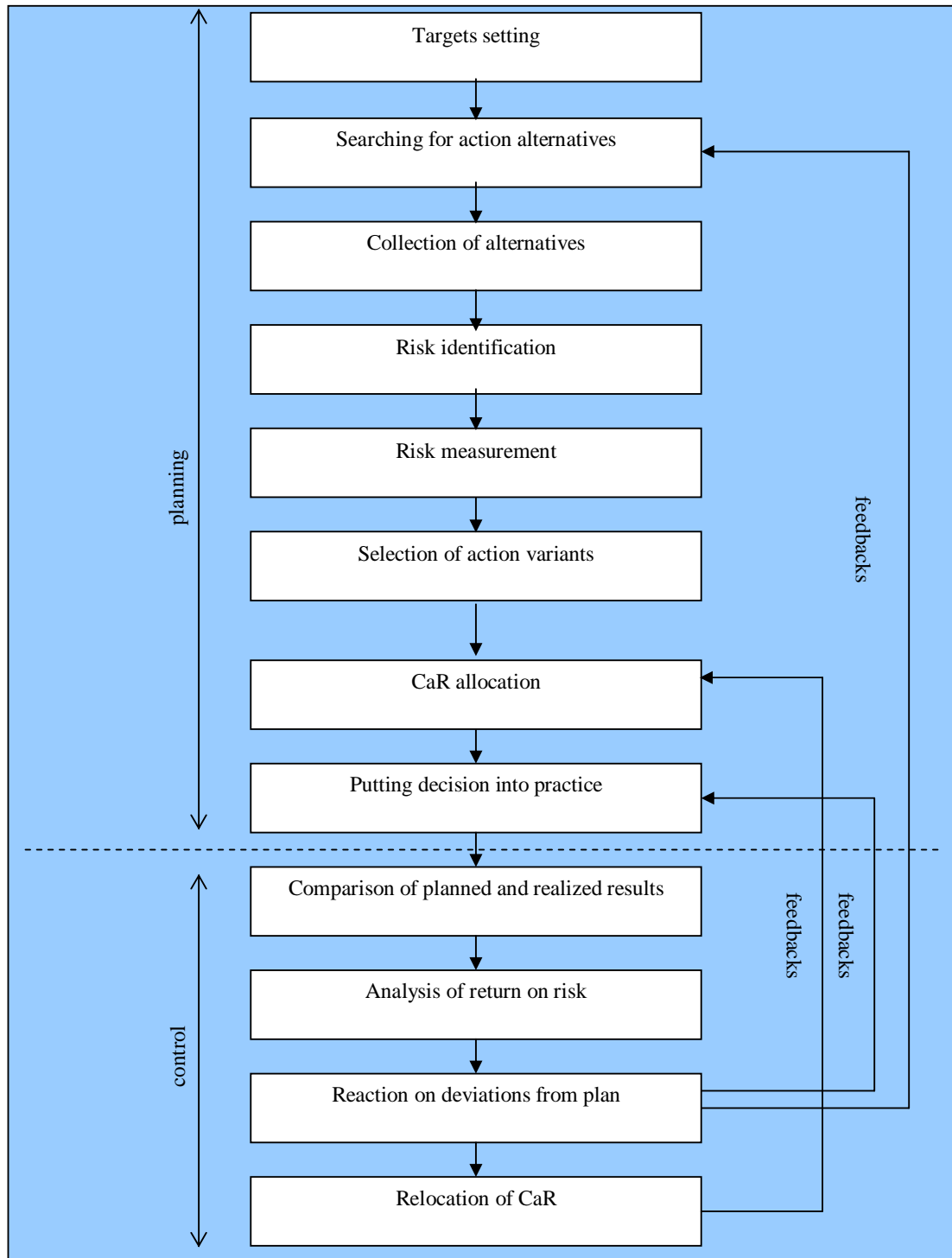
2. Risk Controlling in the Company: Structure and Function

The task of risk controlling in the organization is to depart from treating risk only from the perspective of a threat and a necessity to secure against it. It is necessary to start the efficient management of risk taking, including in this process all the factors potentially leading to both losses and extra profits.

> **Risk controlling is, in this perspective, the over-functional system of steering the stability of expected economic result execution—having the cybernetic characteristics making it possible to implement all kinds of economic activity.**

This situation determines the final structure of risk controlling as:
- capital adequacy and correctness of risk capital (CaR) allocation to the responsibility centers, what reflects in the risk-taking limitation strategy;
- risk monitoring and steering risk exposure level that should be correlated with indications concerning the expected level of profit/risk relation;
- results monitoring—both realized and their projections (risk-adjusted).

Chart 2. General Presentation of Decision-Making Process, Planning and Results Control in the Risky Environment

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                    │        Relocation of CaR         │───────┘  │
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Source: Own study.

Hence, it can be assumed that the efficient decisions are those which allow the company to maximize the expected level of return on invested capital (including CaR) by taking the acceptable risk. The most efficient decision, within the group of alternatives characterized by the same risk value, secures the highest return. The set of such decisions should guarantee the lowest risk level by given return rate.

Future risk depends on actions taken today, while decisions should be considered in the perspective of current risks. Optimal decisions will be taken when we couple the individual's subjective approach to risk taking and objective guidelines of risk instructions. On the basis of their assumptions, there is a measurement allowing for prioritization of alternatives for risk taking (decisions) from an economic results perspective. It should allow for the sustainability of added value creation in the company. However, it should not create the obstacles for risk taking—on the contrary, the balance should be built between risk aversion and taking advantage of opportunities.

Topics form area of risk controlling that should be solved by management control

- Each decision is connected with risk taking. Therefore, the risk underestimation in management control and efficiency evaluation of managers leads to the ineffective capital allocation in the organization and reduction of the utility of the management information system. Moreover, not taking into consideration risk during results settlement can falsify the picture of real customers and products profitability and even the company's financial situation.

- Risk should be considered in the perspective of a company's capital that is the superior source of financing its activity. Such an approach has the fundamental implications for the decision efficiency analysis. This should also consider the CaR. That is why risk should be budgeted during the financial planning.

- As was previously mentioned, each decision is burdened with risks that influence the resources of a company. That is why both decisions and risk should obtain the financial characteristic—each economic activity should be burdened with costs of specific risk capital.

- The proper creation of efficient measurement considers risk, streamlines the attitude to risk taking and maximizes the decision efficiency. It denotes maximizing the economic profits by given costs, minimizing the costs in relation to given profits and maximizing the economic profits by minimizing the risk exposure. Hence, if the risk becomes the non-welcome variable, risk should be considered as a factor lowering the efficiency. If the mentioned approach is introduced, managers obtain the useful information concerning the whole picture of results, considering both realized and unrealized results. Based on the obtained information and frames of risk tolerance, they should aim to increase the area of secured results and to limit the area of uncertain profits.

The risk measurement should be treated by the management control process as part of the financial planning process influencing the definition of demand for risk

capital, while CaR allocation defines the frames for risk taking. It should be the basis for measurement of value added created in the company.

3. Evolution of Risk Management on Power Market

Risk management should influence the whole activity of utilities on the competitive power market: volatility of both prices and volumes, limited market liquidity (comparing to financial markets), credit risk, instability of legislation and regulations and operations mistakes. Hence, the significant evolution of risk management in electric utilities is visible. Not long ago, it was considered only from the perspective of risk modeling and market analysis—during this period the risk complexity concerned only market and credit risk factors.

Next, the risk management influence—following IAS 39 regulations—was expanded on the accountancy. After entrance into life, the MiFID Directive,[1] the new dimension of regulatory exposure was also created.

The importance of risk management efficiency in the power industry is created by a characteristic of risk profile that is a product of many specific factors (only for the power market), affecting each other. The combination of prices seasonality, jumps, instability of environmental regulations, changes in the intensity of demand and supply side (e.g., weather conditions, fixed assets quality in power plants and transmissions companies, fuel prices, etc.) causes significant difficulties in the risk analysis. It is of great importance for the whole activity of a company. Mistakes made in market and risk modeling can be reflected in the faulty decisions regarding investments and hedging or opportunities utilization. Moreover, the disturbances of the market mechanism lead to different price levels than predicted based on the market models. It requires the consideration of possible inaccuracies in the modeling.

The risk controllers should be ready to give hints to decisions concerning the risk reaction. Reaction to risk should ensure both the minimization of unexpected losses and securing the utilization of market opportunities.

4. Analysis of the Retail Portfolio of the Polish Utility

The main risks for the retail portfolio of the power utility are the unexpected price and demand changes. Risk factors are: uncertainty of weather conditions, future demand, technology changes or new competitors.

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[1] *Directive of the European Parliament and of the Council of 21 April 2004 on Markets in Financial Instruments amending Council Directive 85/611/EEC and 93/6/EEC and Directive 2000/12/EC of the European Parliament and of the Council and repealing Council Directive 93/22/EEC*, DzUrz UE L 145, z 30.04.2004 r.

In this paper, the authors concentrate on the analysis of the risk of tariff customers demand changes that results from weather conditions. It was defined as profile risk. It is the product of variation incorporated into sales tariff (swing option)—sales tariff transfers this risk to the suppliers' portfolio.

The change of power consumption can be connected to the change of the purchase profile (for example, limitation of the consumption during cheap hours and increase of demand in the peak hours), which, in the situation of the swing option and executed hedging, can significantly change the expected margin. Demand changes can cause the significant price fluctuations, which can negatively influence the results of companies closing open position.

From this perspective it is useful to perceive the expected result as desirable value and risk, defined by one of the measures (variation, deviation, VaR, PaR, etc.) as an unwelcome effect. The higher the risk, the less probable it is to achieve the planned or expected value. The volatility emerges together with something unexpected. Hence, risk can be considered in the financial planning as an element of costs that is undesirable—it should be treated as decreasing the portfolio efficiency. In this situation it is desired to maximize the welcome values that are expected profits: <u>the rule should be to maximize the potential, expected results and to minimize the exposure to unexpected risks</u>.

The above presented approach permits rationalizing the retail portfolio management: some value drivers increase while others are reduced—it is important to correlate its volatility properly. It can be a basis to expand the area of secured results and minimize the unwelcome risk during hedging action (within the organization risk tolerance)—striving not to reduce the opportunities.

4.1 Profile Risk in Retail Portfolio Position's Hedging

The power supplier, if it leaves the swing optionality in the sales contract, is exposed to the demand changes just before delivery (it should be adjusted on the suppliers' costs). This risk—profile risk—is inseparably connected with hourly changes of demand. It is the product of volatility of spot prices and power consumption, because it is correlated with necessity to close the unexpected open position.

Chart 3. Hedging by Closing Long and Short Position
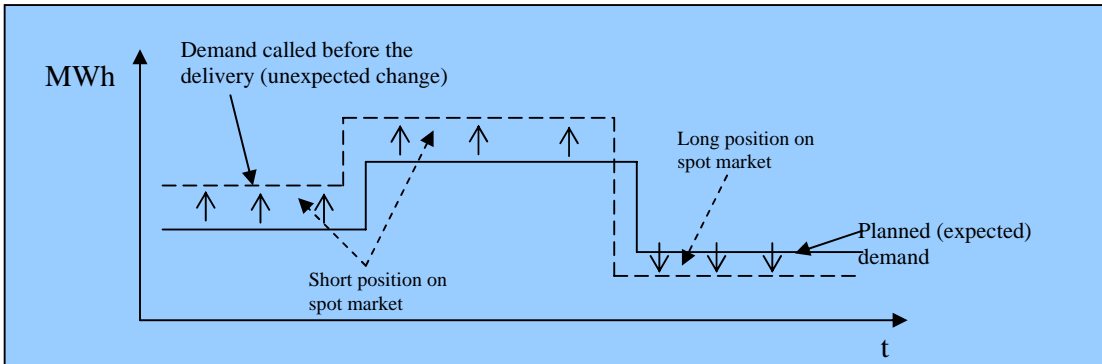
Source: Own study.

The power supplier is forced to close the unplanned position by extra purchase of power (it can significantly change the costs), or sell the power surplus (risk to sell cheaper than price of hedges). Position adjustment takes place on OTC or exchange market by concluding the hourly contracts.

**Chart 4. Risk Connected with Hedging the Result of Retail Portfolio**
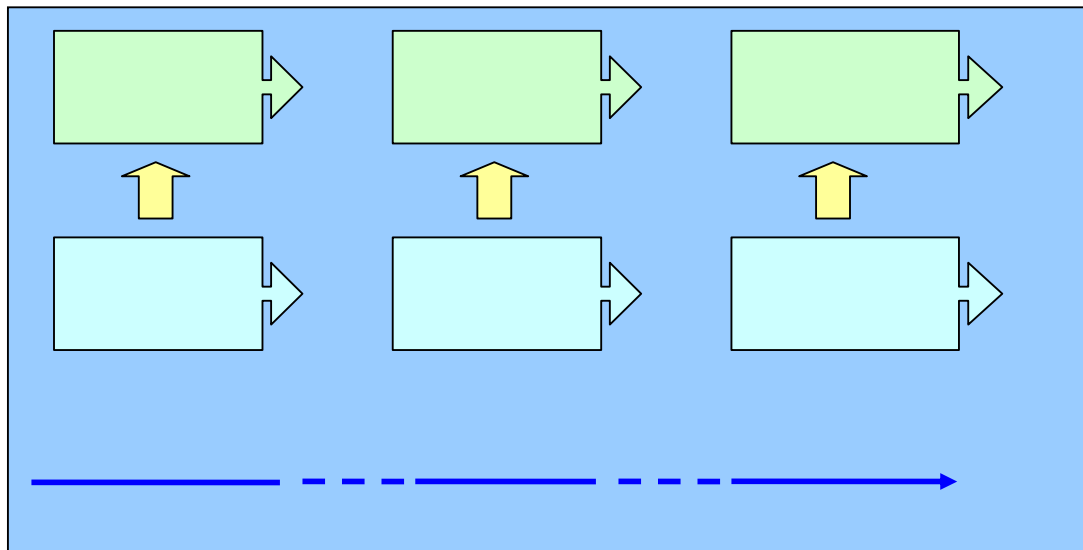
where:
t – time to delivery

Source: Own study.

Position adjustment is usually possible to day before the delivery (t-1). Imbalanced positions are closed mechanically during delivery day—day (time "t")—by transmission system operator and are connected with significant losses.

Chart 5. General philosophy of profile risk analysis
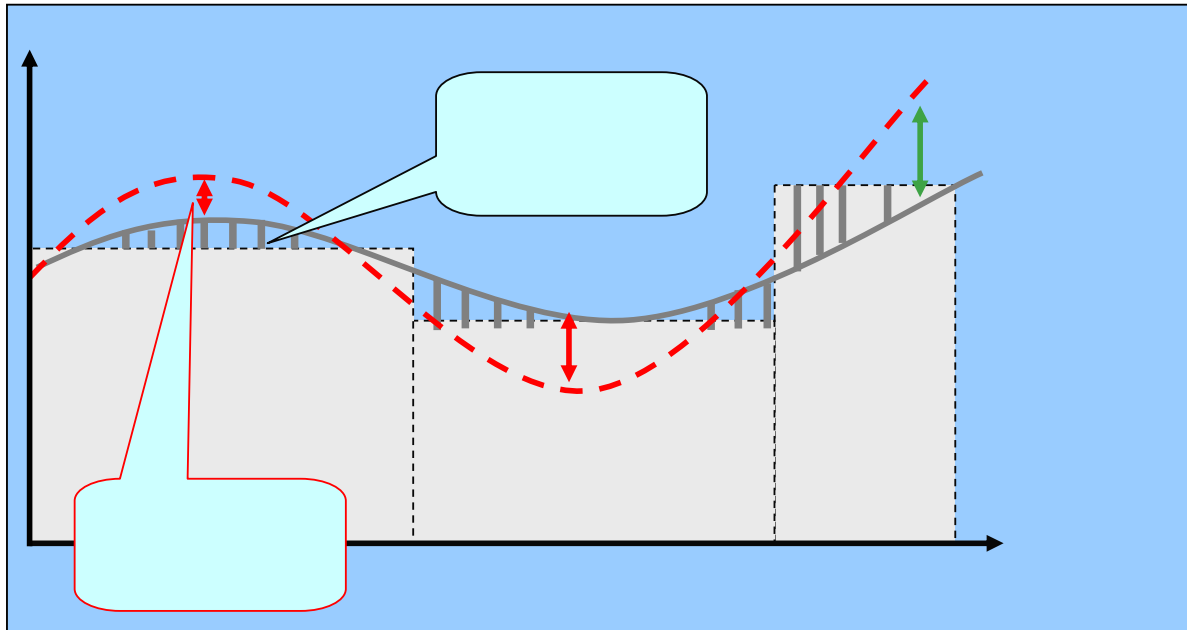
Source: own study.

Profile risk relates thus to the position on spot market. The profile changes can be the source of extreme prices movements on the spot market. Its result is the necessity to consider in the risk modeling the changes of risk factors much above standard values.

4.2 Determination of the Risk Capital for Retail Portfolio

Value of portfolio risk should be divided into three elements: expected risk, unexpected risk and risk of extreme situation. Global risk value should be evaluated using the Monte Carlo simulation of potential changes of both volumes and prices.

4.2.1 Expected Risk

Expected risk consists of the awaited costs of operating activity. It can be valuated on the following approaches:
-   expected value of risk distribution;
-   expected value of assessed risk based on historical data;
-   assessed value based on experts' evaluation (plans).

Risk expected value treated as operational cost influences the PnL statement (costs) and balance sheet of the company (resources necessary for financing this cost). Value of capital necessary for this risk hedging—CaR_E—is included in the investment capital (IC), necessary to fund the company's operational activity.

4.2.2 Unexpected Risk

Unexpected risk should be considered as the difference between risk value for a particular level of confidence and expected risk.

$$R_U = R_\alpha - R_E$$

Where:
R_U – non-hedged value of unexpected risk;
R_α – risk for particular quintile of risk distribution;
R_U – value of expected risk;

Unexpected risk is the value that can potentially reduce the economic result. It is necessary to secure its impact on the company's results by increase of the capital productivity. It is necessary to form the risk capital (CaR) in the value that by given return could cover the unexpected loss on non-hedged position.

$$R_U = CaR_{UR} \times RoCaR_U$$

Where:
R_U – non-hedged value of unexpected risk;
CaR_U – capital formed to found R_U;
$RoCARu$ – return on CaR_U.

Hence the value of CaR_U should be determined by the following:

$$CaR_U = \frac{R_U}{RoCaR_U}$$

CaR affects the whole liabilities structure or the capital costs on the economic results of the company. Risk capital is the limit of exposure for purposes of CaR demand determination. Then CaR in this situation is replaced by value of limit—CaRL, determining the maximum risk exposure: it should be assumed that CaRL constitutes the maximum level of risk that can be taken by a responsibility center.

4.2.3 Risk of Extreme Situation

Risk of extreme situation is determined by defining the probable catastrophic situation for the company's results that can lead to problems with financial liquidity. It is crucial to form some risk capital dedicated to secure the continuity of company functioning (CaRST), even in the very dramatic market conditions. The demand for CaRST is determined as the difference between RST and R_α—hence CaRST = RST - R_α.

Since CaR_{ST} should support the survival of the organization even in the most unfavorable conditions, it should be treated as the important indicator of the company's capital adequacy.

4.3 Risk Capital Funded in the External Entities

CaR_U and CaR_{ST} can be formed directly in the companies' liabilities, or they can be purchased as the service—risk capital outsourcing and formed in the liabilities of external entities . The possibility of capital outsourcing should always be considered during the capital adequacy analysis. It allows for limiting the risk capital formed directly in the company's liabilities, but not capital costs. Such service also costs. Therefore you should analyze the total capital cost including the cost of CaR outsourcing to decide which option is more profitable for the economic results—form whole risk capital directly in the liabilities or transfer part of this value on the third party guaranteeing the access to very liquid funds. The impact of outsourced risk capital on the financial results is the same as forming it in the company's funds. In order to increase the transparency of analysis of funds' sources financing the activity of the company, it is necessary to identify the CaR costs and allocate them to the risk centers creating them. Example of sources of such costs can be letter of credit or insurance.

$$CaR - CaR_E = CaR_U + CaR_{ST} = CaRz + CaRew$$

Where:
CaRz—formed CaR,
CaRew—outsourced CaR.

Chart 6. Capital Structure Considered from the Perspective of Global Demand for the Funds
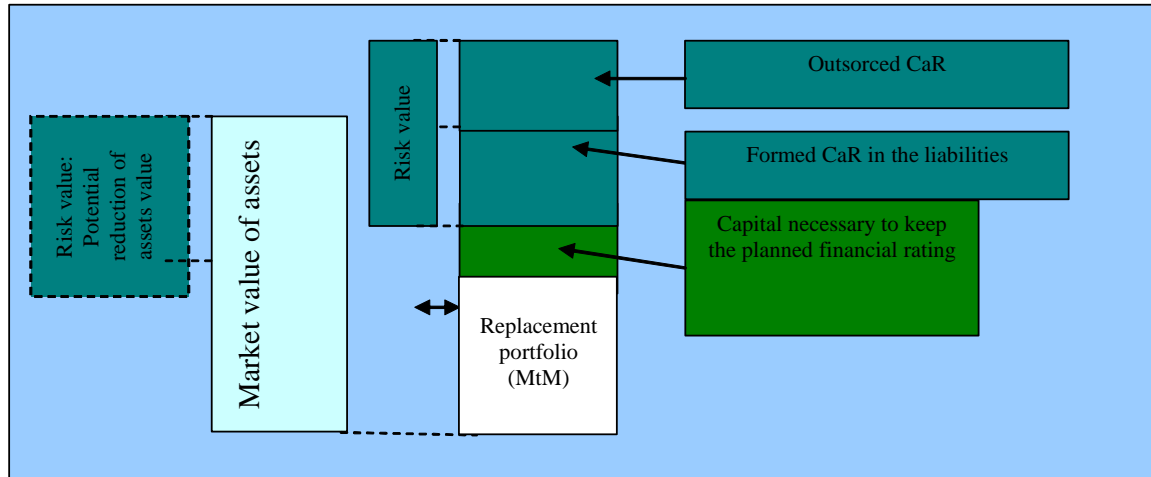
Retained risk should be covered by increase of CaR; transferred risk should be reflected in the outsourced CaR.

Source: Own study.

The above presented approach requires using the total average capital cost (TACC) in place of the weighted average capital cost (WACC). The approach, striving to consider the cost of risk transfer also as capital costs, allows the reflection of real CaR costs in the economic results calculations. Thus, outsourced CaR should be considered in the financial analysis in the same perspective as funded capital in the liabilities.

CaR allocation to the particular responsibility center should match the elements of global risk capital in the company:
1) formed CaR$_z$—following the risk exposure of responsibility center;
2) outsourced CaR$_{ew}$—following costs of risk transfer.

The structure of global risk capital should match the global risk profile of the company and of the particular responsibility center—it should be a TACC analyzed during the research of a company's capital adequacy. Similarly, the definition of return of capital should be based on the TACC requirements and total value of CaR demand.

4.4 Risk-Adjusted Performance Measurement

Each manager should be accountable for decision efficiency taken in the conditions of risk (within the frames of given mandate) having impact on results of the responsible center. As mentioned before, only connecting the combination of the

results of decision efficiency measurement with a motivation system allows risk controlling to have a real influence on the decisions-makers' behaviors.

Monitoring the real financial situation requires the measurement and reporting of the whole economic results (PnL) of the responsibility center. Hence, it should be defined as the sum of the realized and unrealized results (future PnL), where:

- *realized PnL* (PnL_E)—executed result on the executed transactions and settled financial contracts;
- *unrealized PnL* (PnL_N)—measured future result of the company activity being the result of the changes in the fair value of the future, high probable transactions on the reporting date.

The authors propose to use for the analyzed portfolio and reporting period the gross margin as the indicator of the PnL:

- PnL_E constitutes the gross margin worked out until the reporting date (day n);
- PnL_N constitutes the result on the open position and is based on two elements:
  1) PnL_{NH}—hedged margin: the part of portfolio that result is secured and 100 percent sure (not exposed on risk);
  2) PnL_{MtM}—result on the open position (unhedged) defined by mark-to-market.

Hence:

$$PnL = PnL_E + (PnL_{NH} + PnL_{MtM}),$$

Where::
$PnL_N = PnL_{NH} + PnL_{MtM}$

Chart 7. Outlook of the Analyses of the Portfolio Results
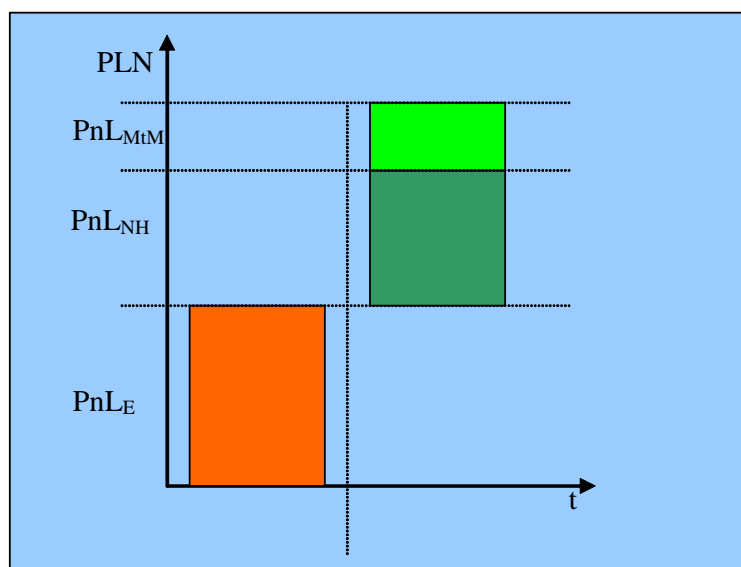
CaR influences a company's costs. The efficiency analyses should be executed based on the risk-adjusted measures presented below:

$$RoRaC = \frac{PnL}{IC + CaR_U}$$

$$RoRaC = \frac{PnL_E + PnL_{NH} + PnL_H}{IC + CaR_U}$$

RoRaC should be higher than TACC (the required return on capital in the company). RoRaC should be treated as the following:

- the steering ratio within the reporting period;
- the result after settlement period closing (end of deliveries, contracts' settlement).

The first function should be more important for supporting the achievement of the company's target—this function allows monitoring of the possibility of reaching targets by particular part of the company. Analysis of RoRaC gives the possibility of adjusting the strategy of economic results hedging.

Chart 8. General Philosophy of Analyzing the Possibilities of Reaching Planned Results
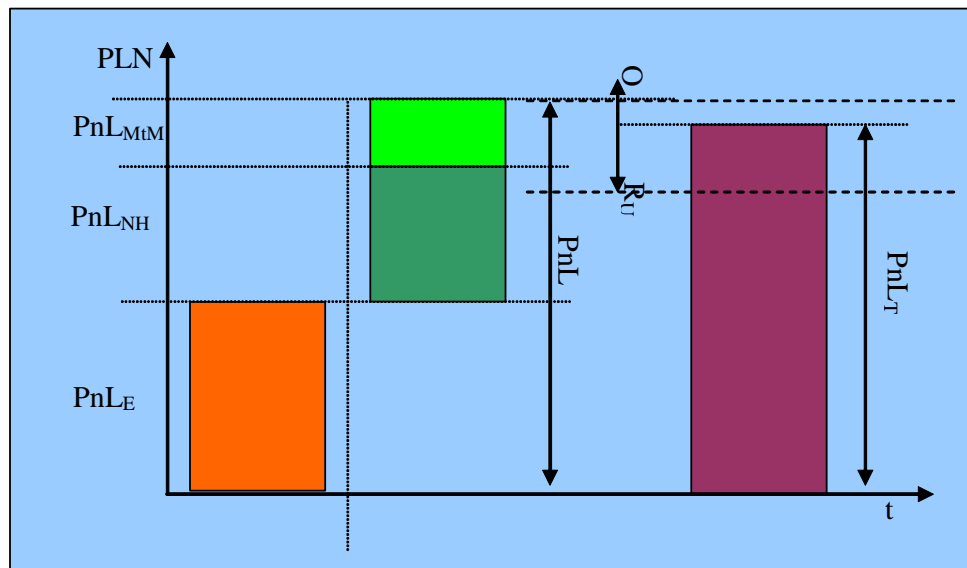
where:
O – opportunities;
PnL_T – planned PnL (target).

It is crucial to place the value of PnL in the area of $[(PnL_T-R_U)$ to $(PnL_T+O)]$. If PnL is lower than minimum of the expected range, it is necessary to adjust the position in such a way as to achieve the expected range.

4.5 Analysis of Risk Influence on the Economics Results of the Retail Portfolio in Hypothetical Utility

Risk of the retail portfolio was analyzed for two months in the year 2006—January and July. These months were characterized by significant deviations from average temperatures characteristic for this period. Hence this period can be the basis for research both for risk analysis and efficiency of potential hedging products. The target of hedging is to secure the planned gross margin.

Changes of the power consumption and load of the analyzed portfolio were determined on changes of demand in the Polish power system in the analyzed period. It gives the research the characteristics of universality and allows for drawing conclusions useful for the whole country.

The sales position of the analyzed portfolio was hedged by standard hedge contracts purchased on the OTC. The hedging strategy is delta hedge—sum of open positions value aims at zero. The hedging is executed by concluding the typical block contracts—baseload, peakload and off-peak.

4.5.1 Analysis of Retail Portfolios Risk in January 2006

Applying the delta hedge strategy allowed the securing of the planned sales position in January 2006 by typical standard products—peakload and off-peak.

Chart 9. January 2006—Planned Sales Position and Hedge Position
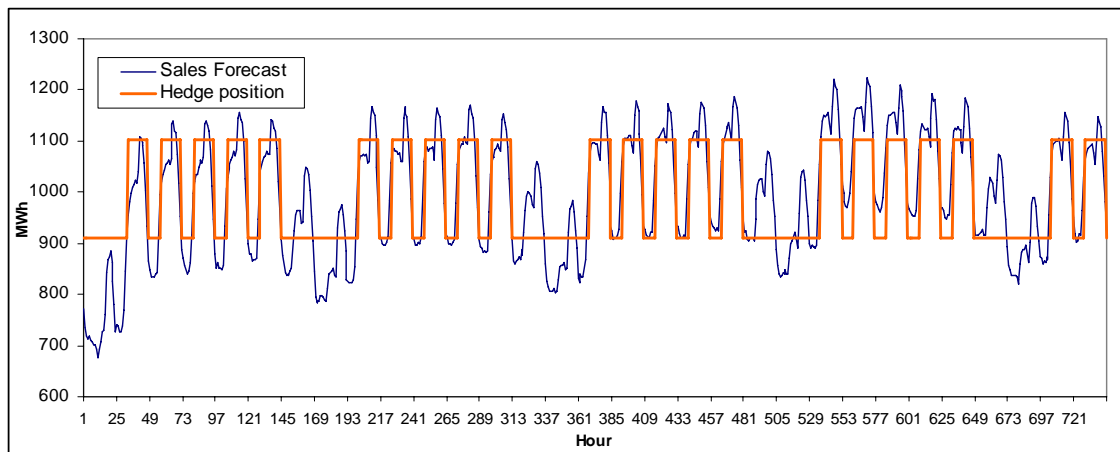
Source: Own study.

The planned sales position changes if there is the possibility for customers to execute the swing option following the changeable weather conditions. Hence it is necessary to consider the pricing techniques based on options valuation for such portfolios.

Short-term open position is closed on the day a-head market (spot) based on the values defined during the short-term planning of sales (n-1) and can be significantly different from previously planned sales, which is the basis for hedge position—long-term forecasting of the sales position and its volatility influences the strategy of hedging.

The above-described issues are the basis for risk valuation by the Monte Carlo method of the hypothetic retail portfolio. This risk is the result of the change of the power consumption profile and necessity of securing the economic results of this portfolio against potential losses being the result of both potential power consumption changes and price volatility on the spot market.

Chart 10. Risk Distribution of the Analyzed Portfolio for January 2006
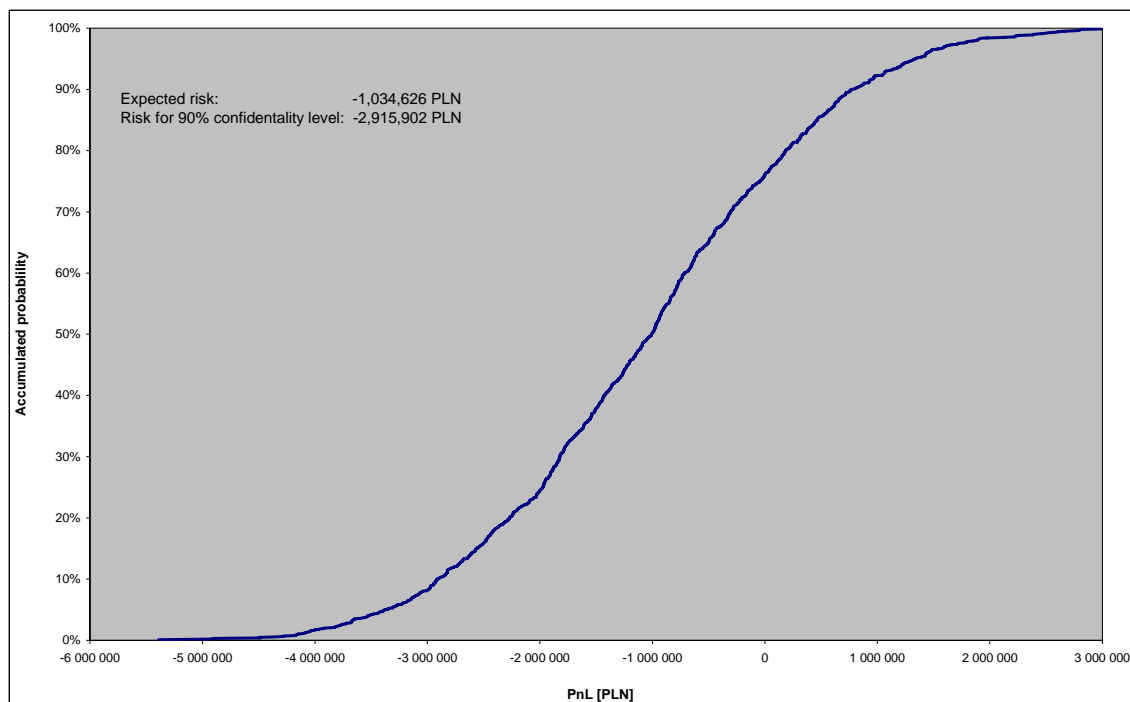
Source: Own study.

Significant temperature fluctuations were observed in January 2006—they differed significantly from average values. The wave of cold increased consumption (see Chart 11) and influenced the rise of spot prices, which was reflected in the gross

margin of the portfolio. The power consumption deviation from planned values is presented in Chart 12.

Chart 11. Temperature Deviation in January 2006
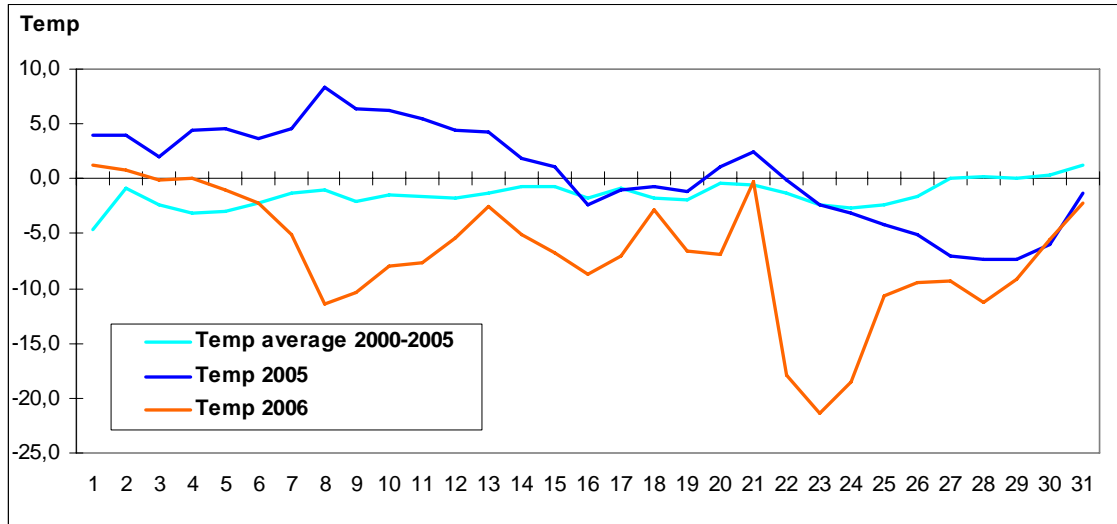
Source: Own study.

Chart 12. January 2006—Sales Deviation from Long-Term Forecast
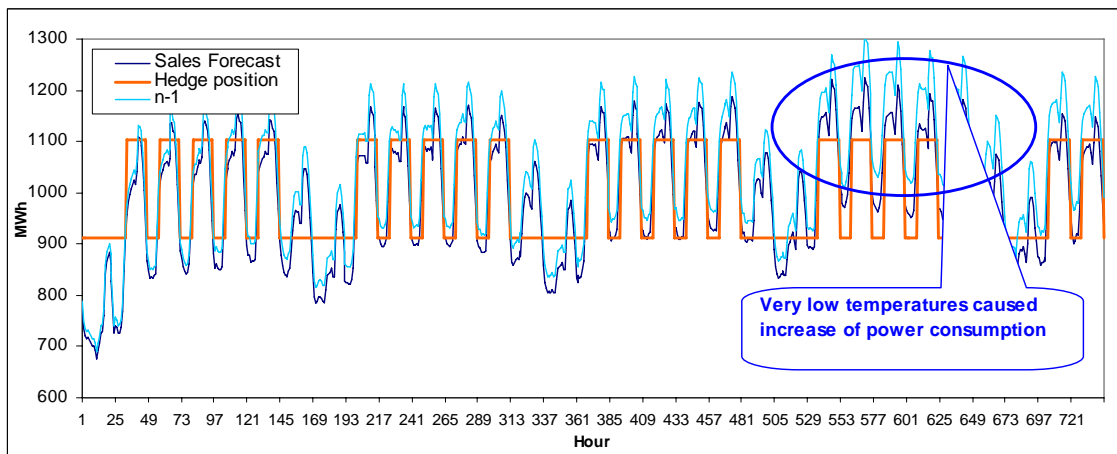
Source: Own study.

Following the above-presented uncertainties, risk was calculated using Monte Carlo techniques to give the picture of possible losses from the correlation of consumption and price changes.

4.5.2 Analyses of Retail Portfolio Risk for July 2006

The delta hedge strategy was applied in July 2006, and the results are presented in Chart 13. The results are similar to those of January 2006.

Chart 13. July 2006—Planned Sales Position and Hedge Position
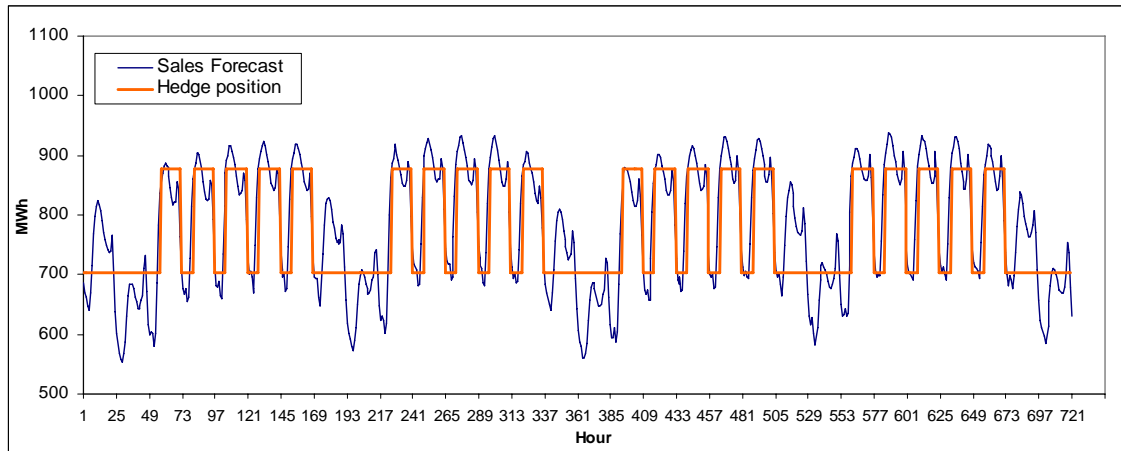
Source: Own study.

There was estimated risk for the retail portfolio based on Monte Carlo simulation. Again, the product of potential volume fluctuation and spot price volatility influences the results from unwelcome positions closing.

Chart 14. Risk Distribution of the Analyzed Portfolio for July 2006

Expected risk: -446,330 PLN
Risk for 90% confidentality level: -1,396,116 PLN

(Vertical axis: Accumulated probability; Horizontal axis: PnL [PLN])
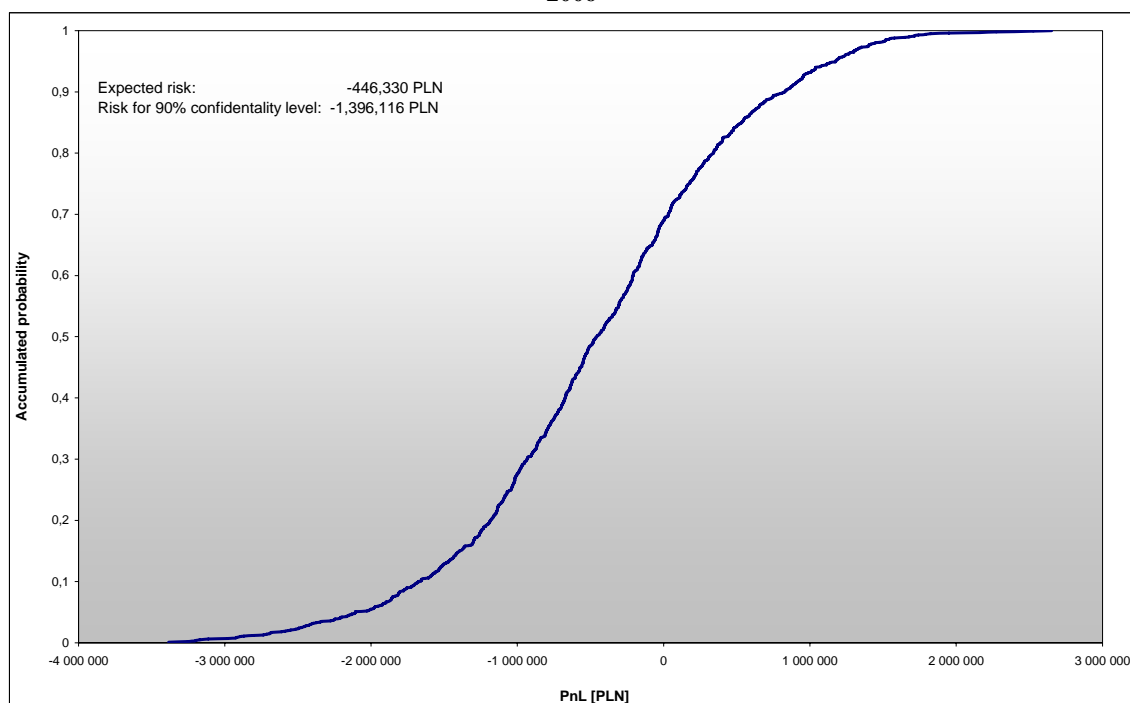
Source: Own study.

The average temperature in July 2006 was 22.3 °C, about 3.1°C higher than the previous year. It also deviated significantly from the five-year average. The power consumption in Poland increased sharply following this heat wave because of the high usage of cooling devices. The product was significant deviation of the short-term forecast from long-term prediction of sales volumes. It caused the open position that had to be closed on the spot market.

Chart 15. Temperature Deviation in July 2006
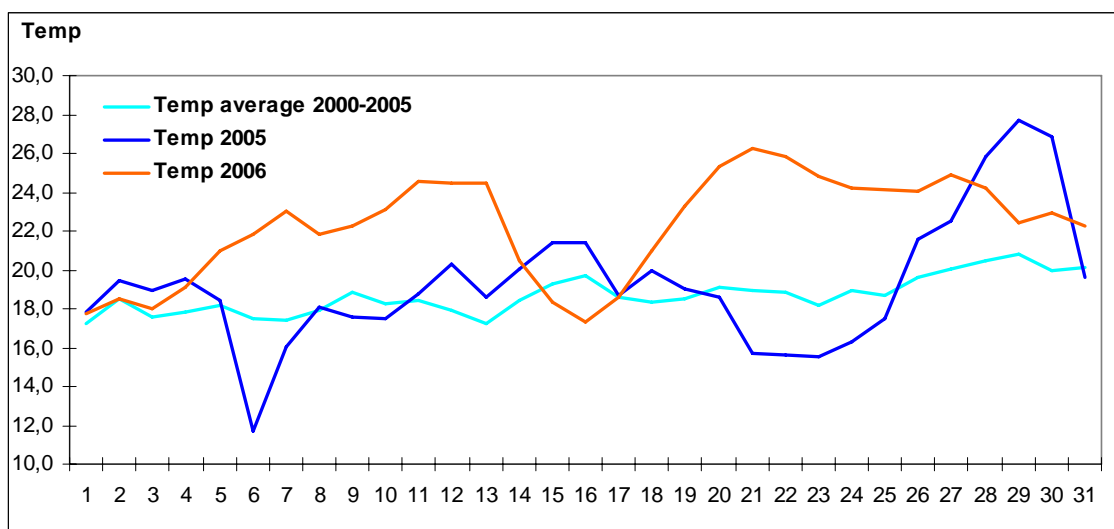
Source: Own study.

Chart 16. July 2006—Sales Deviation from Long-Term Forecast
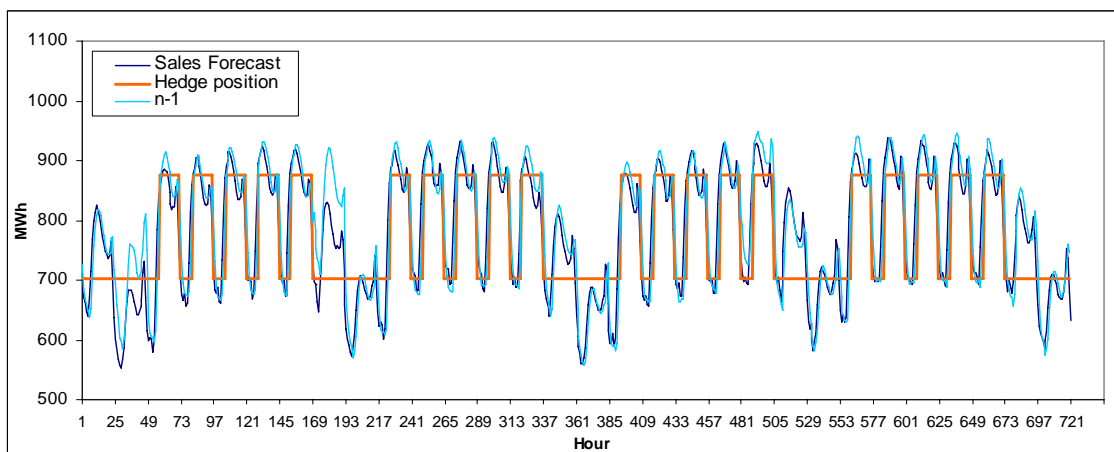
Source: Own study.

4.5.3 Analysis of Hedging Instruments of Retail Portfolio against Profile Risk Caused by Temperature Uncertainty

The following instruments can be used for hedging unwelcome profile risk correlated with weather condition changes—weather derivatives:
1) call option;
2) swap.

Efficiency Analysis of Call Option in January 2006

The long position in the call option should at least theoretically hedge the gross margin of searched portfolio against unexpected weather changes.

Basic definitions for weather derivatives

HDD (heating degree days) is defined for a particular day as the difference between 18°C (hypothetical limit for heating and cooling season) and the average temperature of this day. If the difference is negative, the HDD is estimated on zero.

$HDD = 18°C - T_{EXEC}$,

CDD (cooling degree days) is defined as the difference between 18°C (hypothetical limit for heating and cooling season) and the average temperature of this day. If the difference is negative, the CDD is estimated on zero.

$CDD = T_{EXEC} - 18°C$,

Average temperature is determined following the below formula:

$T = (T_{max} - T_{min})/2$

Where:
T_{max} – maximum temperature within day and night,
T_{min} – minimal temperature within day and night.

Weather derivatives hedging — call option

Assumption: Hedging secures the company against temperature changes.

Option on temperature—call/put—secures the buyer the pay off following the change of HDD, if the real temperature is lower (higher) than strike (defined as particular HDD). Tick is the payoff for each unit HDD change, when option is in the money.

Chart 17. Payoff Function of Call Option on Temperature
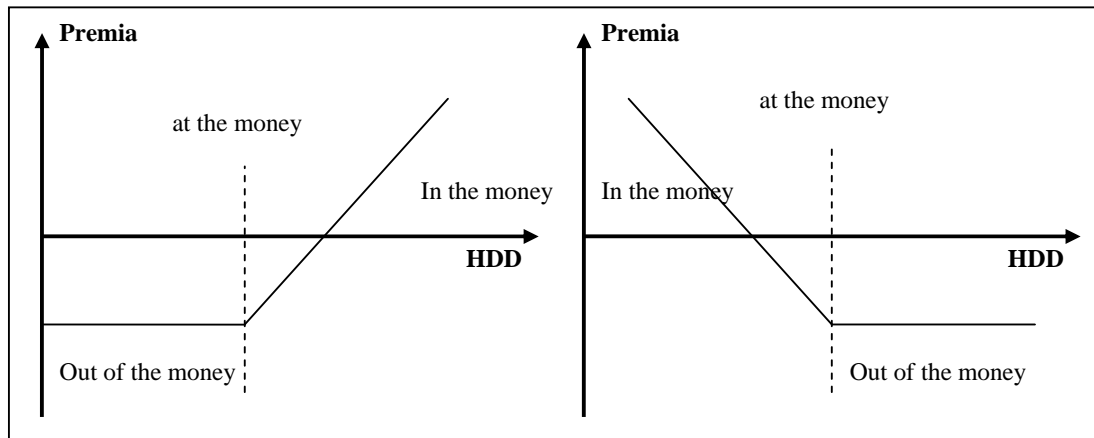
Source: Own study.

Maximum payoff is determined by below-presented formulas:

$$V_{call} = min\{tick * max (0, HDD\text{-}Strike), H\}$$
$$V_{put} = min\{tick * max (0, Strike\text{-}HDD), H\}$$

Where "tick" constitutes price for 1 HDD and H defines the maximal pay-off that could be agreed by contracting parties.

Assumptions to hedging strategy:
- monthly hedging instrument—long position;
- options parameters:
  - Strike: 619 HDD (-2 °C)
  - Tick: 1 880 PLN/HDD
  - Premium: 51 280 PLN

As mentioned before, the winter in January 2006 was significantly frosty. Average temperature was about -6.7 °C, what is 768 HDD. It caused the sharp increase in power consumption by retail customers due to an increase in heating devices. Hence, the significant volatility of prices on spot market could be expected.

PnL in a function of HDD resulting from the use of call option and hedging results are presented in the charts below.

Chart 18. PnL for Analyzed Call Option in January 2006
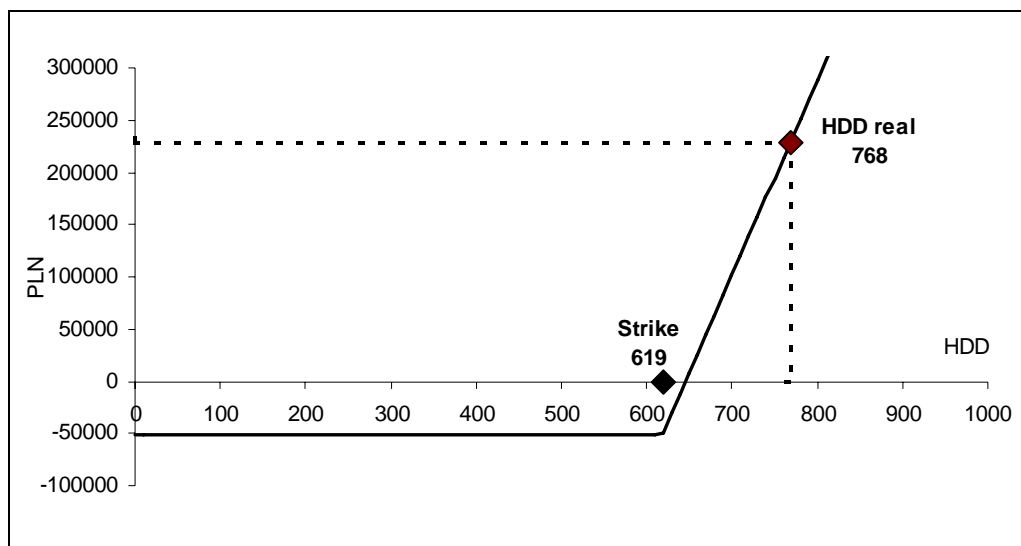
Source: Own study.

Chart 19. Hedging Result by Usage of Call Option in January 2006
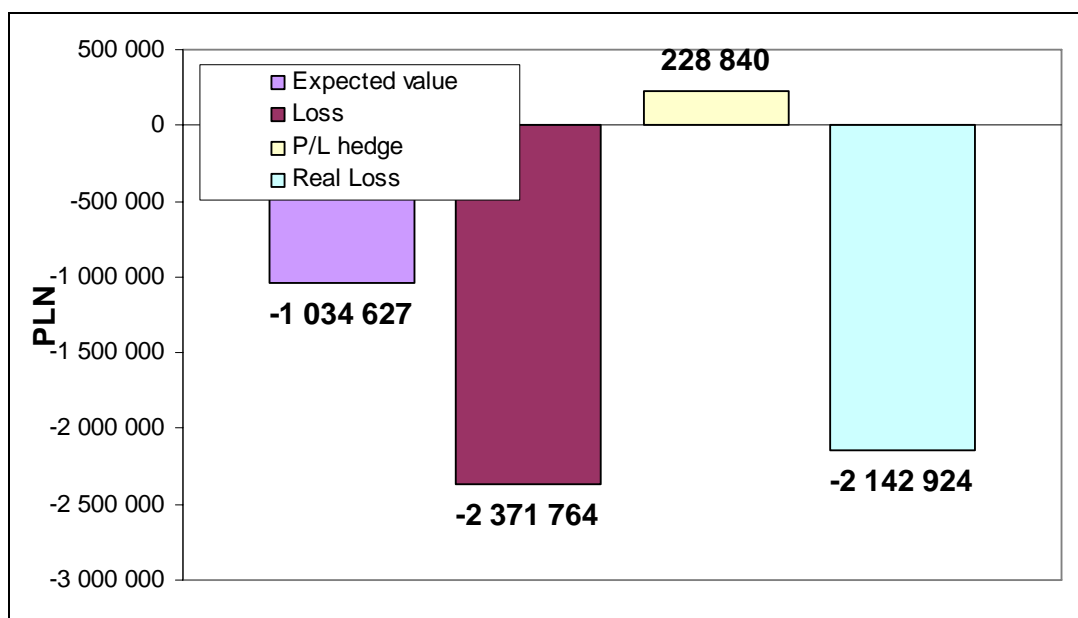
Source: Own study.

The application of call option after premium reduction gave profit of 228,840 PLN. It limited the loss of closing short spot position from -2,371,764 PLN to -2,142,924 PLN. The expected value of profile risk was -1,034,627 PLN—the result of correlation of price and volume volatility. On the Polish market, however, the price changes were not yet observed, although they should be a consequence of a higher demand resulting from extremely cold days.

Efficiency Analysis of Swap in January 2006

Position long swap should hedge the gross margin against unexpected fluctuation of both price and volume.

Hedging with Use of Swap Contract

Assumption: Hedging considers both temperatures and spot price changes.

Chart 20. Payoff Function of Swap Contract
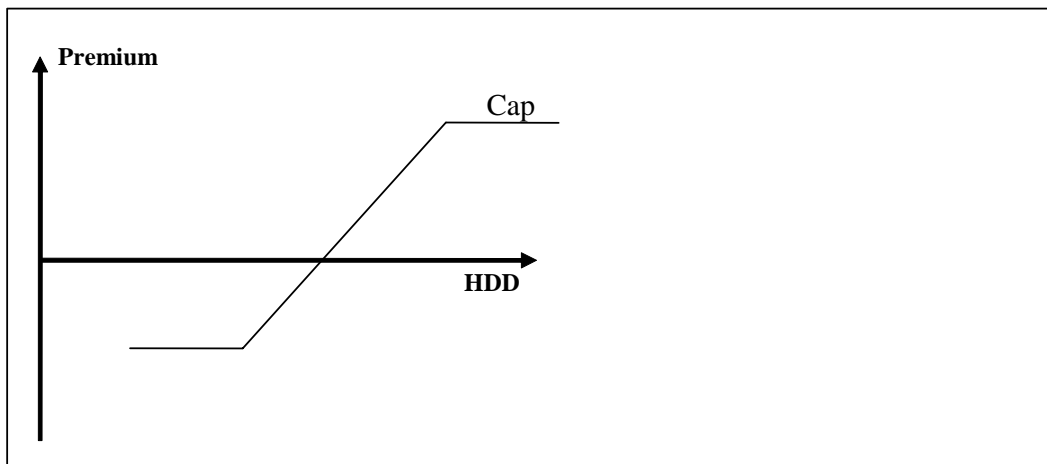
Source: Own study.

Tailor-made swap constitutes some kind of vanilla swap, but the difference is that parties agreed to exchange particular volume of power by change of 1 HDD (replacing in the swap construction the money). The payoff depends on two variables—real HDD and spot price.

Payoff = { (HDD-Strike) * tick } * (P_{FIX} – P_{SPOT})

Where:
P_{FIX} – guaranteed price for particular power unit defined by tick. It means in practice that by real HDD and executed strike the buyer will obtain the payoff following the difference between P_{FIX} and P_{SPOT} and agreed tick.

The above-presented instrument allows the hedge of the spot price (fixed price) of particular power volume (tick) caused by temperature changes (HDD).

Hence, the application of the hedging instrument, that is swap, also enables the securing of the economic results against changes of prices on spot market.

Assumptions to hedging strategy:
- monthly hedging instrument—long position;
- swap parameters:
  - Strike: 562 HDD (-2 °C)
  - Tick: 24 MWh/HDD
  - Fixed Price: 114,60 PLN/MWh
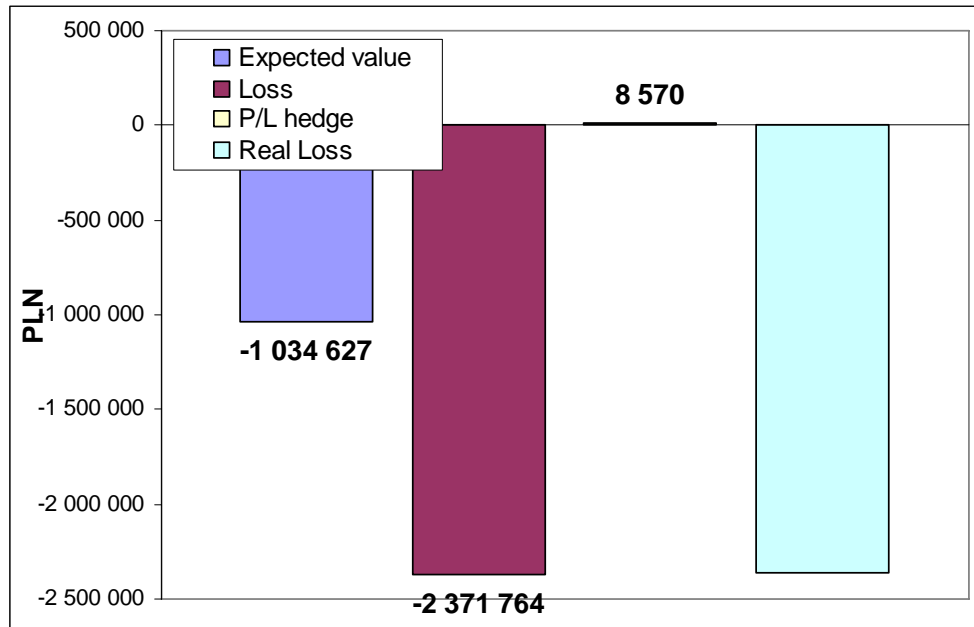 - Premia: unknown

Spot price in January 2006 was 116,7 PLN/MWh. Deviation between executed and hedged price was 116,7-114,6 = 2,1 PLN/MWh. Multiplying this value by tick gives PnL of 8,570 PLN (without premium reduction).

Chart 21. Analyzed Swap Payoff in January 2006
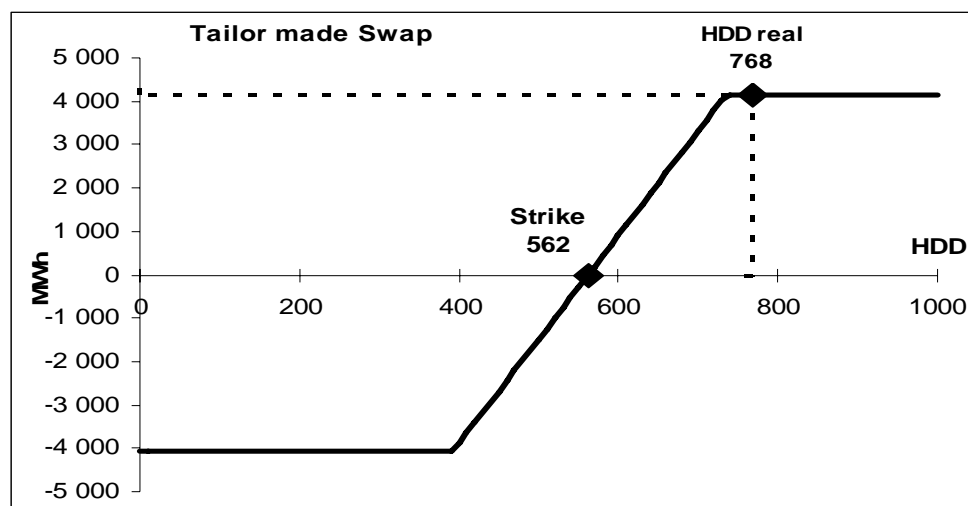
Source: Own study.

Chart 22. Hedging Result by Usage of Swap in January 2006

Source: Own study.

The change of the prices on the spot market was limited. It influenced the PnL from its usage. Hence, this type of product could have limited efficiency on the immature power markets. The value of premium and tick is also unknown.

Simulation of higher price volatility resulting from increased power consumption presents the advantages of the swap's usage to hedging purpose: increase of spot prices to 200 PLN/MWh and rise of price differences to 85,4 PLN/MWh and profit from hedging to 353,473 PLN reduced by premium. This product could hedge the real loss by securing the spot price on the level 114,60 PLN/MWh.

The simulation of different application variants of the analyzed hedging products is reflected in the result of hedging efficiency. What is important, however, is the alternatives' influence on the gross margin, which results from selling the energy to the final customers.

As is clearly visible in the following Table 1, the planned margin was 0,88 PLN/MWh, but the one realized without hedging was lower by 0,18 PLN/MWh. However, it should always be taken into account that what influences the margin is not only higher cost (stemming from buying greater than planned on spot market, amount of energy) but also increased income from selling energy to final customers. Using the call-option guaranteed the gross margin, but even influenced its improvement (pickup).

Applying the exchange contract had no practical influence on margin pickup.

Table 1. Comparison of Hedging Results for Researched Portfolio in January 2006

Gross margin	January [PLN]	July [PLN/MWh]
Planned	634 959	0,88
Realized without hedging	518 458	0,70
Realized with hedging — Option	747 298	1,01
Realized with hedging — SWAP	527 028	0,71

Source: Own study.

Efficiency Analysis of Call Option in July 2006

The utility should have the possibility of hedging against the temperature spikes that cause the consumption jumps as a result of increasing usage of cooling devices. The example of this trend is summer 2006.

Option call was applied to hedging. HDD is replaced for the summer months by CDD.

Assumptions to hedging strategy:
- Strike: 50 CDD 19,6 °C)
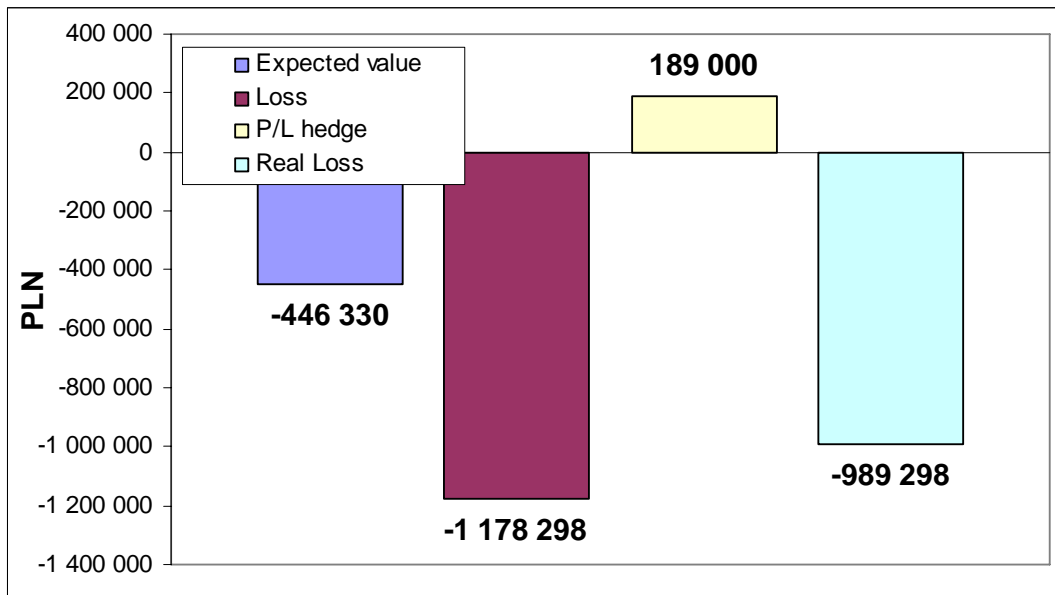- Tick: 3 000 PLN/CDD
- Premium: unknown

The hedging result is presented in Chart 23. CDD was in July 2006 133 (for 22.3°C). If parties had agreed following the assumptions for January 2006, the loss could be -989,298 PLN minus premium.

Chart 23. Analyzed Call Option Payoff in July 2006
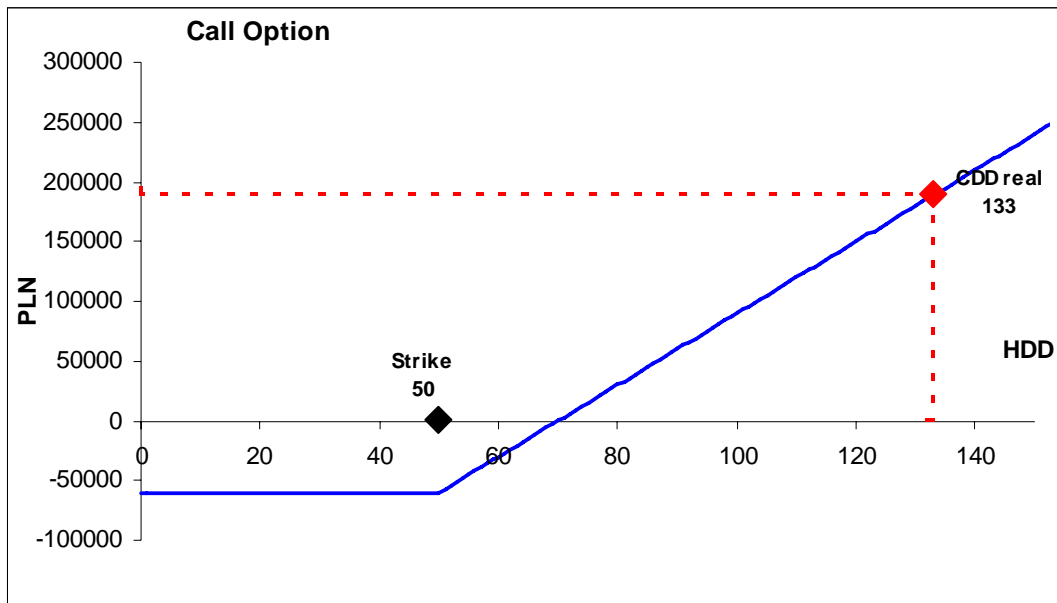
Source: Own study.

Chart 24. Hedging Result by Usage of Call Option in July 2006
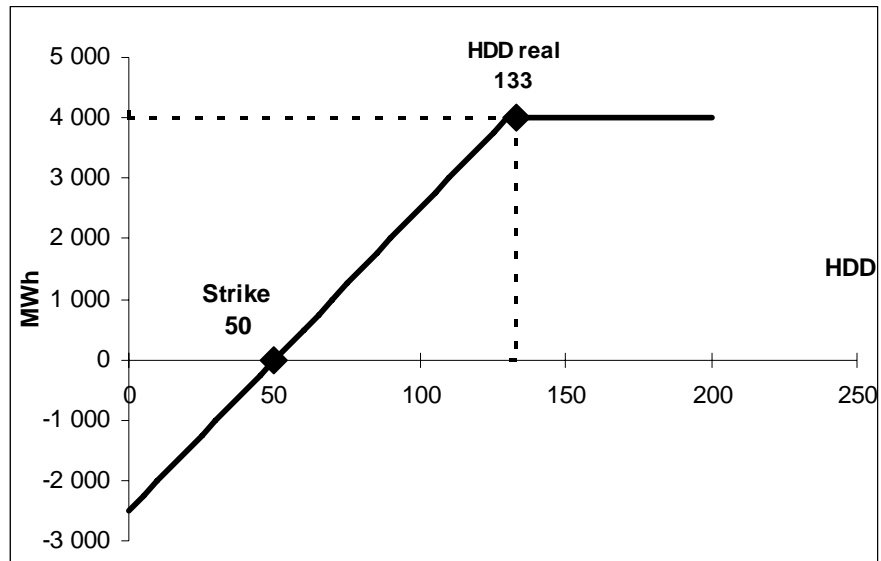

Source: Own study.

Efficiency Analysis of Swap in July 2006

The long position in weather derivative swap should at least theoretically secure the gross margin of searched portfolio against unexpected weather fluctuations.

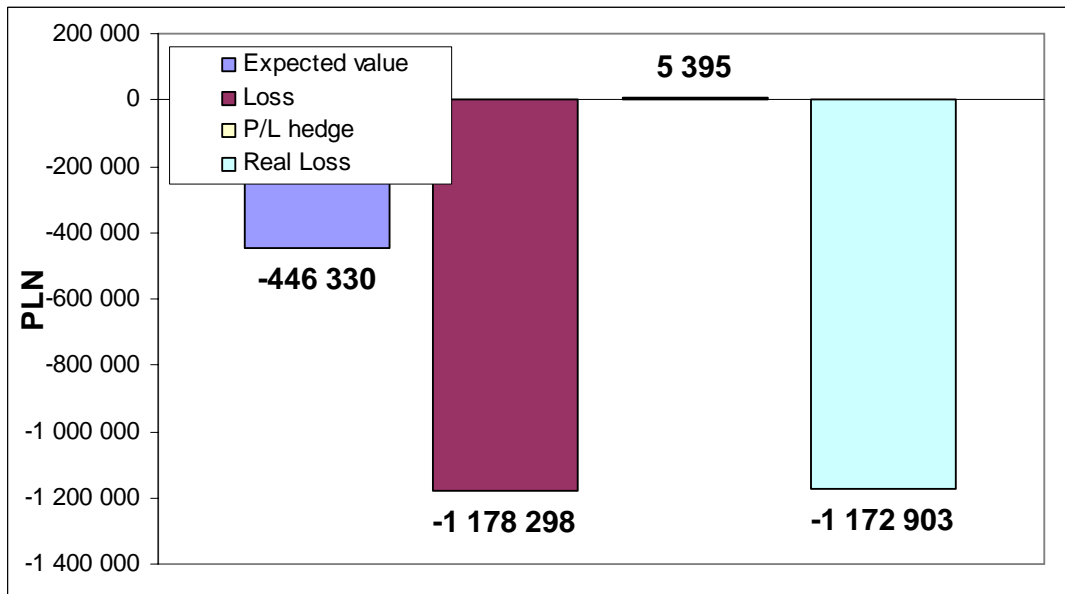Assumptions to hedging strategy:
- Strike: 562 HDD (-2 °C)
- Tick: 100 MWh/HDD
- Fixed Price: 114,60 PLN/MWh
- Premium: unknown

Chart 25. Analyzed Swap Payoff in July 2006

Source: Own study.

Chart 26. Hedging Result by Usage of Swap in July 2006

Source: Own study.

Similar to swap hedging results in January 2006, the swap in July 2006 was also not very effective from an economic results hedging point of view. Swap usage application was not related to significant loss reduction, secondary to low correlation between spot price and temperature changes. Additionally, the efficiency of this kind of hedging was reduced by political risk—the transmission system operator blocked power exportation in order to avoid potential blackouts, maximizing importation at the same time, which significantly reduced (in the conditions of supply surplus) the spot price level compared to other European power markets.

Changes of gross margin, resulting from applying analyzed hedging products in July 2006, are presented in Table 2. The planned margin was 1.12 PLN/MWh. Executed margin without using hedging was the higher of about 0.03 PLN/MWh.

Applied products were to secure against changeability of spot prices, resulting from weather changes. However their low changeability had an influence on the improvement of planned outcome, in practice—on the more than planned increase of margin—for example, in the case of call-option to 1.48 PLN/MWh, and in SWAP to 1.16 PLN/MWh.

Table 2. Comparison of Hedging Results for Researched Portfolio in July 2006

| Gross margin	January [PLN]	July [PLNMWh]
Planned	641 813	1,12
Realized without hedging	670 129	1,15
Realized with hedging—Option	859 129	1,48
Realized with hedging—SWAP	675 524	1,16

Source: Own study.

It is very important to signify that the Polish energy market is in the development phase. That is why risk factors do not reflect the analogical price volatility in extreme weather conditions to observed changes in developed European markets (i.e., in Germany). This situation was illustrated in the following charts, which present the spot prices (EUR/MWh) on PPX and EEX in January and July 2006.

Chart 27. SPOT Price in January 2006
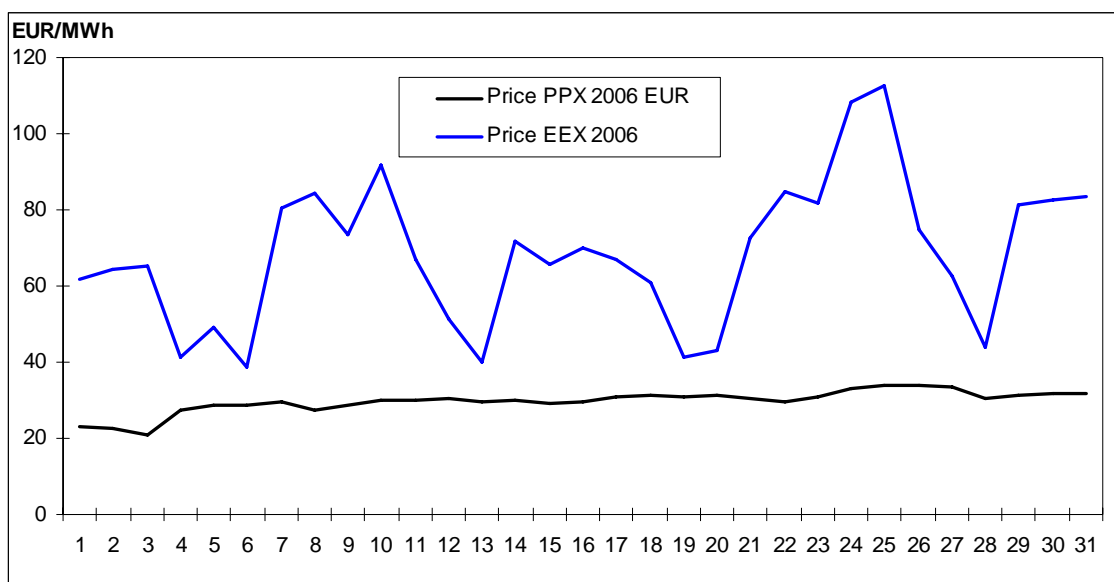
Source: Own study.

Chart 28. SPOT Price in July 2006
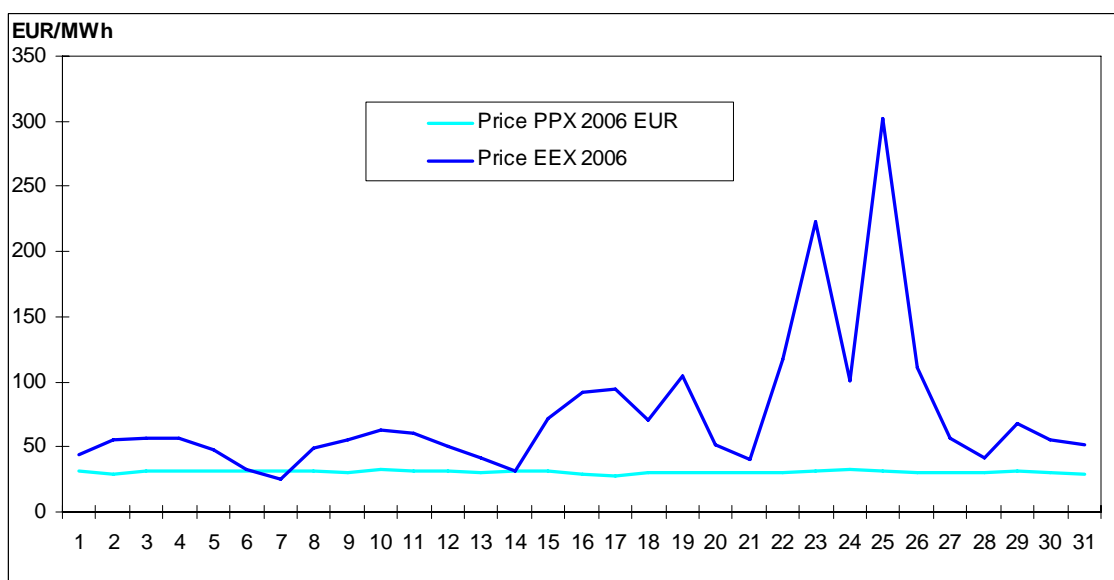
Source: Own study.

The prices on PPX did not change, as it was expected for significant fluctuations of temperatures. However, on EEX, the prices were characterized by major fluctuations. One of the reasons for that kind of situation was the decisions of the sending operator, who, aiming to limit the risk of blackouts, artificially steered the supply on the Polish market (limiting the exchange between systems). This situation reflected political risk, which cannot be forgotten in the process of risk management, and especially in energy emerging markets.

Gross margin in this case would not mark the same values as for the examples of realized spot prices variations in that period on the Polish market. Planned margin at the level of 0.88 PLN/MWh for similar dynamics of price changes on the Polish market on the next day, to respective prices on German market, was a loss at the level of -0.26 PLN/MWh.

Owing to usage of the considered earlier hedging products (call-option and swap contract) the effects of extreme weather changes were significantly less expensive. If the call-option were applied to hedge, the investigated portfolio would mark profitable margin (0.05 PLN/MWh). Through usage of monthly product—SWAP—the loss would be decreased by (0.12 PLN/MWh)

Table 3. Comparison of Hedging Results for Researched Portfolio in January and July 2006 for Simulated Increase of Price Volatility

| Gross margin	January [PLN]	July [PLN/MWhj]
Planned	634 959	0,88
Realized without hedging	-188 634	-0,26
Realized with hedging—Option	40 206	0,05
Realized with hedging—SWAP	-105 900	-0,14

Source: Own study.

4.5.4 Analysis of Return on Risk-Adjusted Capital for Various Hedging Standards of Retail Portfolio—Ex-Ante Approach for Steering Purposes

The following gross margins on analyzed portfolios were planned for the research period:
- January 2006: 634,958 PLN;
- July 2006 r.: 641,813 PLN

The analysis of both demand for CaR in the retail portfolio and return on risk-adjusted capital for these months was executed. RoRaC was considered as steering ratio. Presented below is the demand for CaR in January 2006 determined for analyzed portfolio; the hedging with call option is considered.

Chart 29. CaR Demand of Retail Portfolio in January 2006—Hedging by Call Option Applied
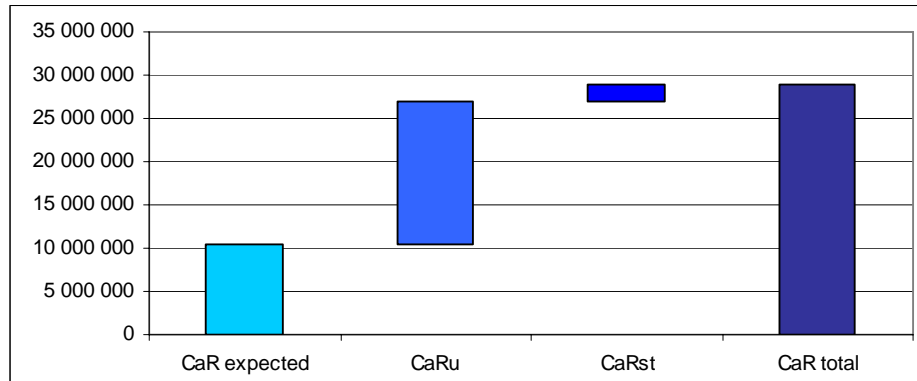
Source: Own study.

The RoRaC is for January 2006 in conditions of call option 4.51 percent and 4.87 percent for hedging with swap. Similar analysis for July 2006 gave adequately 5.65 percent for call option and 5.43 percent for swap. This kind of hedging does not secure enough of the expected level of gross margin (if TACC is assumed to be about 10 percent). It is necessary to introduce other hedging strategies, increasing the expected level of gross margin.

5. Final Remarks

Efficient risk management requires the restructuring of the approach to company management that should be executed in the following dimensions:
- development of consistent approach of whole risk profile valuation;
- combining the risk assessment with efficiency measurement and assessment of decisions in order to integrate the risk perspective with company finance;
- utilization of the possibilities of risk transfer.
-

The human element is also important. Everyone in the company, from managerial staff to operational worker, should be aware of risks connected with the actions they take and of their influence on a company's economic results. General acceptance and understanding of the rules governing risk management, and taking these into consideration in the system of motivation, is a key to smooth restructuring of the approach in the above-mentioned dimensions. It will result in the effective management of the spheres especially prone to risk.

The most important statement is that in order to ensure the long-term economic success of the company, risk should be taken only in the conditions allowing to work out the required level of the return on the capital incorporated in the company activity. Hence, the hedging instruments should be selected following

the requirements of the company's return on capital, taking the risk capital into account also.