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The risk of external conditionsand their impact on the financial standing of the heat distributor company

by

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The purpose of the corporate risk management is not to limit the power and decisions of managers. Organizations based on a culture of risk awareness can "safely" take higher risk than the rest of the organizations in the same sector.

Rafał Rudnicki

Łukasz KĘPA

Executive summary

This thesis is an attempt to outline specific risks that Lubelskie Przedsiębiorstwo Energetyki Cieplnej Sp. z o.o. has to deal with. These are: legislative risk, thermo-modernization risk and weather conditions risk. The first one is supposed to be treated as a kind of obligation to be fulfilled by energy sector companies as all the procedures concerning that risk are regulated in specific legislation acts. As the latter two risk factors are of key importance for energy sector companies, quantitative methods are a commonly used solution. By applying one dimensional linear regression tools, the thesis describes the process of model building that in the latter part of the study is used for conducting a sensitivity analysis. The final part of the work specifies the level of a particular variable that may decide whether or not Lubelskie Przedsiębiorstwo Energetyki Cieplnej Sp. z o.o. may become insolvent.

Key words: corporate risk, modelling, energy sector, linear regression

Contents:

Introduction

The aim of this thesis is mainly to illustrate the impact of weather conditions risk on the financial standing of Lubelskie Przedsiębiorstwo Energetyki Cieplnej Sp. z o.o. (LPEC). Such quantification is of key value for its strategic development plan for years 2013-2015.
In the past, strategy development plans lacked a sort of sensitivity analysis which would show a quantitative relationship between temperature and the bottom line of the company. To achieve such an effect, an econometric model using one dimensional linear regression method was designed. It can precisely project what the amount of expected heat sold to end users will be, including such processes like thermo-modernization, causing that every year the same end user consumes statistically less and less heat. Converting physical quantities into financial data allows for determining financial indicators and realizing how detrimental on the liquidity of LPEC the volatility of average external temperature can be. Thanks to the model, and taking into account credit limits specific for LPEC, now it is possible to determine the breaking point in temperature increase above which Company may go bankrupt unless restructuring procedures in fixed costs is comducted.

The first chapter shows where the “risk” definitions and concepts originate. It specifies typical classifications of risk, and concentrates on the ones associated with the energy sector.

The second chapter gives a brief description of Lubelskie Przedsiębiorstwo Energetyki Cieplnej Sp. z o.o. and its strategy development plan for years 2013-2015. It then elaborates on the methodology and tools that enhance designing econometric model that correlates external temperature with the demand of heat by end users.

The third chapter describes external sources of funding Company’s assets, which is a starting point for the sensitivity analysis that is carried out on the basis of model designed in Chapter 2.

The concluding section provides information for management and supervisory boards that is essential when the strategy development plan for years 2013-2015 is accepted.

Chapter 1 Risk

1.1 Etymology and definitions

Arguably, the modern times significantly differ from the past ages in terms of people's attitude to risk. In the past it was believed that future can be predicted solely from the theological point of view. People perceived it mainly as a result of God's whims. Today, tools and knowledge to run simulations concerning possible events give us a possibility to make rational decisions regarding scenarios that are the most likely to happen. Thanks to such a scientific approach to risk the future becomes more an opportunity than a threat. Science shows how risk should be understood, measured and monitored so that decisions we undertake are the most accurate. The efficiency of controlling risk sets a course of action for large companies [Winiarski 2010].

So far the origin of the word *risk* has not been explained. This word has numerous meanings, depending on different languages; however, the meanings are quite similar [Kaczmarak 2005, p. 51]:

- in Persian *rozi(k)* means fate, daily payment and also bread;
- in Latin the verb *riscare* means to circumvent;
- in Arabic *risq* means a visitation of God;
- in Spanish *ar-risco* means courage and danger, like in French;
- in 18th century German dictionaries the words *risco*, *risico* describe a danger related to breaching fair trading regulations;
- in English there are two words with similar meanings – *risk* and *hazard*. The latter characterizes situations causing danger and potential source of danger, whereas the former refers to the likelihood that something unpleasant might happen;
- in Italian *ris(i)co* or *rischio* mean reef that ships should avoid [Kaczmarak 2005, p. 51].

In Italian, the dominant meaning of the word *risk* is associated with danger that threatens ships sailing across seas and oceans, especially when it comes to financial losses related with sinking. Risk understood in such a way was, on the one hand, closely related with threat and adventure, and, on the other, with financial benefits one should gain when journey was successfully completed.

In 1901 A.H. Willet announced that risk is something objective and associated with subjective uncertainty [Pritchard 2002, p. 128]. This definition is not precise in terms of multiple meanings of the word uncertainty. In the 1930's Frank Knight undertook a scientific attempt to differentiate risk and uncertainty. He assumed that uncertainty is a broader concept than risk that we cannot identify as a source of potential failure, but we can precisely measure the probability of its occurrence. Uncertainty is not measurable but risk is uncertainty that can be expressed in digits [Chong and Brown 2001, p. 9]. Oskar Lange, like Knight, assumed that risk is uncertainty that can be quantified. For Lange, the word *uncertainty* should be used when expected result cannot be described by probabilistic models. According to J. Bizon-Górecka,

business risk can be defined as a multiplication of probability of an occurrence of particular event and its impact on business processes [Bizon-Górecka 2007, p. 8].
A slightly different point of view is presented by M. Masny who claims that risk should be interpreted as a deviation from the expected result [Bizon-Górecka 2007].
According to Committee of Sponsoring Organizations of the Treadway Commision recommendations “risk is the possibility of occurring events that have negative effects on achieving objectives” [COSO 2007, p. 40]
Stabryła describes risk using a statistical formula. He claims that risk $E_i=Y_i*p_i$ is an expected value of i-th result, where p_i is the probability of a particular result, and Y_i is the effect of this result. This definition assumes that all Y_i values are known and countable and probabilities p_i, which correspond with them, as well as density functions are also given [Stabryła 2006, p. 310].
A different definition presents PMBOK® that describes the process of software development. It says that risk is a cumulated effect of probability of uncertain events that may positively or negatively influence a project. Risk refers to the situation where a particular event may occur. Probability that refers to that particular event can be calculated based on a density function of identical or similar events from the past. It is described in that standard that the character of each kind of risk is implicated by three fundamental factors: an event (circumstance in which event occurs), probability, and results [Grocholski and Niemiec 2008, p. 15].
Chapman believes that risk is a likelihood of failing to achieve objectives. According to him, if the success of enterprises is measured in financial units, then risk in this definition is the probability of costs increasing above the level that was originally planned [Berinato 2005, p. 123].
According to Christopher L. Culp [2001, p. 14], risk can also be described as any source of randomness that might have an unfavorable impact on people or organizations. Accordingly, risk management is reaction to risk by individuals or businesses as they attempt to ensure that the risk to which they are exposed is the risk they think they are exposed to and want to be exposed.
The definitions presented above can be divided into those created by separating risk from uncertainty, and those that by their meaning make an attempt to describe risk. The latter can be seen from at least two perspectives:

- the German school that describes risk as the possibility of negative events,
- the American school that sees risk as the likelihood of either negative or positive events.

As we can see, risk can be expressed in many different ways. Most of them have negative connotations. Generally it is perceived as the probability or threat of damage, injury, liability, loss or any other negative occurrence that is caused by external or internal vulnerabilities and that may be avoided through pre-emptive action [BusinessDictionary 2013]. There is also a general agreement that the term *risk factor* denotes exposure that is statistically related in some way to an outcome, e.g. carbon dioxide pollution may be a risk factor for the greenhouse effect that can result in increasing the average temperature of the earth.

1.2 Different types of business risk

There are many classifications that systematize the concept of risk. One of commonly cited source in that field in Poland is Tadeusz Teofil Kaczmarak who proposes a catalogues of risk inherent in: insurance, economy, exchange rate, interest rate, credit, production, legal, safety, organization, politics, new technology, ecology, medicine, epidemiology, pharmacy, chemistry, psychology, sociology, civilization, and culture [Kaczmarak 2005].
Although the list of risks that can occur in enterprises seems to be unlimited [Bizon-Górecka 2007, p. 23], she lists seventeen most important risk groups. The key of them are: equipment damage, breaking contract in terms of quantity and quality, failure to meet a deadline, or the risk of error in a project.
From a financial point of view Krzysztof Jajuga proposes his division. He distinguishes market risk, credit risk, operational risk, liquidity risk and legal risk [Jajuga 2007, p. 18-25].
A division into specific economic and organizational projects based on a generic classification is presented by A. Stabryła. He distinguishes five core areas. These are: macroeconomic risk, industrial risk, operational risk, functional risk, and other remaining risks [Stabryła 2006, p. 308].
The most general dual divisions of risk in business processes are contained in the recommendations of The Committee of Sponsoring Organizations of the Treadway Commission (COSO). This distinguishes inherent and residual risks. Inherent risk is such that appears together with the lack of measures that a management board could undertake to change (decrease) the likelihood or impact of risk. Residual risk is such that remains after some actions are taken by a management board to change the likelihood or impact of risk [COSO 2007, p. 125].
A different approach to risk is presented by J. Zemke. He proposes a division into so-called “decision-making areas”. Risk is classified according to the place of its origin. These are areas of: production (services), logistics, technology, marketing, finance, and human resources. The author also defines what types of risks are included in these particular areas. The following belong to the financial area: risk connected with capital allocation, risk connected with equity and working capital management, dividend policy risk, risk associated with the management of financial improvements, risk inherent in mergers and acquisitions, risk connected with financing with long-term debts, risk of financial burden policy, and risk of corporate property management [Zemke 2006].

Further in this chapter we will elaborate on chosen financial risks.

Investment risk
Investment process in market economy is inextricably connected with the concept of investment risk that should be interpreted as countable uncertainty in terms of achieving future gains or incurring losses. Investment risk is tightly associated with the fact that achieved rate of return may significantly differ from the one expected by

investors due to random factors such as fluctuations in commodity prices. Investment risk is the risk of failing to achieve the expected profitability on investment. A proper assessment of the overall risk of investment is necessary to evaluate the feasibility of the investment. Investment risk consists of many elements.
Depending on whether the character of investment is tangible, intangible, or financial, different factors play a role in shaping the profitability index of the particular investment [Winiarski 2010].
Apparently, the old saying ”don’t put all your eggs in one basket” holds true for investments. While risk can’t be eliminated, it can be managed, e.g. by putting your assets in a range of investments. Then if one investment loses money, it can be balanced by other investments that have been profitable. Having a portfolio of products or diversifying them helps to spread risk.
Typical risks related to investments are [Vanguard Asset Management 2012]:

- Inflation risk which is like a stealth tax eating away at the value of money. You won’t see a smaller cash balance in your account, but you will definitely lose buying power. In other words, the amount that you can purchase with each pound in your pocket slowly erodes over time;
- Economic and political risk that play an important role in the performance of investment markets. Economic factors include economic growth, inflation, employment, interest rates and business sentiment while political risk includes changes in government, political uncertainty and international conflicts;
- Shortfall risk denotes the risk of failing to meet your long-term investment target. This could mean that you did not take on enough risk to obtain potentially higher rewards, or that you took on too much risk and your portfolio fell in value. Investing too aggressively or too conservatively can each lead to shortfall risk;
- Country risk is the risk that domestic events, such as a political upheaval, financial troubles, or natural disasters, will weaken a country’s financial markets;
- Currency risk occurs when changes in currency exchange rates cause the value of an investment to decline;
- Interest rate risk is the possibility that the prices of bonds will fall if interest rates rise;
- Liquidity risk is the chance that an investment will be difficult to buy or sell;
- Manager risk is the chance that a pooled fund will underperform due to poor investment decisions;
- Market risk is the risk that any market such as equities, bonds, property, or cash, may decline;
- Sector risk is the risk that a particular sector within a market, such as the oil and gas sector or the travel sector, may decline in value. For example, if oil prices surge, the oil and gas sector might rise, but the travel sector might fall due to rising fuel costs;

- Specific risk is the risk that a specific share, bond or fund you've invested in performs badly;
- Volatility risk can be measured by investment value fluctuations over time. This is referred to as volatility and is often used to assess the potential risk associated with an investment.

Insurance risk

The definition of insurance risk has not been precisely specified in Polish law. Surprisingly, the Act on Insurance Activity (Journal of Laws, 2003 No. 124, item 1151) does not clarify the idea of risk, even though it was introduced in the glossary of terms in Article 3 of the Act. In 1966 Insurance Glossary Commission in the USA gave a definition of insurance risk, having recognized it as a risk of uncertainty related to the occurrence of specific events. Eminent authors from insurance fields attempt to make up for a lack of a definition in Polish law. E. Kowalewski identifies this risk with danger, uncertainty, probability of incurring losses, and with deviation of real results from the expected ones [Kowalewski 1996, p. 11-19]. M. Orlicki [2002] defines insurance risk as uncertainty of certain events occurring. Risk presented in such a way should be treated as a potential loss which can be prevented by having an insurance policy. Given the absence of a clear definition some entities underwriting risk for their own needs make an attempt to determine what constitutes risk. The most commonly, this phenomenon is manifested in disparities between contracts for liability insurance [Orlicki 2002, p. 4]. In fact, recent changes in the insurance market and socio-economic environment mean that the risks that insurers are now facing have evolved. These range from volatile investment conditions, increase in longevity, and mortality risks to terrorism threats and climate change [The Financial Services Authority 2006].

Therefore, insurers rely on sound and comprehensive internal risk governance to respond effectively to changing market conditions. The risk management function should be preventive, independent, and empowered. This will foster a genuinely risk-aware culture in each organization by clearly articulating and tracking the corporate risk tolerance. Integrated risk management should be more than the sum of its parts. Every insurance company have to bear a wide range of risks, some of which are discrete and some interdependent. Since the insurance industry benefits from taking on risk, there is always potential for conflicting priorities in writing business. Therefore, risk management ought to be a function independent from profit-and-loss responsibility, but closely connected with corporate strategy. Risk management needs both reviewing corporate strategy and assessing the risks associated with it.

Figure 1 Integrated Risk Governance

Source: CRO Forum, 2009, Insurance Risk Management Response to the Financial Crisis

Risk tolerance should be expressed in regularly-monitored risk limits. As we can see in Figure 1, business needs managing against these limits in a forward looking way, anticipating where limits may be crossed, and determining remedial actions to circumvent undesirable risk exposure [CRO Forum 2009].

Market risk

It is a risk of incurring losses on a balance sheet, off-balance sheet and cash flow positions as a result of changes in: market prices, interest rates, exchange rates, or value of stock prices. All entities, especially banks, are obliged to present their assets held for trading in a market value price. Such a valuation permits an identification of possible losses regardless of whether the bank will be cumulating or selling assets. In a bank's operational activity the main areas of market risks are associated with trading of these [Winiarski 2010]:

- Shares;
- Commodities (e.g. wheat, oil);
- Exchanges (volatility);
- Debt securities (financial instruments with fixed or variable interest rates e.g. bonds);
- Derivatives (e.g. FRA, options and futures, currency swaps and interest rate swaps, foreign exchange forwards);
- Other derivatives (equity swaps, options on futures contracts and warrants).

In the economic literature, market risk is not clearly classified. The most important elements of market risk are [Winiarski 2010, p. 8]:

- Interest rate risk – a bank's financial position that can melt down along with adverse changes of interest rates;
- Currency risk – defines danger of deterioration of a bank's financial situation due to unfavourable changes in exchange rates;
- The risk of changes in commodity and equity prices – specifies the risk of decline in commodity prices and financial instruments that are object of trade.

In order to manage market risk several methods have been developed to identify and evaluate it. The most common are [Winiarski 2010, p. 9]:

- RAROC method (Risk Adjusted Return on Capital) – based on estimating return on invested capital adjusted for the size of risk (thanks to its methodology profitability is rated)
- VAR method (Value at Risk) – focuses on determining value that allows to judge whether the bank has sufficient funds to cover potential losses related to market risk. In order to acknowledge results obtained by this method banks also perform scenario analysis and stress tests. The former involves developing unfavourable scenarios, and then by using stress tests the maximum loss exposure is calculated.

Operational risk

It is associated with errors occurring during performed transactions. It can be also defined as a risk of possible losses posed by inadequate or failing internal processes, people, technical systems or external events. Operational risk is neither directly related to the volatility of the market nor to the creditworthiness of the counterparties. Usually, operational risk is inherent in the following [Kendall 1998, p. 119]:

- the relationship with the natural environment;
- human resources;
- new technology;
- operational technology risk.

Credit risk

It is a risk associated with a borrower's failure to meet the obligation to pay off the loan. This is a situation where the payment associated with debt service will be neither partly nor wholly settled by a client within the time agreed in the credit agreement. The resultant delays may cause a company to become insolvent, and thus can be a source of losses for the lender. Literally speaking, credit risk is associated with loans, credits, debt buyout, credit lines, warranties and guaranties. In more general terms, it covers additional risk associated with acquisition by means of debt instruments issued by other entities and OTC derivatives [Winiarski 2010, p. 10].

According to Leszek Grocholski, credit risk is a very general concept, which is associated with the following [Grocholski and Niemiec 2008]:

- The risk of loss (insolvency) due to the lack of certainty regarding the future financial situation of the borrower. It describes uncertainty that the payment resulting from the credit agreement will not be settled wholly or just partly;
- Security risk defines the danger that results from damage or destruction of the collateral used in order to reduce this risk (e.g. the destruction of a security item that was not insured);
- Interest rate risk concerns the risk that a spread between the market interest rate and the rate accepted in the credit agreement affects the bank's financial standing (this risk concerns loans with fixed interest rates or loans where interest rates spread is limited);
- Currency risk involves the likelihood that the value of repaid loan may decrease due to changes in the exchange rate (this risk concerns loans taken in foreign currencies);
- The risk of the value of money refers to the situation where the real value of the loan returned will decrease due to inflation;
- Liquidity risk is associated with the danger that payment will be inconsistent with the repayment schedule, in other words where the maturity dates of assets and liabilities are synchronized.

Each bank has its own credit risk management policy aimed at achieving a competitive advantage. Risk assessment methods differ among banks and the principles of risk management are highly confidential.

Financial risk

It is associated with market risk, credit risk, and operational risk. Not all researchers specify this kind of risk in their classifications. Financial risk is defined as a threat of incurring losses due to changeable market conditions (an element of market risk), deterioration in the financial situation, or customers going bankrupt (an element of credit risk), imperfections of processes and systems applied by organizations, or human errors (operational risk). Financial risk is associated with the capital structure of the borrower's balance sheets. If the borrower is financing their activity largely with external funds (loans, credits, bonds, etc.), then there is a risk that the costs of obtaining additional external capital will be so high that the borrower may find itself in a difficult economic situation where the future loan repayment will not be feasible. The higher the share of equity in total assets the lower the financial risk, which translates into sustainable and sound growth of bank operation [Winiarski 2010, p. 11].

Legal risk

It concerns the area of socioeconomic life that is ordered by civil law, criminal law, administrative law, fiscal law, banking law, and trading law. These rules regulate internal country relations. International private and public law, on the other hand, regulates relations between people and foreign countries. Legal risk in economy is associated with a threat of incurring losses by entities running their activities which fall outside the scope of the relevant legislation. What is more, legal risk also relates to difficulty in executing contract terms. In the literature one may come across the following legal risk divisions [Kaczmarak 2005, p. 67]:

- the risk of excessive (exaggerated) normalization of a particular segment of socioeconomic life, which results in limited economic independence and freedom;
- the risk of insufficient regulation of a particular area of socioeconomic life;
- the risk of leaving loopholes in legislation;
- the risk that specific legal regulations will not be applied;
- the risk of difficulties in executing law.

To sum it up, risk has not a homogeneous character and this is why the formulation of a universal and unambiguous definition is hardly possible. Regardless of that, the more risk you bear the higher rate of return you can expect.

1.3 Main risks in the heating sector

In the company where the main business activity concentrates on heat distribution there a multitude of risks that company has to face every day [Eydeland and Wolyniec 2003]. Most of them were mentioned in part 1.2 of this chapter. The three that are worth concentrating on at this part of the thesis are legislative risk, weather conditions risk and thermo-modernization risk.

Legislative risk

Some of us have encountered the impact of tax burden imposed by fiscal authority. In my opinion, there are countless people who have a negative attitude towards taxes. Possibly, this is what company executives from the energy sector had in mind on 14th November 2012 when the Energy Efficiency Directive (2012/27/EU) [Directive from 25th October 2012] was promulgated. The full name of this document is:
"Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC".
Some measures that are proposed in this document are connected with new requirements for companies from energy sector. One of them postulates a reduction of the amount of heat sold to end users by 1.5% year by year. The amount of heat

that each company has to reduce is converted for "TOE" which is polish abbreviation of one tone of equivalent oil. The formula for calculating the amount of TOE is presented in Article 12 of Energy Efficiency Act [Ustawa z 15 kwietnia 2011] of 15th April 2011. The amount of TOE x_t that particular heat company has to save for year t is:

$$x_t = \mu_t * \frac{\text{rev}_t}{\text{fee}_t} \quad (1)$$

where,
μ_t - percentage ratio for year t. μ_{2013}=1%; μ_{2014}= μ_{2015}=1.5%
rev_t – revenues from heat sold in year t
fee_t – alternative unit payment for year t. fee_{2013}= fee_{2014}= fee_{2015}=1.000 PLN

Table 1 presents the expected amount of TOE that Lubelskie Przedsiębiorstwo Energetyki Cieplnej Sp. z o.o. (LPEC) will have to save until 2015.

Table 1 Expected amount of TOE that has to be saved by LPEC

Year	2013	2014	2015
Amount of TOE	1 276	2 002	2 118

Source: Own study exemplified in the xls attachment

Saving TOE is a statutory requirement. The company can fulfil this requirement in two ways by either modernizing its network in a way which will allow for reduction of heat lost on transfer (TOE), or by paying an alternative payment. The amount of alternative payment equals x_t * fee_t. Table 1 shows that for a company like LPEC typical expenditures on network modernization allow to save on average 200 TOE per year. It means that the requirement of saving over 1 thousand TOE in 2013, 1.8 thousand TOE in 2014 and 1.9 thousand TOE in 2015 will have to be met by paying an alternative payment in the amount of:

- over PLN 1 m for year 2013
- over PLN 1.8 m for year 2014
- over PLN 1.9 m for year 2015

Normally, it should not be a problem as energy companies include their costs in tariffs for consumers. However, when it comes to the cost of alternative payment regulations are not so favourable. According to Article 3 section 2 of "Regulation of the Minister of Economy from 4 September 2012 concerning the method of calculating the amount of primary energy equivalent to the value of energy efficiency certificates and alternative unit payment" [Rozporządzenie MG z 4 września 2012], when an energy company pays its alternative payment, it can be included in the tariffs in the year following the year when the alternative payment was made. For companies like LPEC this means a higher demand for working capital that can be met, for example, either by additional payments from shareholders or by extending the limit of revolving credit.

Thus, this is a significant risk that energy companies have to face. It can disturb liquidity ratios and if it not well managed it can even lead to insolvency [Crouhy et al. 2006].

Thermo-modernization risk

The act about supporting thermo-modernization projects was adopted in 1998 and amended in 2001. It created a state aid system for everyone who wants to run thermo-modernization projects for their buildings in order to reduce the consumption of heat and hot water. State aid system is a kind of fund that reimburses some costs of such a projects. That means that up to 80% of investment costs can be financed by the state. This scheme is quite popular in Poland because, on the one hand, you can reduce the consumption of energy, which translates into lower bills, and on the other, a vast majority of investment costs can be financed by a third party. Table 2 presents the effects of thermo-modernization projects.

Table 2 Effects of energy saving in thermo-modernization projects

Ordinal	*The way of saving energy*	*Reduction of the heat consumption compared to the previous state*
1	Comprehensive modernization of the heating system	10% - 25%
2	External insulation of building partitions (walls, roof, ceiling) without windows replacement	15% - 25%
3	Windows replacement on the sealed windows with a lower value of diffusion coefficient	10% - 15%
4	Making improvements in heating substations including weather and automatic control devices	10% - 25%
5	Introduction of cost allocators	around 5%

Source: Michalska-Foryś K., Mrugała-Konstanciuk E., 2007, Termomodernizacja budynków

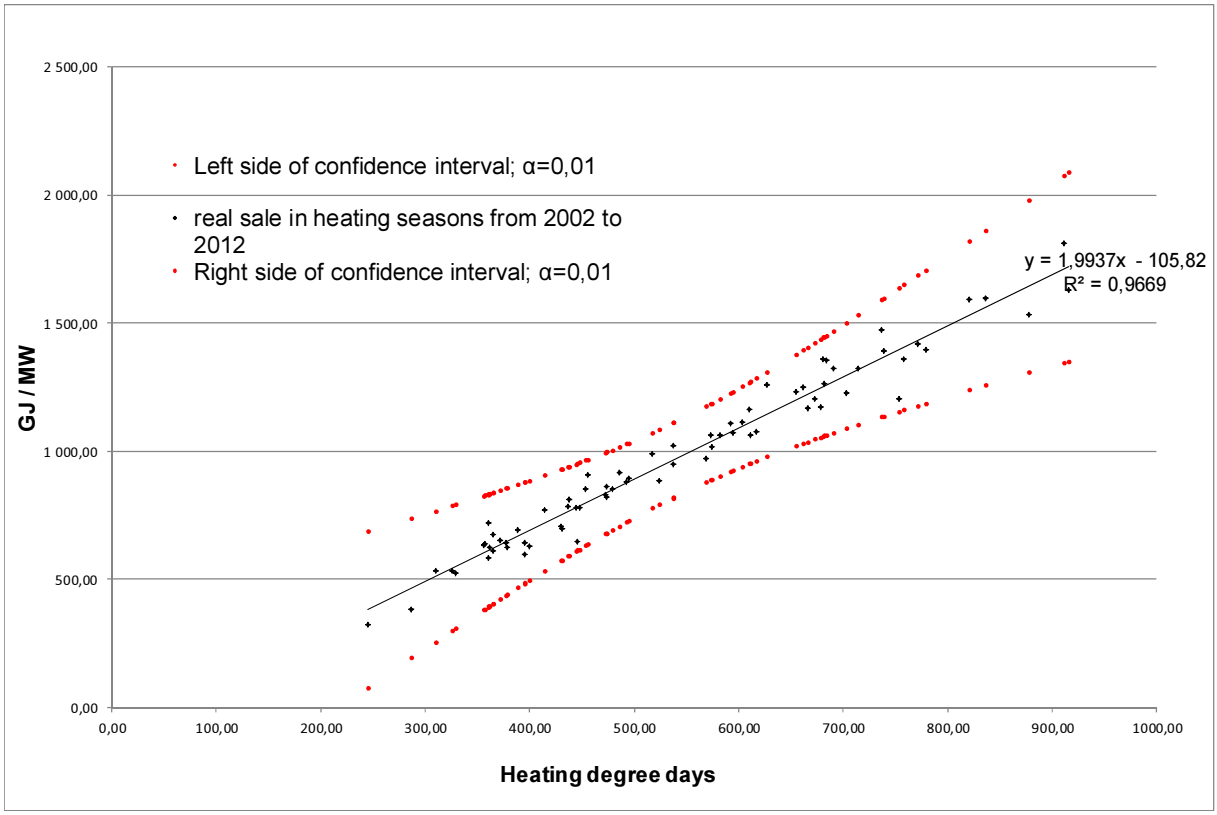
This phenomenon affects the LPEC pricing policy as every year on average less and less heat is used by buildings of comparable technical parameters. The amount of heat sold (GJ) depends on power (MW) and heating degree days (HDD). See below:

$$GJ = MW * (a * HDD + b) \tag{2a}$$

where *a* and *b* are coefficients of linear function.
The above equation works in heating season which falls on the months from January until April and from October until December.

To illustrate the impact of thermo-modernization projects on the amount of heat sold, a variable needs to be found that will represent heat per unit household and will correlate with weather conditions (temperature). The best approximation turned out to be heat to power ratio (GJ/MW).
Thus, pairs of variables (GJ/MW, HDD), ranging from heating seasons from 2002 to 2012 were analysed in a linear regression model. The results are shown is Graph 1.

Graph 1 The value of GJ/MW ratio depending on the heating degree days in monthly heating seasons from 2002 to 2012



Source: Own study exemplified in the xls attachment

Hence the equation:

$$\frac{GJ}{MW} = a * HDD + b \qquad (2b)$$

Where a=1.9937 and b= -105.82
The model from equation (2b) describes real values quite accurately. 96.69% of variability of explanatory variable (GJ/MW) is explained by the variability of the dependent variable (HDD), which means that when the value of HDD is given, the ratio of GJ/MW can be predicted relatively accurately by the model. The process of model creation will be thoroughly described in Chapter 2. In this part of the thesis, the Author intends to illustrate the impact of thermo-modernization projects on the amount of heat sold when heating degree days are constant.
To measure this impact a series of regression analyses were run. Pairs of GJ/MW and HDD were compared for different heating seasons. The first regression model

was built for the heating seasons of 2002-2012 and the last for heating seasons of 2009-2012. The results are shown in Table 3.

Table 3 Coefficients a_i, b_i and some statistics for different heating seasons

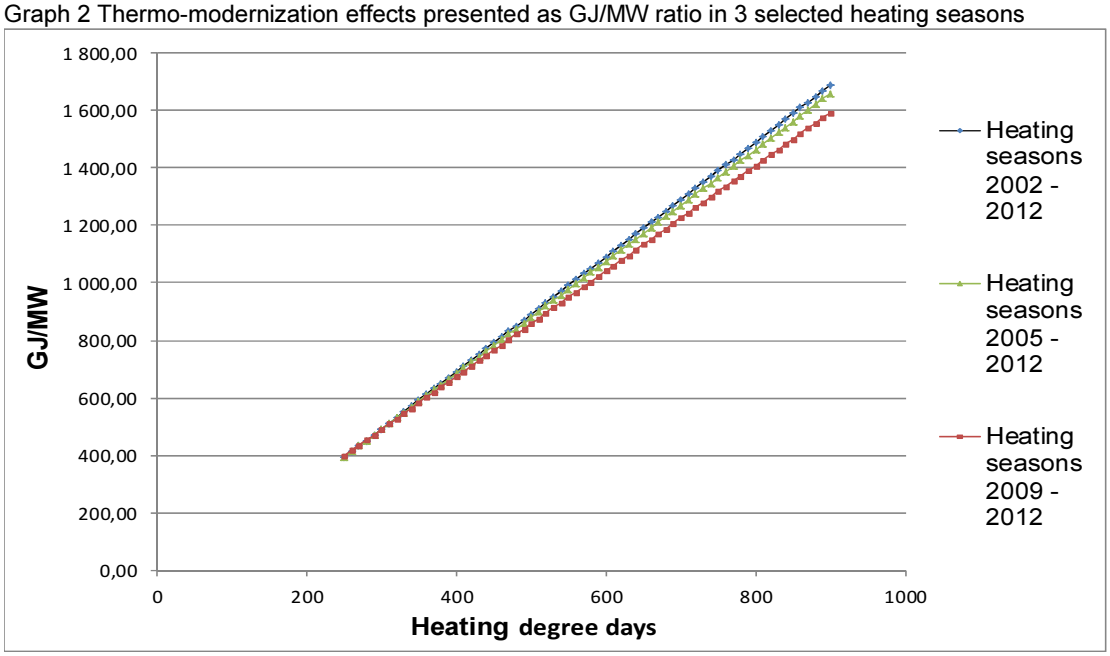
	Coefficient a_i	*Coefficient b_i*	*p-Value for a_i*	*p-Value for b_i*	*R square*
Heating seasons 2002 - 2012	1,994	-105,822	0,000%	0,006%	96,69%
Heating seasons 2003 - 2012	1,979	-104,700	0,000%	0,010%	96,85%
Heating seasons 2004 - 2012	1,960	-97,344	0,000%	0,034%	97,05%
Heating seasons 2005 - 2012	1,946	-93,169	0,000%	0,099%	97,16%
Heating seasons 2006 - 2012	1,886	-63,417	0,000%	2,165%	97,38%
Heating seasons 2007 - 2012	1,847	-46,993	0,000%	8,361%	97,71%
Heating seasons 2008 - 2012	1,833	-47,261	0,000%	10,106%	97,94%
Heating seasons 2009 - 2012	1,836	-59,991	0,000%	5,873%	98,29%

Source: Own study exemplified in the xls attachment

p-value is the probability that the sample data would occur provided that a pre-defined "null hypothesis" were in fact true in the population.

Each model has the equation of GJ/MW = a_i * HDD + b_i and fits the set of data well. Additionally, coefficients a_i and b_i are statistically significant as shown in Table 3. To visualise impact of thermo-modernisation projects three heating seasons 2002-2012, 2005-2012 and 2009-2012 were chosen to graphically illustrate this phenomenon. It is presented in Graph 2.

Graph 2 Thermo-modernization effects presented as GJ/MW ratio in 3 selected heating seasons



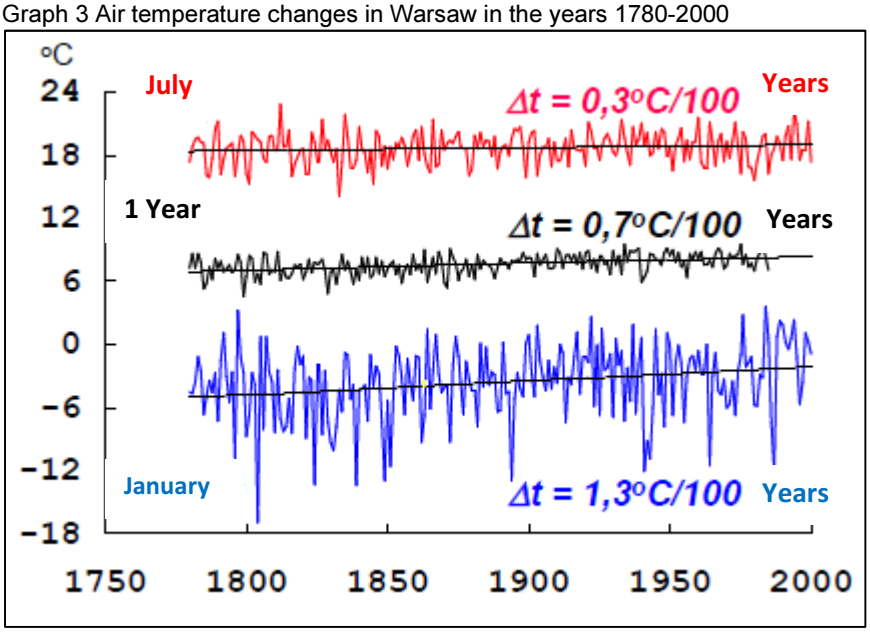
Source: Own study exemplified in the xls attachment

Graph 2 illustrates the above phenomenon. When heating degree days are constant (temperature and the number of days are constant) 1 MW of power generates less and less heat sold in GJ as time passes. This is another risk that LPEC has to face in order to mitigate its impact on the company's pricing policy.

Weather conditions risk

The weather has a huge impact on business activity. It includes temperature, rainfall intensity, and wind speed. It is estimated that weather influences (directly or indirectly) three out of four companies [Michalak 2011]. Therefore, managing weather risk is important both from the perspective of individual players and the whole economy. Risk is an element that accompanies to a greater or lesser extent any business [Fraser and Simkins 2010]: it involves either adverse or positive effects, which means that the outcome may be different than that originally planned [Sokołowska 2008]. Energy sector is the one that is the most exposed to weather risk. Risk associated with operating activities of heat distributors and heat plants is primarily one of changing the level of heat sold. Depending on the weather this type of business revenues can fluctuate dramatically. This fact is also of the essence to end users as a decrease in the amount of heat sold, (which results in lower revenues), affects clients. Responsibility for losses that convert into higher prices of unit energy is usually transferred to customers.

Graph 3 Air temperature changes in Warsaw in the years 1780-2000



Source: Olszewski K., Kicińska B., 2008, Czy w Polsce notujemy wzrost temperatury i inne przejawy ocieplenia klimatu?, Uniwersytet Warszawski

As the average temperature and its volatility in Poland rise the key task for energy companies in terms of risk management is to find models that enable them to measure the impact of changes on their financial situation - mainly liquidity. Therefore, this work presents how this problem was solved in LPEC.

Chapter 2 Strategy and modelling

2.1 General information on Lubelskie Przedsiębiorstwo Energetyki Cieplnej Sp. z o.o. and its strategy development plan for years 2013-2015

LPEC District Heating Company is located in Lublin in the South East of Poland. The company is 100% owned by the City of Lublin. The company's core activity concentrates on the distribution of heat to residential and commercial areas as well as public utility facilities, and on ensuring that the municipal heat distribution network in Lublin is fully operative. Housing accounts for 70% of all customers. The company satisfies 60% of the total demand for heating of the town supplying thermal power to over 1400 users. LPEC ranks ninth among the biggest district heating distributors in Poland. It purchases thermal power from two Lublin-based CHP plants and distributes it to end users by means of its own distribution network. Thermal power generated by these two CHP plants totals 970 MW. The total length of the company's network is 427 km including 243 km of high temperature pipelines and 184 km of low temperature pipelines. Some 52% of the distribution network is over 20 years old and is in need of on-going modernisation and refurbishment.

Table 4 LPEC technical potential

• 427 km of the heat distribution network of pipes, • 1629 heat exchangers (units), • 560 MW of thermal power contracted by buyers, • Sales of 4.000.000 GJ.

Source: Own study based on data from LPEC

LPEC remains an unquestionable leader in it sector both in Lublin and in the entire heat generation and distribution industry. Numerous awards and certificates bear witness to this including the second place on the National Ranking List of Top District Heating Establishments, the title of the Voivodship Business Leader, Gazela Biznesu award or "Teraz Polska" Polish Promotional Emblem for District Heating distributed by LPEC.

Company's Bodies of Authority
LPEC Sp. z o.o. in Lublin is fully owned by the City of Lublin.

Board of Directors
Mr Lech Kliza – President of the Board

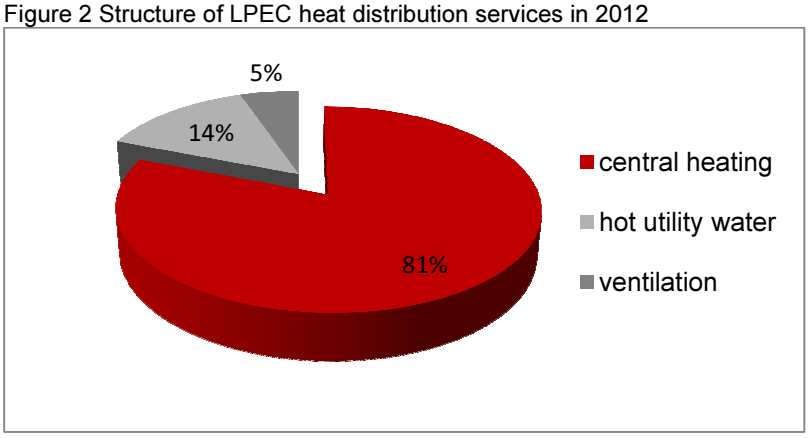
Supervisory Board
Mr Jacek Drozd – President of the Supervisory Board
Mr Paweł Bobołowicz – Vice-President of the Supervisory Board
Mr Mirosław Kasprzak – Secretary of the Supervisory Board

Mr Konrad Barański – Member of the Supervisory Board
Ms Irena Mazurek – Member of the Supervisory Board

Sales of heat

LPEC Sp. z o.o. offers thermal power for central heating, ventilation, and hot utility water. Thermal power for central heating is dominant and accounts for 81% of the demand for contracted thermal power; hot utility water ranks second with 14%, followed by 5% for ventilation.

Figure 2 Structure of LPEC heat distribution services in 2012

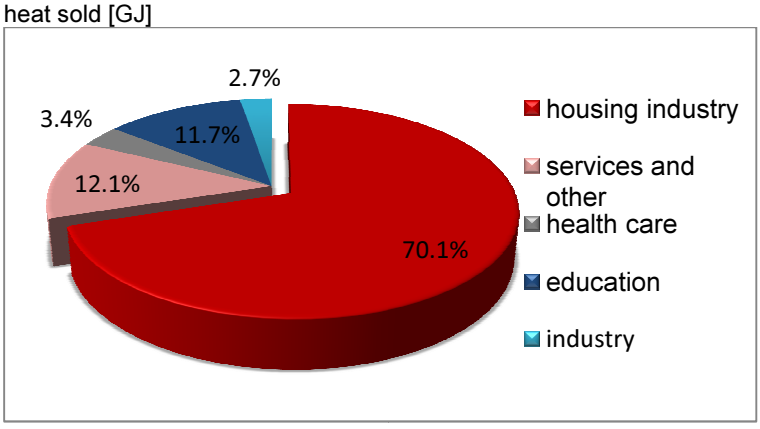


Source: Own study based on data from LPEC

Clients

The housing industry remains the company's strategic buyer accounting for approx. 70% of all heat deliveries executed by LPEC. With 11.7% of share in the sales structure, educational facilities rank third in terms of the volume of heat sold. Health care facilities and industry account for 3% each, the remaining buyers account for approx. 12 % of the total sales.

Figure 3 Structure of buyers in 2012 broken down by the volume of heat sold [GJ]

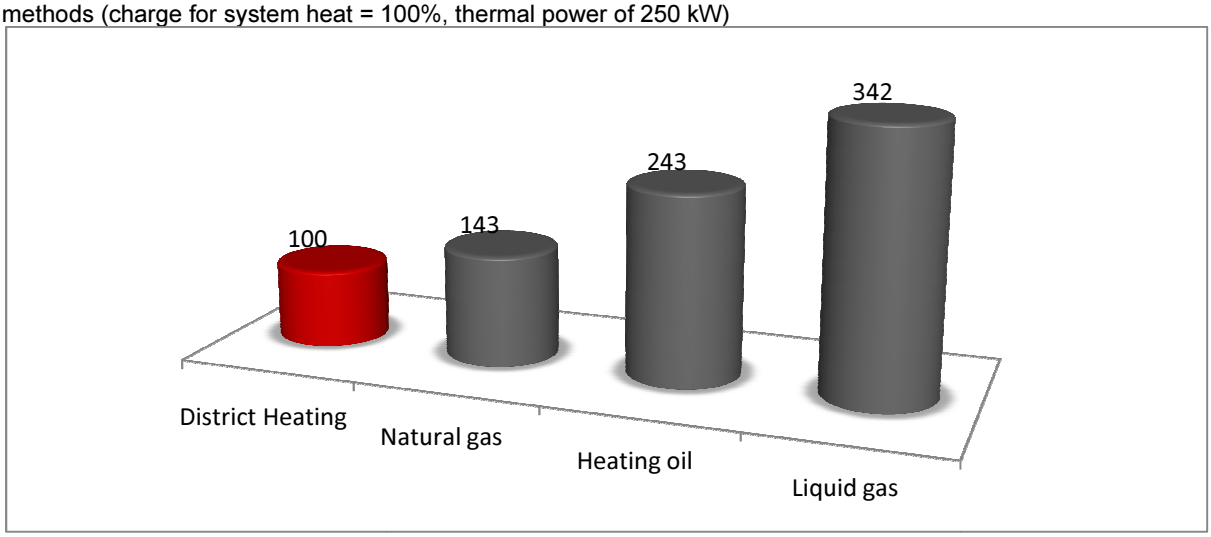


Source: Own study based on data from LPEC

Prices of heat

Local sources of thermal power are a competitive alternative to the services rendered by LPEC. They include devices powered by natural gas, heating oil, and liquid gas. Current analyses of heating costs indicate that District Heating {Pol. *Ciepło Systemowe*} delivered by LPEC is the cheapest source of thermal power. Furthermore, LPEC continues to tailor its services to meet the expectations of its clients (who use alternative sources of energy) to ensure the most attractive prices relative to alternative solutions.

Figure 4 Comparison of heating charges for Districts Heating provided by LPEC with those for alternative heating methods (charge for system heat = 100%, thermal power of 250 kW)



Source: Own study based on data from LPEC

The graph shows heating charges of a residential building for central heating and hot water (total thermal power of 250 kW). Heating charges for alternative sources include charges for system heat, natural gas, heating oil, and liquid gas. They are more expensive than LPEC distributed heat by 43%, 143%, and 242% respectively.

Development Strategy

The company's investment strategy is laid down in *The Development Strategy of LPEC Sp. z o.o. for the years 2013 – 2015*. The main goals defined in the document include:

- increasing safety and reliability of deliveries to buyers,
- eliminating defects in the heat distribution system,
- reducing heat transfer losses,
- connecting new buyers to the heat distribution network,
- improving the quality of delivered heat,
- ensure sustainable financial policy and smart growth,
- optimising management processes.

Security and reliability of heat supply is the company's top priority. Therefore, its investment activity largely focuses on the modernisation of its distribution network. Each year some 10 km of obsolete pipes are replaced with modern insulated pipes. At the same time the company develops its network extending it to new residential and commercial areas, in line with the town's growth. State-of-the-art technologies are regularly implemented to ensure almost maintenance-free management of the entire network. When the weather changes, a defect occurs or taking measurements is required, the company's lead time continues to be substantially reduced. Investments made by LPEC contribute to improved competitiveness of the region both from the prospective of investors and residents alike. The development of its distribution network substantially increases accessibility to the most economically attractive source of heat while the on-going modernisation of the existing infrastructure translates into more secure and reliable supplies of heat to end users. Equally important is the continuous reduction of transfer-related losses of heat, which means financial savings and a reduction of carbon dioxide emissions into the atmosphere. Some of the company's investment plans are co-financed by the European Union within the terms of reference of The Refurbishment of the Heat Distribution Network in Lublin Project. The project is executed under the Infrastructure and Environment Operational Programme, Priority Axis 9: Environment-friendly Energy Infrastructure and Energy Effectiveness, Activity 9.2 Efficient Energy Distribution.

As one of the goals defined in Development Strategy goals is to "ensure a sustainable financial policy and smart growth", hence it is crucial to measure the following key risks that endanger operational activity:

- Thermo-modernization risk;
- Weather conditions risk;
- Legislative risk.

In the building of the strategic financial plan for the years 2013-2015 all three sensitive areas were considered. When it comes to legislative risk, provisions for alternative payment were made in the following amounts:

- 1% of revenue from core business activity for the year 2013 as at 31st Dec 2013
- 1.5% of revenue from core business activity for the year 2014 as at 31st Dec 2014
- 1.5% of revenue from core business activity for the year 2015 as at 31st Dec 2015

according to formula $x_t = \mu_t * \frac{\mathrm{rev_t}}{\mathrm{fee_t}}$ that was presented in Chapter 1.

Article 39 of the Act on Accounting [the Act of 29 September 1994] says that entities create provisions for certain or highly probable future liabilities the amount of which can be reliably estimated. That means that all conditions to create provision were

satisfied. Thus the risk of incurring unexpected losses from alternative payment was decreased [Aczel 2000].
The outstanding two risks (thermo-modernization and weather conditions) have not been considered in the previous strategic plans. Therefore, it was necessary to quantify these risks by framing them into an econometric model.

2.2 Building econometric model

Risk models are of key importance when it comes to gauging capital adequacy, designing and managing products, developing business and valuing portfolios. They are increasingly used for regulatory purposes. Risk models should be embedded in the risk governance framework and should not be developed in isolation. Although they have numerous functions, they can never be a substitute for common sense as they do have their inherent limitations. Risk models need to be regularly improved in the light of gained experience, and to be effective they need feedback from smart management judgment. No model is ever perfect. Internal models are not able to fully account for or accurately reflect all risks equally well. There are many financial situations that can result in unprecedented events. The last financial crisis demonstrated that models need continuous improvement to remain effective. Risk model and risk judgement are two different sides of the coin. They are intended not to replace decision processes but to support them. There is no substitute for a deep understanding of risk, nor for common sense [CRO Forum 2009].
An effective model serves as a simplified representation of a real phenomenon, such as an actual process or system. A real phenomenon is represented by a model in order to predict, explain, and control it. The goals of econometric models correspond to structural analysis, forecasting and policy valuation. Modeling, sometimes referred to as the art of model building, is an integral part of most sciences, as the real-world systems regarding presented issue are enormously complex. In order to maximize its usability, the model has to strike a reasonable balance between realism and manageability. It should incorporate the main elements of the phenomenon that represent and specify the interrelationships among essential parts of the system in such a way that is sufficiently explicit and detailed to ensure that the analysis of the model leads to insights relating to the real-word system. It should at the same time be manageable in removing irrelevant influences and simplifying processes in order to ensure that it brings insights and allow drawing conclusions that are not obtainable from direct observation of the real-word system. The art of model building requires balancing often competing goals of realism and manageability [Griliches and Intriligator 1983].
There are many different types of models that are used in economics and social sciences. Among the most important types are geometric models, verbal/logical models, physical models and algebraic models including alternative ways of approximating the real-world system [Guzik 2000].

The model that is fundamental to this thesis is a algebraic model. It represents a real-world system by means of algebraic relations that form a system of equations. The system of equations requires so-called endogenous variables. They are the jointly dependent variables of the model, and at the same time they are determined by the system of equations. Usually the system contains other variables that are called exogenous and they are determined outside the system. They influence the system by affecting the values of the endogenous variables. The model also contains parameters which are generally calculated on the basis of the appropriate data using econometric techniques.
In general, algebraic models can be presented like the following system of g independent and consistent equations in the g endogenous variables, $y_1, y_2,\ldots,y_g$, the k exogenous variables, $x_1, x_2,\ldots,x_k$, and the m parameters, $\sigma_1, \sigma_2,\ldots, \sigma_m$: [Griliches and Intriligator 1983].

$f^1(y_1, y_2,\ldots,y_g; x_1, x_2,\ldots,x_k;\sigma_1, \sigma_2,\ldots, \sigma_m)=0$
$f^2(y_1, y_2,\ldots,y_g; x_1, x_2,\ldots,x_k;\sigma_1, \sigma_2,\ldots, \sigma_m)=0$
.
.
.
$f^g(y_1, y_2,\ldots,y_g; x_1, x_2,\ldots,x_k;\sigma_1, \sigma_2,\ldots, \sigma_m)=0$

The key task of this thesis was to build a model that will correlate the weather conditions with heat sold to end users. The best approximation of weather conditions is heating degree days (HDD). It measures the severity and duration of cold weather and is determined as follows:

HDD=(20-t)*D,

where:

t - outside temperature in Celsius degree
D – number of days in heating period

It was a major challenge to find an estimator that will reflect heat sold to an end user - Gigajoule (GJ). To avoid situation when the weather conditions are constant and heat sold increases because of network expansion the best estimator was decided to be heat sold per unit user. The number of end users is well represented by power sold - Megawatt (MW). Hence, an estimator is GJ/MW – the ratio of heat capacity utilization.

Table 5 Ratio of heat capacity utilization depending on heating degree days in monthly heating seasons from 2002 to 2012

Date	HDD - X_i	GJ/MW - Y_i	Date	HDD - X_i	GJ/MW - Y_i
I 2002	626.94	1 258.82	III 2007	413.84	768.88
II 2002	455.84	905.50	IV 2007	359.80	584.21
III 2002	473.57	861.84	X 2007	325.67	531.58
IV 2002	377.44	641.65	XI 2007	582.42	1 063.02
X 2002	364.84	675.80	XII 2007	771.48	1 419.69
XI 2002	517.14	987.94	I 2008	437.64	811.87
XII 2002	911.16	1 808.94	II 2008	654.85	1 232.54
I 2003	536.76	1 021.25	III 2008	492.71	880.13
II 2003	835.72	1 594.78	IV 2008	361.76	622.67
III 2003	592.48	1 107.68	X 2008	371.35	651.78
IV 2003	436.80	785.21	XI 2008	388.36	694.17
X 2003	445.83	646.52	XII 2008	714.47	1 321.21
XI 2003	453.32	851.70	I 2009	616.46	1 077.19
XII 2003	690.42	1 323.22	II 2009	611.52	1 061.68
I 2004	672.88	1 205.26	III 2009	573.62	1 014.93
II 2004	610.40	1 162.54	IV 2009	399.16	630.43
III 2004	573.30	1 062.32	X 2009	395.42	596.28
IV 2004	430.32	696.40	XI 2009	443.99	778.73
X 2004	309.72	534.06	XII 2009	758.13	1 357.46
XI 2004	447.47	777.39	I 2010	753.22	1 202.00
XII 2004	683.28	1 355.56	II 2010	682.08	1 263.94
I 2005	473.50	818.59	III 2010	568.98	969.35
II 2005	680.67	1 359.22	IV 2010	328.57	524.53
III 2005	661.49	1 248.62	X 2010	395.08	642.31
IV 2005	429.99	704.38	XI 2010	356.41	634.54
X 2005	286.72	380.81	XII 2010	915.75	1 627.96
XI 2005	472.80	830.51	I 2011	494.69	894.97
XII 2005	820.17	1 592.67	II 2011	665.60	1 166.66
I 2006	678.48	1 173.24	III 2011	594.06	1 069.77
II 2006	736.89	1 475.11	IV 2011	365.10	612.26
III 2006	779.13	1 394.02	XI 2011	523.59	884.54
IV 2006	357.00	638.11	XII 2011	702.62	1 227.11
X 2006	245.28	321.52	I 2012	478.56	852.99
XI 2006	485.86	916.68	II 2012	877.54	1 531.34
XII 2006	603.05	1 114.79	III 2012	537.70	947.20
I 2007	360.64	721.44	IV 2012	378.70	623.41
II 2007	739.20	1 391.38			

Source: Own study exemplified in the xls attachment

Having the data ranging from January 2002 till April 2012 (Table 5) 73 pairs (HDD;GJ/MW) were located on a Cartesian coordinate system – see Graph 1 in Chapter 1.3. The graph shows that the pairs are located either on the regression line or closely to it. This allows us to assume that the links between GJ/MW ratio and HDD can be described as follows:

$$\frac{GJ}{MW} = a * HDD + b$$

where *a* and *b* are linear function parameters.

Using Analysis ToolPak in Excel, a regression line formula based on least squares method was determined.

Table 6 Key statistics output from Excel based on data from Table 5

SUMMARY OUTPUT		
Regression statistics		
Multiple R	98,33%	
R square	96,69%	
Adjusted R square	96,64%	
Standard Error	60,53	
Observations	73	
	Coefficients	**p-Value**
Intercept	-105,82	0,006%
HDD - Xi	1,99	0,000

Source: Own study exemplified in the xls attachment

Hence the dependence of GJ/MW ratio on HDD is described by the following formula:

$$\frac{GJ}{MW} = 1{,}99 * HDD - 105{,}82$$

Having a ready formula does not mean having an effective model. The one-dimensional linear regression model is effective when [Hair et al. 1995, p. 78-106; Lee et al. 2009, p. 57-61]:

1) Coefficient of variation < 10%
2) R square > 90%
3) p-Value < 1%
4) T>K, where T is the number of observations and K is the number of exogenous variables.

Ref. 1)
Coefficient of variation (V) is the ratio of standard deviation to the mean. Sometimes it is also called unitized risk. It can be described as follows:

$$V = \frac{s}{Y_{av}}$$ where

s – standard error. It equals square root of unbiased variation between projected endogenous variables and their real equivalents.
Y_{av} – average ratio of GJ/MW

According to Tables 5 and 6, s = 60.53 and Y_{av} = 974.23, hence *V* = 6,21% < 10%.
Ref. 2)
R square is a statistical measure of how well a regression line approximates real data points. Its values range from 0 to 1. The higher the value the better a regression line approximates the real data. According to Table 6, R square equals 96.69% which means that approximation is very strong.

The first two conditions stand for goodness of fit with relation to the sample.

Ref. 3)
p-Value is the probability that either of the linear function parameters equals 0. According to Table 6 the probability that either the intercept coefficient or HDD coefficient equals 0, provided that null hypothesis is true, is 0,006% and 2,7E-54~0% respectively.

Ref. 4)
The number of observations (73) is significantly higher that the number of exogenous variables (1).

All four conditions are satisfied and thus it is assumed that the model is effective. However, to improve the model two issues have to be taken into account, namely, the function field and the thermo-modernisation process.

While forecasting the sales of heat (GJ) when the average outside temperature (t), power (MW), and the number of days in the heating period (D) are given, the empirical field of function can be exceeded. For the purpose of long-term planning at LPEC it is assumed that the average outside temperature in heating season equals 2.06 degree of Celsius and heating seasons consist of 211 days. It gives 3788 HDD. Table 5 shows that the maximum value for HDD measured within 2002-2012 is 915.75. The assumption that the formula for GJ/MW ratio for HDD from far outside the empirical field of function is the same as for HDD from the empirical field of function may be deceptive [Curwin and Slater 2008]. Therefore, the period of 211 days was divided into sub-periods, each consisting of 30 days. That gives us 7.04 sub-periods (211/30). To determine the expected amount of heat sold more accurately for, say the year 2013 for planned MW=568,23, t=2,06 and D= 211 the formula is as follows:

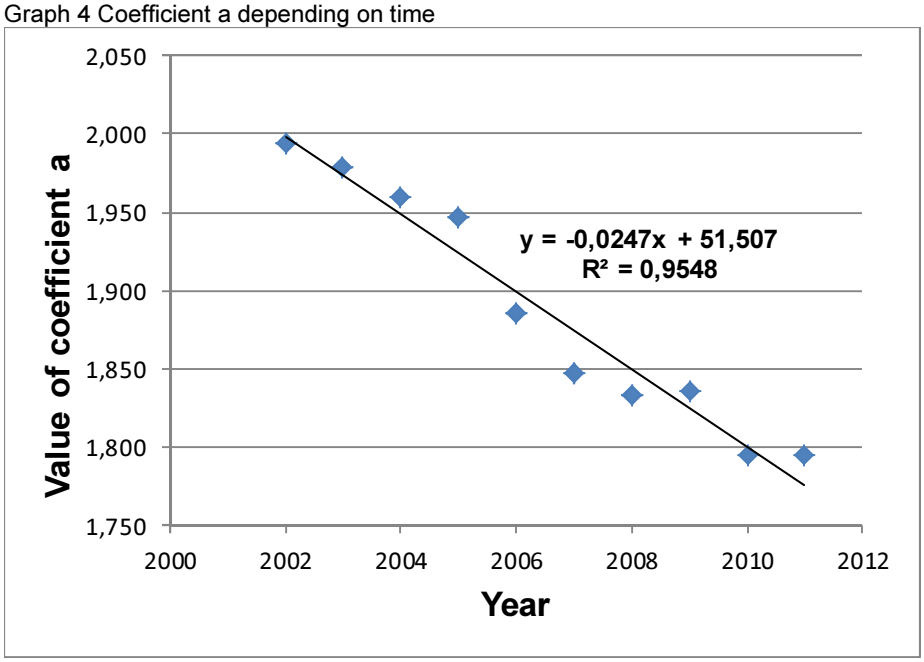
GJ = MW*{211/30*[1,99*(20-2,06)*30-105,82]}= 3 688 720

During the non-heating seasons at LPEC the average GJ/MW ratio is assumed to be constant (independent of weather conditions) and equals 701 GJ/MW.
Thus the total amount of heat sold in long term period can be described in following formula:
GJ = {MW*{D/30*[1,99*(20-t)*30-105,82]} + MW*701}*(1-e), (3)
where:

- t is the expected average outside temperature in Celsius during the heating season;
- MW is the expected power connected to end users;
- e is the correction factor (1,4%).

The formula (3) does not include thermo-modernisation effect which leads to a decrease in the ratio of GJ/MW at constant HDD. The idea is to make *a* and *b* coefficients dependent on time (years). To quantify the influence of this process on the ratio of GJ/MW, pairs (GJ/MW;HDD) were compared for different heating seasons, starting from period 2002-2012 and ending at 2009-2012. As a result of applying a one-dimensional linear regression model eight separate values of coefficients *a* and *b* were obtained, each one assigned to different periods of time. The results are shown in Table 3 in Chapter 1.3. Additionally, Graphs 4, 5 and Tables 7, 8 describe the effectiveness of obtained model.

Graph 4 Coefficient a depending on time



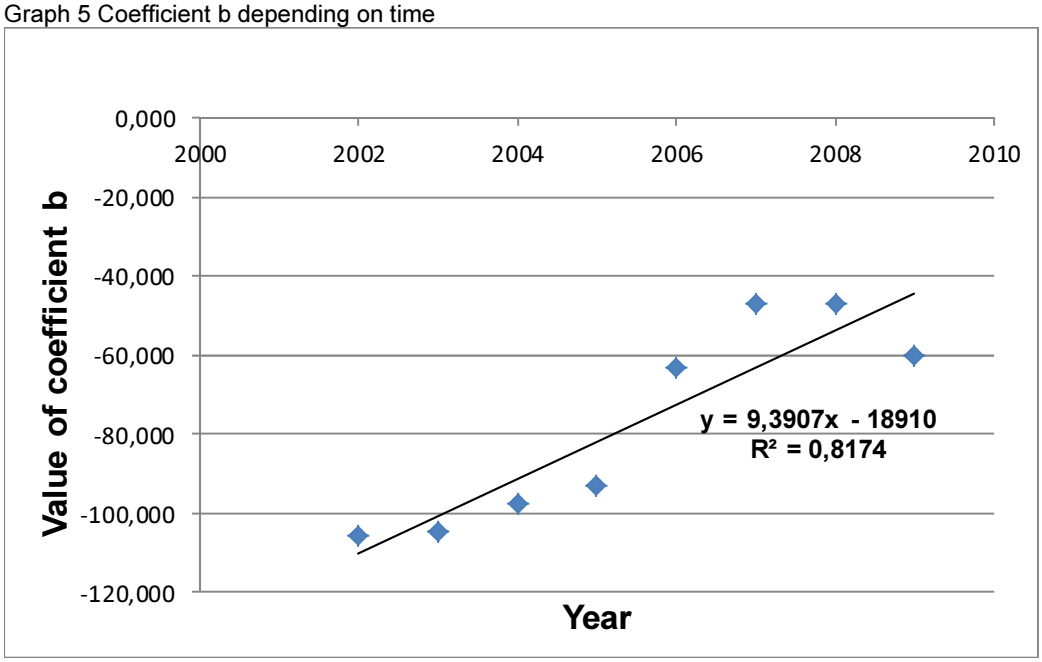
Source: Own study exemplified in the xls attachment

Table 7 Key statistics output from Excel based on data from Graph 4

SUMMARY OUTPUT		
Regression statistics		
Multiple R	97,71%	
R square	95,48%	
Adjusted R square	94,92%	
Standard Error	0,02	
Observations	10	
	Coefficients	**p-Value**
Intercept	51,51	0,0001%
Coefficient a	-0,02	0,0001%

Source: Own study exemplified in the xls attachment

Graph 5 Coefficient b depending on time



Source: Own study exemplified in the xls attachment

Table 8 Key statistics output from Excel based on data from Graph 5

SUMMARY OUTPUT		
Regression statistics		
Multiple R	90,41%	
R square	81,74%	
Adjusted R square	78,70%	
Standard Error	11,74	
Observations	8	
	Coefficients	**p-Value**
Intercept	-18 910,39	0,2007%
Coefficient b	9,39	0,2049%

Source: Own study exemplified in the xls attachment

Equations for coefficient *a* and *b* in Graphs 4 and 5 are useful when the following conditions for effectiveness of the model are fulfilled:

1) Coefficient of variation < 10%
2) R square > 90%
3) p-Value < 1%
4) T>K, where T is the number of observations and K is the number of exogenous variables.

Ref. to coefficient *a*

1) V = 0,02 / 1,89 = 0,92% < 10%
2) R square = 95,48% > 90%
3) p-Values of both intercept and coefficient *a* are lower than 1%
4) T=10 and K=1. Hence T>K

All four conditions for the equation with coefficient *a* were fulfilled and therefore this equation is strongly effective.

Ref. to coefficient *b*

1) V = 11,74 / |-77,34| = 15,18% > 10%
2) R square = 81,74% < 90%
3) p-Values of both intercept and coefficient *b* are lower than 1%
4) T=8 and K=1. Hence T>K

Although the first two conditions that describe very strong goodness of model fit were not fulfilled, it still can be claimed that the model quite accurately reflects reality. Conditions 3) and 4) were fulfilled and therefore the equation for coefficient *b* is claimed to be effective.

From the above we have:

Coefficient a_t = -0,02 * Y_t + 51,51 (4)

Coefficient b_t = 9,39 * Y_t – 18.910,39, (5)

where Y_t is the year for simulation.

Thus, including outside temperature and thermo-modernization process, the total amount of heat sold in long term period can be described by following formula:

GJ = {MW*{D/30*[(coefficient a_t)*(20-t)*30 + coefficient b_t]} + MW*701}*(1-e), (6a)

And using equations (4) and (5) we have

GJ = {MW*{D/30*[(-0,02 * Y_t + 51,51)*(20-t)*30 + (9,39 * Y_t – 18.910,39)]} + MW*701}*(1-e), (6b)

where

MW is the expected power connected to end users,
D is the amount of days in heating season,
Y_t is the year of simulation
t is the expected average outside temperature in Celsius during heating season,
e is the correction factor (1,4%).

Using equation (6b) Table 9 presents the projected amount of heat sold for years 2013-2024 at particular power connected to end users. For the purpose of simulation, it is assumed that average outside temperature in heating seasons equals 2.06 degree of Celsius and heating seasons consist of 211 days.

Table 9 Projected amount of heat sold for years 2013-2024

Year	Power MW	Coefficient a_t	Coefficient b_t	Projected heat to be sold (GJ)
2013	568.23	1.73	-6.91	4 029 528
2014	570.01	1.70	2.48	4 026 619
2015	573.71	1.68	11.87	4 037 150
2016	574.60	1.65	21.27	4 027 835
2017	574.60	1.63	30.66	4 012 212
2018	574.60	1.60	40.05	3 996 588
2019	574.60	1.58	49.44	3 980 965
2020	574.60	1.55	58.83	3 965 341
2021	574.60	1.53	68.22	3 949 718
2022	574.60	1.50	77.61	3 934 095
2023	574.60	1.48	87.00	3 918 471
2024	574.60	1.45	96.39	3 902 848

Source: Own study based on data from LPEC

As the year 2016 is such a long perspective it is assumed that starting from then till the year 2024 the expected power connected to end users is 574.6 MW. With that variable constant it is visible from Table 9 that the thermo-modernisation process has a significant impact on projected heat sold year on year. The annual decrease of heat sold caused by the last factor is over 15 thousand GJ.

Equation (6b) allows us also to run sensitivity analysis depending on average outside temperature, amount of power connected to end users and amount of days during the heating season. Assuming that the average outside temperature in heating seasons rises by 0.1, 0.5 and 1 degree of Celsius and the remaining variables are constant, the projected amount of heat sold for years 2013-2024 is as follows:

Table 10 Projected amount of heat sold for years 2013-2024 including the rise of average outside temperature

Year	Power MW	Projected heat to be sold (GJ) including the temperature increase by 0,1 degree of Celsius ceteris paribus	Projected heat to be sold (GJ) including the temperature increase by 0,5 degree of Celsius ceteris paribus	Projected heat to be sold (GJ) including the temperature increase by 1 degree of Celsius ceteris paribus
2013	568.23	4 009 100	3 927 391	3 825 255
2014	570.01	4 006 421	3 925 631	3 824 643
2015	573.71	4 017 117	3 936 984	3 836 818
2016	574.60	4 008 067	3 928 992	3 830 150
2017	574.60	3 992 739	3 914 848	3 817 485
2018	574.60	3 977 412	3 900 704	3 804 821
2019	574.60	3 962 084	3 886 561	3 792 156
2020	574.60	3 946 756	3 872 417	3 779 492
2021	574.60	3 931 429	3 858 273	3 766 827
2022	574.60	3 916 101	3 844 129	3 754 163
2023	574.60	3 900 774	3 829 985	3 741 498
2024	574.60	3 885 446	3 815 841	3 728 834

Source: Own study based on data from LPEC

Hence, when the average outside temperature increases only by 0.1 degree of Celsius, the expected heat to be sold falls by 20.4 thousand GJ in 2013 and 17.4 thousand GJ in 2024. The equation (6b) represents a linear model so when the increase of the average outside temperature reaches 1 degree of Celsius during the heating season the expected heat to be sold decreases by 204.2 thousand GJ in 2013, and 174.0 thousand GJ in 2024.

Another sensitivity analysis including either the change in the amount of power connected to end users or the change in the amount of days during the heating season, other variables being equal, is presented in Tables 11 and 12.

Table 11 Projected amount of heat sold for years 2013-2024 including decrease of power connected to end users

Year	*Projected heat to be sold (GJ) including the power decrease by 1 MW ceteris paribus*	*Projected heat to be sold (GJ) including the power decrease by 5 MW ceteris paribus*	*Projected heat to be sold (GJ) including the power decrease by 10 MW ceteris paribus*
2013	4 023 127	3 997 525	3 965 523
2014	4 020 245	3 994 752	3 962 886
2015	4 030 804	4 005 420	3 973 689
2016	4 021 516	3 996 241	3 964 646
2017	4 005 920	3 980 753	3 949 295
2018	3 990 324	3 965 266	3 933 943
2019	3 974 728	3 949 778	3 918 592
2020	3 959 131	3 934 291	3 903 240
2021	3 943 535	3 918 803	3 887 889
2022	3 927 939	3 903 316	3 872 537
2023	3 912 343	3 887 828	3 857 186
2024	3 896 746	3 872 341	3 841 834

Source: Own study based on data from LPEC

Table 12 Projected amount of heat sold for years 2013-2024 including decrease in the amount of days during the heating season

Year	*Power MW*	*Projected heat to be sold (GJ) including decrease in the amount of days during the heating season by 1 day ceteris paribus*	*Projected heat to be sold (GJ) including decrease in the amount of days during the heating season by 5 days ceteris paribus*	*Projected heat to be sold (GJ) including decrease in the amount of days during the heating season by 10 days ceteris paribus*
2013	568.23	4 012 307	3 943 426	3 857 323
2014	570.01	4 009 418	3 940 615	3 854 610
2015	573.71	4 019 911	3 950 957	3 864 764
2016	574.60	4 010 644	3 941 877	3 855 920
2017	574.60	3 995 094	3 926 624	3 841 036
2018	574.60	3 979 545	3 911 370	3 826 152
2019	574.60	3 963 995	3 896 117	3 811 269
2020	574.60	3 948 446	3 880 863	3 796 385
2021	574.60	3 932 896	3 865 610	3 781 501
2022	574.60	3 917 347	3 850 356	3 766 618
2023	574.60	3 901 797	3 835 102	3 751 734
2024	574.60	3 886 248	3 819 849	3 736 850

Source: Own study based on data from LPEC

Tables 11 and 12 show that sensitivity of the amount of heat to be sold is greater for the increase of average outside temperature than for decrease of power and amount of days in the heating period. For example when temperature increases by 1 degree of Celsius the expected amount of heat to be sold in 2024 decreases by 174 thousand GJ, whereas a decrease of power connected to end users by 10 MW or a decrease in the amount of days during the heating season by 10 days will result in a decrease of expected amount of heat to be sold in 2024 by 61 thousand GJ and 166 thousand GJ, respectively. These losses result in significant revenue downturn and increase the need for additional resources to finance operational activity. This issue will be thoroughly analysed in Chapter 3.

Chapter 3 The effect of external factors on Company's standing

3.1 External sources of funding Company's assets

As at 31st December 2012 LPEC has five sources of funding its assets:

1) Investment loan in the amount of 9 m PLN in BGK SA
2) Preferential loan in the amount of 3.3 m PLN in WFOŚiGW
3) Revolving credit in the amount of 6.5 m PLN in PKO BP SA
4) Revolving credit in the amount of 4.8 m PLN in Millennium SA
5) Leasing in the amount of 0.6 m PLN in Pekao Leasing SA (financial leasing in accordance with the accounting law and operational leasing under the tax law)

In August 2013 the agreement with Millennium SA for revolving contract with the limit of 7 m PLN expires. The company's strategy for the period 2013-2015 is to swap this source of cash with long-term financing – an investment credit. This step is taken in order to improve liquidity and solvency ratios [Tracy 1994] which, as at 31st December 2012, were:

1) Current ratio[1] – 0,77
2) Quick ratio I[2] – 0,67
3) Durability of financial structure ratio[3] – 78,2%
4) Golden principle balance sheet ratio[4] – 94,1%

The above presented ratios are far below the average in the energy sector [Ranking Spółek Giełdowych 2013].

Table 13 Average liquidity ratios in energy sector

Year	III 2012	2011	2010	2009	2008	2007
Current ratio[1]	1.46	1.37	1.30	1.78	1.07	1.17
Quick ratio I[2]	1.06	1.05	1.15	1.58	0.92	1.04
Ratio of working capital to total assets[5]	0.07	0.06	0.04	0.10	0.01	0.02
Working capital in days of turnover[6]	40	40	31	76	8	15

Source: Ranking Spółek Giełdowych, 2013, Sektor Energetyka

LPEC current ratio as at 31st December 2012 is almost twice as low as the average in the industry in the 3rd quarter of 2012. According to generally accepted managerial

[1] Current ratio = Current assets / Current liabilities
[2] Quick ratio = (Cash + Account receivable) / Current liabilities
[3] Durability of financial structure ratio = Fixed capital / Total assets. Fixed capital = equity + long-term provisions + long-term liabilities
[4] Golden principle balance sheet ratio = Fixed capital / Fixed assets
[5] Working capital = Current assets - Current liabilities
[6] Working capital in days of turnover = Number of days in the period * (Current assets - Current liabilities) / Sales revenues

accounting standards current assets should cover more than the whole current liabilities which makes current ratio higher than 1 [Hawawini and Viallet 2011, p. 85; Rutkowski 2003]. This indicator varies depending on the sector and should not be lower than 1.5. Golden principle balance sheet ratio, which equals fixed capital divided by fixed assets [Gryko et al. 2008], also confirms that working capital at LPEC is negative. This is a result of financing fixed assets by current liabilities (revolving credits) as the cost of short-term capital may seem to be lower than the cost of long-term capital. On the other hand, pursuing such a strategy in the long-term may, and probably will, result in failure to settle liabilities and finally to insolvency.

Therefore, in September 2012 LPEC signed a contract with BGK SA for an investment loan. It consists of two parts. The first one, in the amount of 30 m PLN, is designed to finance investment projects in years 2012-2016. The loan will be paid on a monthly basis in equal principal instalments within the period of 2016-2024. Optionally, the company can start repaying the outstanding balance from the 1st January 2015 in monthly instalments.

The second part of the contract is a credit promise for the amount of 20 m PLN. It is designed to refinance expenditures on investment projects for years 2010-2011. The promise is valid till the end of 2013, and if used, it will be converted into loan contract on the same conditions as the first loan, in particular amortization, intensity of payments and termination of agreement. So the credit promise can serve for the Company as a sort of revolving credit with the significant difference that it will be paid in long term period, and major part of its principal will be presented in financial statements as long term liabilities. This move will make it possible to raise liquidity and solvency ratios of LPEC in the strategic horizon.

As it was mentioned in the Chapter 2 the next strategy development plan of LPEC is made for the years 2013-2015. However, as it will be shown it the further part of this study, the horizon for sensitivity analysis should reach at least year 2024 as due to certain event, e.g. particular weather conditions, some symptoms of cash shortage may occur just after the year 2016.

3.2 Sensitivity analysis

While creating financial statements for the 2013-2015 strategy development plan fundamental managerial accounting rules were applied as follows:

1) Receivables, payables and inventories are estimated according to average turnover ratios from the years 2006-2011;
2) Tangible and intangible fixed assets at the end of year t are the sum of tangible and intangible fixed assets at the end of year t-1 and investments plus modernization minus depreciation at the year t;
3) Provisions for White Certificates are calculated according to the Article 12 of Energy Efficiency Act of 15th April 2011 [Ustawa z 15 kwietnia 2011], and according to Article 3 Section 2 of "Regulation of the Minister of Economy from 4 September 2012 on the method of calculating the amount of primary energy equivalent to the value of energy efficiency certificates and alternative unit payment" [Rozporządzenie MG z 4 września 2012];
4) Revenues and cost related to the core activity are calculated according to the expected level of power connected to end users and equation (6b) from Chapter 2. The simulation is made on the assumption that the average outside temperature during heating seasons equals 2.06 degrees Celsius and heating seasons consist of 211 days. Additionally, during the non-heating seasons the average GJ/MW ratio is assumed to be constant (independent of weather conditions) and equals 701 GJ/MW;
5) The rest of operational revenues and costs are expected to increase according to expected inflation rate;
6) Financial costs in particular years are based on level of projected liabilities from credit facilities and loans;
7) Opening balance as at 1st January 2013 was the closing balance as at 31st December 2012.

Applying the above mentioned rules there are projected financial statements and key performance indicators in the optimal scenario presented in Tables 14-17. Optimal scenario in terms of weather conditions is described in point 4) above.

Table 14 Balance Sheets in the optimal scenario

	Assets as at	31.12.2012	31.12.2013	31.12.2014	31.12.2015	31.12.2016	31.12.2017	31.12.2018	31.12.2019	31.12.2020	31.12.2021	31.12.2022	31.12.2023	31.12.2024
A.	**Fixed Assets**	**173 001 824**	**180 071 438**	**184 262 761**	**181 339 945**	**179 141 010**	**177 583 869**	**175 341 659**	**172 236 378**	**168 317 085**	**163 627 886**	**158 075 617**	**151 747 038**	**144 615 921**
I.	Intangible assets	3 161 102	2 218 131	1 275 160	388 568	145 087	0	0	0	0	0	0	0	0
II.	Tangible fixed assets	168 385 232	176 397 817	181 532 110	179 495 887	177 540 433	176 128 379	173 886 168	170 780 887	166 861 595	162 172 396	156 620 127	150 291 548	143 160 431
III.	Long-term receivables													
IV.	Long-term investments													
V.	Long-term prepayments and accrued income	1 455 490	1 455 490	1 455 490	1 455 490	1 455 490	1 455 490	1 455 490	1 455 490	1 455 490	1 455 490	1 455 490	1 455 490	1 455 490
B.	**Current Assets**	**35 136 545**	**38 864 995**	**40 473 015**	**43 771 143**	**44 858 121**	**46 303 828**	**47 663 232**	**49 252 926**	**51 201 916**	**58 942 776**	**66 889 909**	**74 537 342**	**81 786 704**
I.	Inventory	1 699 134	1 713 662	1 758 211	1 793 432	1 820 744	1 859 912	1 899 776	1 939 882	1 980 700	2 022 246	2 064 538	2 107 595	2 151 435
II.	Short-term receivables	30 219 227	33 922 224	35 536 039	37 542 565	39 053 064	40 473 878	41 957 542	43 641 086	45 428 729	47 090 695	48 806 203	50 592 998	52 434 546
III.	Short-term investments	257 298	268 222	217 878	1 474 259	1 023 426	1 009 152	845 027	711 071	831 602	6 868 950	13 058 282	18 875 863	24 239 836
-	cash and other financial assets	257 298	268 222	217 878	1 474 259	1 023 426	1 009 152	845 027	711 071	831 602	6 868 950	13 058 282	18 875 863	24 239 836
IV.	Short-term prepayments and accrued income	2 960 886	2 960 886	2 960 886	2 960 886	2 960 886	2 960 886	2 960 886	2 960 886	2 960 886	2 960 886	2 960 886	2 960 886	2 960 886
Total Assets		**208 138 370**	**218 936 433**	**224 735 776**	**225 111 088**	**223 999 131**	**223 887 697**	**223 004 891**	**221 489 303**	**219 519 001**	**222 570 662**	**224 965 526**	**226 284 380**	**226 402 625**
	Liabilities as at	**31.12.2012**	**31.12.2013**	**31.12.2014**	**31.12.2015**	**31.12.2016**	**31.12.2017**	**31.12.2018**	**31.12.2019**	**31.12.2020**	**31.12.2021**	**31.12.2022**	**31.12.2023**	**31.12.2024**
A.	**Equity**	**133 003 039**	**128 455 693**	**128 178 413**	**131 199 953**	**132 371 290**	**136 113 313**	**139 234 721**	**142 234 981**	**145 344 144**	**147 703 902**	**148 888 003**	**148 917 443**	**147 665 210**
I.	Share (initial) capital	102 225 000	102 225 000	102 225 000	102 225 000	102 225 000	102 225 000	102 225 000	102 225 000	102 225 000	102 225 000	102 225 000	102 225 000	102 225 000
II.	Outstanding contributions to share capital	0												
III.	Own shares	0												
IV.	Supplementary capital	28 146 069	28 146 069	28 146 069	28 146 069	28 146 069	28 146 069	28 146 069	28 146 069	28 146 069	28 146 069	28 146 069	28 146 069	28 146 069
V.	Revaluation capital													
VI.	Other reserve capital													
VII.	Profit (loss) carry forward	-3 424 676	-3 424 676	-3 424 676	-3 424 676	-3 424 676	-75 678	3 624 828	6 703 888	9 660 952	12 726 055	15 040 874	16 179 135	16 179 135
VIII.	Net profit (loss)	6 056 646	1 509 300	1 232 020	4 253 560	5 424 897	5 817 922	5 238 825	5 160 025	5 312 123	4 606 778	3 476 061	2 367 239	1 115 006
IX.	Net profit deductions during financial year													
B.	**Liabilities and provisions against liabilities**	**75 135 331**	**90 480 740**	**96 557 363**	**93 911 135**	**91 627 841**	**87 774 384**	**83 770 169**	**79 254 322**	**74 174 858**	**74 866 760**	**76 077 523**	**77 366 937**	**78 737 415**
I.1.	Provisions for old age pensions and similar	7 242 665	7 242 665	7 242 665	7 242 665	7 242 665	7 242 665	7 242 665	7 242 665	7 242 665	7 242 665	7 242 665	7 242 665	7 242 665
I.2.	Provisions for White Certificates	0	1 275 750	2 002 500	2 117 742	2 204 495	2 286 098	2 371 310	2 468 002	2 570 673	2 666 125	2 764 653	2 867 275	2 973 042
II.	Long-term liabilities	11 309 000	27 610 300	26 920 300	24 553 300	21 777 778	17 055 556	12 119 048	6 599 206	444 444	0	0	0	0
II.1.	credit facilities and loans	10 805 000	27 235 000	26 700 000	24 500 000	21 777 778	17 055 556	12 119 048	6 599 206	444 444	0	0	0	0
II.2.	other financial liabilities	504 000	375 300	220 300	53 300	0	0	0	0	0	0	0	0	0
III.	Short-term liabilities	43 679 145	38 600 703	35 399 416	34 510 196	35 545 671	36 962 833	38 439 914	39 977 216	41 579 844	43 250 737	44 992 973	46 809 765	48 704 475
1.	Towards associated entities													
2.	Towards other entities	43 679 145	38 600 703	35 399 416	34 510 196	35 545 671	36 962 833,42	38 439 914,28	39 977 216,33	41 579 843,65	43 250 737,36	44 992 972,62	46 809 764,70	48 704 475,40
2.1.	credit facilities and loans	12 797 989	7 070 000	2 535 000	200 000	0	0	0	0	0	0	0	0	0
2.2.	deliveries and services	30 738 156	31 387 703	32 721 416	34 167 196	35 545 671	36 962 833	38 439 914	39 977 216	41 579 844	43 250 737	44 992 973	46 809 765	48 704 475
2.3.	other financial liabilities	143 000	143 000	143 000	143 000	0	0	0	0	0	0	0	0	0
IV.	Accruals and deferred income	12 904 521	15 751 321	24 992 482	25 487 233	24 857 233	24 227 233	23 597 233	22 967 233	22 337 233	21 707 233	21 077 233	20 447 233	19 817 233
Total Liabilities		**208 138 370**	**218 936 433**	**224 735 776**	**225 111 088**	**223 999 131**	**223 887 697**	**223 004 891**	**221 489 303**	**219 519 001**	**222 570 662**	**224 965 526**	**226 284 380**	**226 402 625**

Source: Own study exemplified in the xls attachment

Table 15 Profit and Loss Accounts in the optimal scenario

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
A. Net income from sales and equivalent	**209 319 757**	**217 955 350**	**229 480 715**	**238 156 932**	**246 318 001**	**254 840 081**	**264 510 255**	**274 778 369**	**284 324 602**	**294 178 382**	**304 441 625**	**315 019 367**
I. Net income from sales of products	61 165 506	63 908 556	67 977 766	69 331 910	70 293 707	71 283 222	73 079 836	75 111 602	76 028 457	76 852 293	77 667 388	78 358 316
II. Change in products	-1 275 750	-2 002 500	-2 117 742	-2 204 495	-2 286 097,59	-2 371 309,78	-2 468 001,75	-2 570 672,53	-2 666 125,21	-2 764 653,07	-2 867 275,12	-2 973 041,87
III. Cost of product manufacturing for own needs	13 800 000	13 800 000	13 800 000	13 800 000	13 800 000,00	13 800 000,00	13 800 000,00	13 800 000,00	13 800 000,00	13 800 000,00	13 800 000,00	13 800 000,00
IV. Net income from sales of goods and materials	135 630 001	142 249 293	149 820 690	157 229 517	164 510 391	172 128 168	180 098 420	188 437 439	197 162 270	206 290 743	215 841 512	225 834 093
B. Cost of operating activity	**205 671 015**	**214 339 795**	**222 495 452**	**230 003 620**	**237 847 025**	**247 357 292**	**257 405 365**	**267 794 683**	**278 547 770**	**289 820 270**	**301 451 468**	**313 574 439**
I. Depreciation	18 137 168	18 837 341	18 354 816	17 626 935	17 003 141	17 688 211	18 551 281	19 365 293	20 135 199	20 998 269	21 774 579	22 577 117
II. Materials and energy consumption	11 943 328	12 342 493	12 421 137	12 567 957	12 759 351	12 956 953	13 166 265	13 382 505	13 605 905	13 836 701	14 075 141	14 321 480
III. Outsourced services	2 325 154	2 390 259	2 457 186	2 525 987	2 596 715	2 669 423	2 722 811	2 777 268	2 832 813	2 889 469	2 947 259	3 006 204
IV. Taxes and charges	7 088 295	7 561 974	8 009 959	8 300 541	8 592 795	8 885 202	9 177 764	9 470 483	9 763 359	10 056 395	10 349 593	10 642 953
V. Remuneration	23 564 690	23 813 916	24 179 219	24 422 338	24 910 785	25 409 001	25 917 181	26 435 524	26 964 235	27 503 519	28 053 590	28 614 662
VI. Social insurance and other benefits	5 835 885	5 974 003	6 057 277	6 109 879	6 227 418	6 347 261	6 469 454	6 594 043	6 721 076	6 850 601	6 982 667	7 117 326
VII. Other costs by type	1 146 493	1 170 516	1 195 169	1 220 467	1 246 429	1 273 074	1 302 190	1 332 129	1 362 915	1 394 572	1 427 127	1 460 605
VIII. Value of goods and materials sold	135 630 001	142 249 293	149 820 690	157 229 517	164 510 391	172 128 168	180 098 420	188 437 439	197 162 270	206 290 743	215 841 512	225 834 093
C. Profit (loss) on sales (A-B)	**3 648 742**	**3 615 555**	**6 985 262**	**8 153 311**	**8 470 976**	**7 482 789**	**7 104 889**	**6 983 686**	**5 776 831**	**4 358 113**	**2 990 157**	**1 444 928**
D. Other operating income	791 000	791 000	791 000	791 000	791 000	791 000	791 000	791 000	791 000	791 000	791 000	791 000
E. Other operating costs	600 000	600 000	600 000	600 000	600 000	600 000	600 000	600 000	600 000	600 000	600 000	600 000
F. Profit (loss) on operating activity (C+D-E)	**3 839 742**	**3 806 555**	**7 176 262**	**8 344 311**	**8 661 976**	**7 673 789**	**7 295 889**	**7 174 686**	**5 967 831**	**4 549 113**	**3 181 157**	**1 635 928**
G. Financial income	0	0	0	0	0	0	0	0	0	0	0	0
H. Financial costs	1 442 590	1 880 502	1 663 354	1 391 990	1 225 647	951 548	668 239	357 858	23 493	0	0	0
I. Profit (loss) on economic activity (F+G-H)	**2 397 152**	**1 926 053**	**5 512 908**	**6 952 321**	**7 436 329**	**6 722 241**	**6 627 650**	**6 816 827**	**5 944 338**	**4 549 113**	**3 181 157**	**1 635 928**
J. Result of extraordinary events	0	0	0	0	0	0	0	0	0	0	0	0
K. Gross profit (loss) (I + J)	**2 397 152**	**1 926 053**	**5 512 908**	**6 952 321**	**7 436 329**	**6 722 241**	**6 627 650**	**6 816 827**	**5 944 338**	**4 549 113**	**3 181 157**	**1 635 928**
L. Income tax	887 851	694 032	1 259 349	1 527 424	1 618 407	1 483 416	1 467 625	1 504 705	1 337 560	1 073 052	813 918	520 922
M. Net profit (loss) (K-L)	**1 509 300**	**1 232 020**	**4 253 560**	**5 424 897**	**5 817 922**	**5 238 825**	**5 160 025**	**5 312 123**	**4 606 778**	**3 476 061**	**2 367 239**	**1 115 006**

Source: Own study exemplified in the xls attachment

Table 16 Cash Flow Statements in the optimal scenario

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
A. Cash flow from operating activity												
I. Net profit (loss)	**1 509 300**	**1 232 020**	**4 253 560**	**5 424 897**	**5 817 922**	**5 238 825**	**5 160 025**	**5 312 123**	**4 606 778**	**3 476 061**	**2 367 239**	**1 115 006**
II. Total adjustments	**17 157 531**	**20 489 942**	**18 907 445**	**18 316 342**	**17 637 571**	**18 048 523**	**18 499 864**	**18 969 989**	**19 591 527**	**20 451 231**	**21 234 141**	**22 062 206**
1. Depreciation	18 137 168	18 837 341	18 354 816	17 626 935	17 003 141	17 688 211	18 551 281	19 365 293	20 135 199	20 998 269	21 774 579	22 577 117
2. Profit (loss) due to foreign exchange rate differences												
3. Interest and participation in profit (dividends)	1 442 590	1 880 502	1 663 354	1 391 990	1 225 647	951 548	668 239	357 858	23 493	0	0	0
4. Profit (loss) on investment activity												
5. Change in provisions	1 275 750	2 002 500	2 117 742	2 204 495	2 286 098	2 371 310	2 468 002	2 570 673	2 666 125	2 764 653	2 867 275	2 973 042
6. Change in inventory	-14 528	-44 549	-35 221	-27 312	-39 168	-39 864	-40 106	-40 817	-41 546	-42 292	-43 057	-43 840
7. Change in receivables	-3 702 998	-1 613 815	-2 006 526	-1 510 499	-1 420 814	-1 483 664	-1 683 544	-1 787 643	-1 661 966	-1 715 509	-1 786 795	-1 841 548
8. Change in short-term liabilities without credit facilities an loans	649 547	1 333 713	1 445 780	1 378 475	1 417 162	1 477 081	1 537 302	1 602 627	1 670 894	1 742 235	1 816 792	1 894 711
9. Change in accruals and deferred income	-630 000	-630 000	-630 000	-630 000	-630 000	-630 000	-630 000	-630 000	-630 000	-630 000	-630 000	-630 000
10. Other adjustments - fees for White Certificates		-1 275 750	-2 002 500	-2 117 742	-2 204 495	-2 286 098	-2 371 310	-2 468 002	-2 570 673	-2 666 125	-2 764 653	-2 867 275
III. Net cash flow on operating activity (I+/-II)	**18 666 831**	**21 721 962**	**23 161 005**	**23 741 239**	**23 455 493**	**23 287 348**	**23 659 889**	**24 282 112**	**24 198 305**	**23 927 292**	**23 601 380**	**23 177 213**
B. Cash flow on investment activity												
I. Income	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
1. Sale of intangible assets and tangible fixed assets												
2. Sale of investmnets in real property and intangible assets												
3. From financial assets												
4. Other income on investments												
II. Expenditure	**25 206 782**	**23 028 664**	**15 432 000**	**15 428 000**	**15 446 000**	**15 446 000**	**15 446 000**	**15 446 000**	**15 446 000**	**15 446 000**	**15 446 000**	**15 446 000**
1. Purchase of intangible assets and tangible fixed assets												
2. Investments in real property and intangibles												
3. In financial assets												
4. Other investment expenditure	25 206 782	23 028 664	15 432 000	15 428 000	15 446 000	15 446 000	15 446 000	15 446 000	15 446 000	15 446 000	15 446 000	15 446 000
III. Net cash flow on investment activity (I-II)	**-25 206 782**	**-23 028 664**	**-15 432 000**	**-15 428 000**	**-15 446 000**	**-15 446 000**	**-15 446 000**	**-15 446 000**	**-15 446 000**	**-15 446 000**	**-15 446 000**	**-15 446 000**
C. Cash flow on financial activity												
I. Income	**20 976 800**	**9 871 161**	**1 124 750**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
1. Net income from distribution of shares and other capital instruments and capital contributions												
2. Credit facilities and loans	17 500 000	0	0	0	0	0	0	0	0	0	0	0
2.1. short-term credit facilities and loans												
2.2. investment credit	17 500 000				0	0	0	0	0	0	0	0
3. Issue of debt securities												
4. Other financial income - EU grants	3 476 800	9 871 161	1 124 750	0	0	0	0	0	0	0	0	0
II. Expenditure	**14 425 925**	**8 614 803**	**7 597 374**	**8 764 072**	**8 023 767**	**8 005 472**	**8 347 846**	**8 715 581**	**2 714 957**	**2 291 960**	**2 337 799**	**2 367 239**
1. Purchase of own shares												
2. Dividends and other payments to owner	4 100 950	0	0	2 198 326	0	0	0	0	0	0	0	0
3. Other expenses in respect of profit distribution	1 955 696	1 509 300	1 232 020	2 055 234	2 075 899	2 117 417	2 159 765	2 202 960	2 247 020	2 291 960	2 337 799	2 367 239
4. Repayment of credits and loans	6 797 989	5 070 000	4 535 000	2 922 222	4 722 222	4 936 508	5 519 841	6 154 762	444 444	0	0	0
4.1. short-term credit facilities and loans	6 797 989	5 070 000	2 535 000	200 000	0	0	0	0	0	0	0	0
4.2. investment credit	0	0	0	2 722 222	2 722 222	2 436 508	2 019 841	1 319 841	111 111	0	0	0
4.3. upfront instalments of investment credit	0	0	2 000 000		2 000 000	2 500 000	3 500 000	4 834 921	333 333			0
5. Repurchase of debt securities												
6. In respect of other financial liabilities												
7. Payments under lease agreements	128 700	155 000	167 000	196 300								
8. Interests	1 442 590	1 880 502	1 663 354	1 391 990	1 225 647	951 548	668 239	357 858	23 493	0	0	0
9. Other financial expenses												
III. Net cash flow on financial activity (I-II)	**6 550 875**	**1 256 358**	**-6 472 624**	**-8 764 072**	**-8 023 767**	**-8 005 472**	**-8 347 846**	**-8 715 581**	**-2 714 957**	**-2 291 960**	**-2 337 799**	**-2 367 239**
D. Total net cash flow (A.III.+/-B.III.+/-C.III.)	**10 924**	**-50 344**	**1 256 381**	**-450 833**	**-14 274**	**-164 124**	**-133 956**	**120 531**	**6 037 348**	**6 189 332**	**5 817 581**	**5 363 974**
E. Cash resources at the beginning	257 298	268 222	217 878	1 474 259	1 023 426	1 009 152	845 027	711 071	831 602	6 868 950	13 058 282	18 875 863
F. Cash resources at the end (E+/-D)	268 222	217 878	1 474 259	1 023 426	1 009 152	845 027	711 071	831 602	6 868 950	13 058 282	18 875 863	24 239 836

Source: Own study exemplified in the xls attachment

Table 17 Key performance indicators in the optimal scenario

	Units of measurement	2012 r.	2013 r.	2014 r.	2015 r.	2016 r.	2017 r.	2018 r.	2019 r.	2020 r.	2021 r.	2022 r.	2023 r.	2024 r.
Key balance sheet values														
Total assets	thousand PLN	208 138	218 936	224 736	225 111	223 999	223 888	223 005	221 489	219 519	222 571	224 966	226 284	226 403
Net assets (entity's book value)	thousand PLN	133 003	128 456	128 178	131 200	132 371	136 113	139 235	142 235	145 344	147 704	148 888	148 917	147 665
Working capital	thousand PLN	-10 249	-1 818	1 770	5 892	6 026	6 138	6 104	6 239	6 669	12 822	19 111	25 024	30 462
Credit facilities, loans and lease agreements	thousand PLN	24 250	34 823	29 598	24 896	21 778	17 056	12 119	6 599	444	0	0	0	0
Key Profit and Loss Account values														
Net income from sales of products, goods and materials	thousand PLN	190 173	196 796	206 158	217 798	226 561	234 804	243 411	253 178	263 549	273 191	283 143	293 509	304 192
Profit (loss) on sales	thousand PLN	6 310	3 649	3 616	6 985	8 153	8 471	7 483	7 105	6 984	5 777	4 358	2 990	1 445
Net profit (loss)	thousand PLN	6 057	1 509	1 232	4 254	5 425	5 818	5 239	5 160	5 312	4 607	3 476	2 367	1 115
Liquidity ratios														
Current ratio		0,77	0,96	1,05	1,16	1,16	1,15	1,15	1,15	1,15	1,28	1,40	1,51	1,59
Quick ratio I		0,67	0,84	0,92	1,03	1,03	1,03	1,03	1,03	1,04	1,17	1,29	1,40	1,49
Solvency and capital and equity structure indicators														
Debt to total assets ratio	%	36,1%	41,3%	43,0%	41,7%	40,9%	39,2%	37,6%	35,8%	33,8%	33,6%	33,8%	34,2%	34,8%
Golden principle balance sheet ratio	%	94,1%	99,0%	101,0%	103,2%	103,4%	103,5%	103,5%	103,6%	104,0%	107,8%	112,1%	116,5%	121,1%
Durability of financial structure ratio	%	78,2%	81,4%	82,8%	83,2%	82,7%	82,1%	81,4%	80,6%	79,7%	79,3%	78,8%	78,1%	77,3%
Profitability indicators														
Return on sales by profit from sales	%	3,3%	1,9%	1,8%	3,2%	3,6%	3,6%	3,1%	2,8%	2,6%	2,1%	1,5%	1,0%	0,5%
Return on sales by net profit	%	3,2%	0,8%	0,6%	2,0%	2,4%	2,5%	2,2%	2,0%	2,0%	1,7%	1,2%	0,8%	0,4%
Return on equity	%	4,6%	1,2%	1,0%	3,2%	4,1%	4,3%	3,8%	3,6%	3,7%	3,1%	2,3%	1,6%	0,8%
Financial gearing	percentage point	1,37	-0,05	-0,26	0,75	1,17	1,23	1,07	1,05	1,10	1,04	0,79	0,54	0,26
Financial covenants														
Credit facilities, loans and lease agreements / Total assets	30% (max)	11,7%	15,9%	13,2%	11,1%	9,7%	7,6%	5,4%	3,0%	0,2%	0,0%	0,0%	0,0%	0,0%
Net debt / EBITDA	3,5 (max)	0,99	1,57	1,30	0,92	0,80	0,63	0,44	0,23	0,00	0,00	0,00	0,00	0,00
Equity / Total assets	50% (min)	63,9%	58,7%	57,0%	58,3%	59,1%	60,8%	62,4%	64,2%	66,2%	66,4%	66,2%	65,8%	65,2%

Source: Own study exemplified in the xls attachment

As shown in Table 17 changing the structure of financing assets (swapping short-term debt with long-term one) is likely to improve the liquidity and solvency ratios. Working capital is starting to rise from 2013 to break a positive level in the year 2014. It is also the moment when liquidity ratio starts to be higher than 1 and golden principle balance sheet ratio exceeds 100%. Apart from escalating process of tangible assets depreciation starting in 2019 all key performance indicators are at acceptable levels. However, this information does not show how sensitive LPEC net profit is for the volatility of average temperature in the heating season.

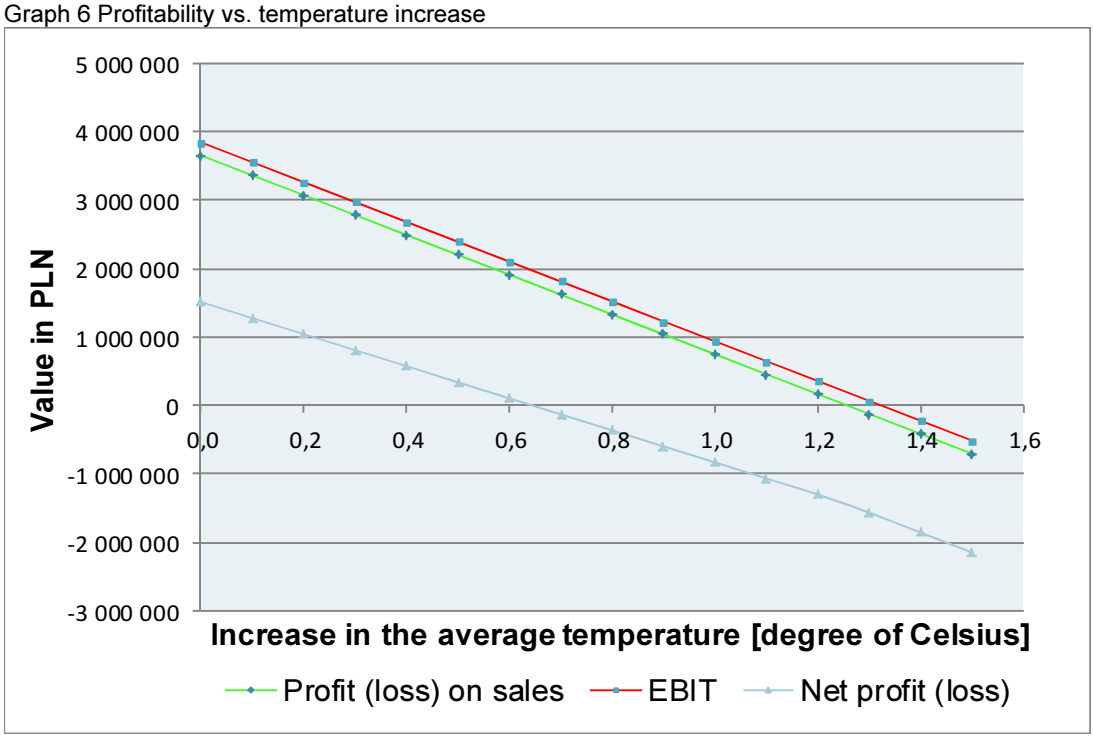
Table 18 Profitability depending on the increase above average temperature in heating season

Increase above the average temperature [degree of Celsius]	*Profit (loss) on sales*	*EBIT*	*Net profit (loss)*
0,0	3 648 742	3 839 742	1 509 300
0,1	3 358 667	3 549 667	1 275 268
0,2	3 068 592	3 259 592	1 041 235
0,3	2 778 517	2 969 517	807 203
0,4	2 488 442	2 679 442	573 170
0,5	2 198 367	2 389 367	339 138
0,6	1 908 292	2 099 292	105 105
0,7	1 618 217	1 809 217	-128 927
0,8	1 328 142	1 519 142	-362 960
0,9	1 038 067	1 229 067	-596 992
1,0	747 992	938 992	-831 025
1,1	457 917	648 917	-1 065 057
1,2	167 842	358 842	-1 299 090
1,3	-122 232	68 768	-1 563 823
1,4	-412 307	-221 307	-1 853 898
1,5	-702 382	-511 382	-2 143 973

Source: Own study exemplified in the xls attachment

By applying equation (6b) from Chapter 2 it is possible to model the amount of expected heat to be sold and convert it into financial data, all the rest being equal. Table 18 shows that different levels of increase in the average temperature make different kinds of profitability (profit on sale, EBIT, net profit) turn into losses. For example, an increase in temperature by 0.7 degrees Celsius makes LPEC incur a net loss, whereas EBIT becomes negative with an increase of 1.4 degrees Celsius.

Graph 6 Profitability vs. temperature increase



Source: Own study exemplified in the xls attachment

Graph 6, which visualizes data from Table 18, constitutes a fundamental element of the 2013-2015 strategy development plan for both the management and supervisory boards as it quantifies the risk that was previously known but whose influence on LPEC revenues was not measured.

The critical point of this thesis is to find such a level of increase in average temperature that makes it impossible for LPEC to operate – settle down its liabilities on time. Provided that the average temperature in heating seasons is 3.56^0C, which makes it 1.5 degree higher than the current level, and when the other factors (variables) stay unchanged, the expected cash flow from operating activity reaches in 2016 around 19 m PLN. In normal conditions at this time, the company is expected to generate around 4.5 m PLN more on this type of activity. This, in result translates into inability to cover outflows from investment and financial activities, which finally ends up in negative total net cash flows starting from 2017.
Provided that the average temperature in heating season rises by 1.5 degree of Celsius, from the above we assume that unless the Company reduces its costs, it is projected to go bankrupt in 2021. Financial statements and key performance indicators for the above mentioned pessimistic scenario are presented in Tables 19-22.

Table 19 Balance sheets in the pessimistic scenario

	Assets as at	31.12.2012	31.12.2013	31.12.2014	31.12.2015	31.12.2016	31.12.2017	31.12.2018	31.12.2019	31.12.2020	31.12.2021	31.12.2022	31.12.2023	31.12.2024
A.	**Fixed Assets**	**173 001 824**	**180 071 438**	**184 262 761**	**181 339 945**	**179 141 010**	**177 583 869**	**175 341 659**	**172 236 378**	**168 317 085**	**163 627 886**	**158 075 617**	**151 747 038**	**144 615 921**
I.	Intangible assets	3 161 102	2 218 131	1 275 160	388 568	145 087	0	0	0	0	0	0	0	0
II.	Tangible fixed assets	168 385 232	176 397 817	181 532 110	179 495 887	177 540 433	176 128 379	173 886 168	170 780 887	166 861 595	162 172 396	156 620 127	150 291 548	143 160 431
III.	Long-term receivables													
IV.	Long-term investments													
V.	Long-term prepayments and accrued income	1 455 490	1 455 490	1 455 490	1 455 490	1 455 490	1 455 490	1 455 490	1 455 490	1 455 490	1 455 490	1 455 490	1 455 490	1 455 490
B.	**Current Assets**	**35 136 545**	**37 451 855**	**38 596 153**	**40 054 639**	**62 418 142**	**58 102 090**	**54 109 592**	**50 960 097**	**48 802 512**	**46 771 989**	**44 775 725**	**42 633 831**	**40 208 140**
I.	Inventory	1 699 134	1 713 662	1 758 211	1 793 432	1 820 744	1 859 912	1 899 776	1 939 882	1 980 700	2 022 246	2 064 538	2 107 595	2 151 435
II.	Short-term receivables	30 219 227	32 008 340	33 396 707	35 292 797	36 731 269	38 096 709	39 529 704	41 150 740	42 872 429	44 481 460	46 144 807	47 878 877	49 668 308
III.	Short-term investments	257 298	768 966	480 349	7 523	20 905 243	15 184 583	9 719 225	4 908 588	988 497	-2 692 604	-6 394 506	-10 313 527	-14 572 489
-	cash and other financial assets	257 298	768 966	480 349	7 523	20 905 243	15 184 583	9 719 225	4 908 588	988 497	-2 692 604	-6 394 506	-10 313 527	-14 572 489
IV.	Short-term prepayments and accrued income	2 960 886	2 960 886	2 960 886	2 960 886	2 960 886	2 960 886	2 960 886	2 960 886	2 960 886	2 960 886	2 960 886	2 960 886	2 960 886
Total Assets		**208 138 370**	**217 523 293**	**222 858 914**	**221 394 584**	**241 559 153**	**235 685 959**	**229 451 250**	**223 196 475**	**217 119 597**	**210 399 875**	**202 851 342**	**194 380 869**	**184 824 061**
	Liabilities as at	**31.12.2012**	**31.12.2013**	**31.12.2014**	**31.12.2015**	**31.12.2016**	**31.12.2017**	**31.12.2018**	**31.12.2019**	**31.12.2020**	**31.12.2021**	**31.12.2022**	**31.12.2023**	**31.12.2024**
A.	**Equity**	**133 003 039**	**124 733 663**	**121 084 315**	**120 323 205**	**120 431 943**	**119 942 549**	**119 028 876**	**118 025 155**	**117 129 268**	**115 529 782**	**113 028 063**	**109 526 818**	**104 859 165**
I.	Share (initial) capital	102 225 000	102 225 000	102 225 000	102 225 000	102 225 000	102 225 000	102 225 000	102 225 000	102 225 000	102 225 000	102 225 000	102 225 000	102 225 000
II.	Outstanding contributions to share capital	0												
III.	Own shares	0												
IV.	Supplementary capital	28 146 069	28 146 069	28 146 069	28 146 069	28 146 069	28 146 069	28 146 069	28 146 069	28 146 069	28 146 069	28 146 069	28 146 069	28 146 069
V.	Revaluation capital													
VI.	Other reserve capital													
VII.	Profit (loss) carry forward	-3 424 676	-3 424 676	-5 637 406	-9 286 754	-10 047 864	-10 047 864	-10 428 520	-11 342 193	-12 345 914	-13 241 801	-14 841 287	-17 343 006	-20 844 251
VIII.	Net profit (loss)	6 056 646	-2 212 730	-3 649 348	-761 110	108 738	-380 656	-913 673	-1 003 721	-895 887	-1 599 487	-2 501 719	-3 501 245	-4 667 653
IX.	Net profit deductions during financial year													
B.	**Liabilities and provisions against liabilities**	**75 135 331**	**92 789 630**	**101 774 599**	**101 071 379**	**121 127 210**	**115 743 411**	**110 422 374**	**105 171 319**	**99 990 329**	**94 870 093**	**89 823 280**	**84 854 052**	**79 964 896**
I.1.	Provisions for old age pensions and similar	7 242 665	7 242 665	7 242 665	7 242 665	7 242 665	7 242 665	7 242 665	7 242 665	7 242 665	7 242 665	7 242 665	7 242 665	7 242 665
I.2.	Provisions for White Cerificates	0	1 202 470	1 879 630	1 988 529	2 071 146	2 149 568	2 231 870	2 324 972	2 423 855	2 516 267	2 611 799	2 711 393	2 814 167
II.	Long-term liabilities	11 309 000	30 110 300	32 420 300	30 053 300	49 666 667	43 458 333	37 250 000	31 041 667	24 833 333	18 625 000	12 416 667	6 208 333	0
II.1.	credit facilities and loans	10 805 000	29 735 000	32 200 000	30 000 000	49 666 667	43 458 333	37 250 000	31 041 667	24 833 333	18 625 000	12 416 667	6 208 333	0
II.2.	other financial liabilities	504 000	375 300	220 300	53 300	0	0	0	0	0	0	0	0	0
III.	Short-term liabilities	43 679 145	38 482 875	35 239 522	36 299 652	37 289 500	38 665 612	40 100 606	41 594 783	43 153 243	44 778 928	46 474 916	48 244 427	50 090 832
1.	Towards associated entities													
2.	Towards other entities	43 679 145	38 482 875	35 239 522	36 299 652	37 289 500	38 665 611,63	40 100 606,42	41 594 782,90	43 153 243,05	44 778 928,20	46 474 916,10	48 244 427,36	50 090 832,07
2.1.	credit facilities and loans	12 797 989	8 070 000	3 535 000	3 200 000	3 000 000	3 000 000	3 000 000	3 000 000	3 000 000	3 000 000	3 000 000	3 000 000	3 000 000
2.2.	deliveries and services	30 738 156	30 269 875	31 561 522	32 956 652	34 289 500	35 665 612	37 100 606	38 594 783	40 153 243	41 778 928	43 474 916	45 244 427	47 090 832
2.3.	other financial liabilities	143 000	143 000	143 000	143 000	0	0	0	0	0	0	0	0	0
IV.	Accruals and deferred income	12 904 521	15 751 321	24 992 482	25 487 233	24 857 233	24 227 233	23 597 233	22 967 233	22 337 233	21 707 233	21 077 233	20 447 233	19 817 233
Total Liabilities		**208 138 370**	**217 523 293**	**222 858 914**	**221 394 584**	**241 559 153**	**235 685 959**	**229 451 250**	**223 196 475**	**217 119 597**	**210 399 875**	**202 851 342**	**194 380 869**	**184 824 061**

Source: Own study exemplified in the xls attachment

Table 20 Profit and Loss Accounts in the pessimistic scenario

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
A. Net income from sales and equivalent	**198 289 881**	**205 667 153**	**216 558 180**	**224 820 679**	**232 663 684**	**240 894 724**	**250 205 858**	**260 095 135**	**269 337 315**	**278 891 481**	**288 851 873**	**299 130 259**
I. Net income from sales of products	56 741 101	58 427 576	62 158 725	63 367 624	64 253 444	65 200 463	66 892 112	68 805 140	69 685 013	70 482 554	71 274 262	71 951 457
II. Change in products	-1 202 470	-1 879 630	-1 988 529	-2 071 146	-2 149 568,21	-2 231 870,30	-2 324 972,24	-2 423 855,01	-2 516 267,49	-2 611 799,49	-2 711 393,35	-2 814 166,83
III. Cost of product manufacturing for own needs	13 800 000	13 800 000	13 800 000	13 800 000	13 800 000,00	13 800 000,00	13 800 000,00	13 800 000,00	13 800 000,00	13 800 000,00	13 800 000,00	13 800 000,00
IV. Net income from sales of goods and materials	128 951 250	135 319 208	142 587 985	149 724 202	156 759 809	164 126 131	171 838 718	179 913 850	188 368 570	197 220 727	206 489 005	216 192 969
B. Cost of operating activity	**198 992 263**	**207 409 709**	**215 262 747**	**222 498 305**	**230 096 442**	**239 355 255**	**249 145 664**	**259 271 094**	**269 754 071**	**280 750 254**	**292 098 960**	**303 933 315**
I. Depreciation	18 137 168	18 837 341	18 354 816	17 626 935	17 003 141	17 688 211	18 551 281	19 365 293	20 135 199	20 998 269	21 774 579	22 577 117
II. Materials and energy consumption	11 943 328	12 342 493	12 421 137	12 567 957	12 759 351	12 956 953	13 166 265	13 382 505	13 605 905	13 836 701	14 075 141	14 321 480
III. Outsourced services	2 325 154	2 390 259	2 457 186	2 525 987	2 596 715	2 669 423	2 722 811	2 777 268	2 832 813	2 889 469	2 947 259	3 006 204
IV. Taxes and charges	7 088 295	7 561 974	8 009 959	8 300 541	8 592 795	8 885 202	9 177 764	9 470 483	9 763 359	10 056 395	10 349 593	10 642 953
V. Remuneration	23 564 690	23 813 916	24 179 219	24 422 338	24 910 785	25 409 001	25 917 181	26 435 524	26 964 235	27 503 519	28 053 590	28 614 662
VI. Social insurance and other benefits	5 835 885	5 974 003	6 057 277	6 109 879	6 227 418	6 347 261	6 469 454	6 594 043	6 721 076	6 850 601	6 982 667	7 117 326
VII. Other costs by type	1 146 493	1 170 516	1 195 169	1 220 467	1 246 429	1 273 074	1 302 190	1 332 129	1 362 915	1 394 572	1 427 127	1 460 605
VIII. Value of goods and materials sold	128 951 250	135 319 208	142 587 985	149 724 202	156 759 809	164 126 131	171 838 718	179 913 850	188 368 570	197 220 727	206 489 005	216 192 969
C. Profit (loss) on sales (A-B)	**-702 382**	**-1 742 556**	**1 295 434**	**2 322 374**	**2 567 242**	**1 539 469**	**1 060 195**	**824 041**	**-416 755**	**-1 858 773**	**-3 247 087**	**-4 803 056**
D. Other operating income	791 000	791 000	791 000	791 000	791 000	791 000	791 000	791 000	791 000	791 000	791 000	791 000
E. Other operating costs	600 000	600 000	600 000	600 000	600 000	600 000	600 000	600 000	600 000	600 000	600 000	600 000
F. Profit (loss) on operating activity (C+D-E)	**-511 382**	**-1 551 556**	**1 486 434**	**2 513 374**	**2 758 242**	**1 730 469**	**1 251 195**	**1 015 041**	**-225 755**	**-1 667 773**	**-3 056 087**	**-4 612 056**
G. Financial income	0	0	0	0	0	0	0	0	0	0	0	0
H. Financial costs	1 511 347	2 136 261	2 165 964	2 125 183	2 975 224	2 604 587	2 233 949	1 863 312	1 492 674	1 122 037	751 399	380 762
I. Profit (loss) on economic activity (F+G-H)	**-2 022 730**	**-3 687 817**	**-679 530**	**388 191**	**-216 983**	**-874 118**	**-982 755**	**-848 271**	**-1 718 430**	**-2 789 810**	**-3 807 487**	**-4 992 818**
J. Result of extraordinary events	0	0	0	0	0	0	0	0	0	0	0	0
K. Gross profit (loss) (I + J)	**-2 022 730**	**-3 687 817**	**-679 530**	**388 191**	**-216 983**	**-874 118**	**-982 755**	**-848 271**	**-1 718 430**	**-2 789 810**	**-3 807 487**	**-4 992 818**
L. Income tax	190 000	-38 469	81 580	279 453	163 673	39 555	20 966	47 616	-118 943	-288 091	-306 242	-325 165
M. Net profit (loss) (K-L)	**-2 212 730**	**-3 649 348**	**-761 110**	**108 738**	**-380 656**	**-913 673**	**-1 003 721**	**-895 887**	**-1 599 487**	**-2 501 719**	**-3 501 245**	**-4 667 653**

Source: Own study exemplified in the xls attachment

Table 21 Cash Flow Statements in the pessimistic scenario

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
A. Cash flow from operating activity												
I. Net profit (loss)	**-2 212 730**	**-3 649 348**	**-761 110**	**108 738**	**-380 656**	**-913 673**	**-1 003 721**	**-895 887**	**-1 599 487**	**-2 501 719**	**-3 501 245**	**-4 667 653**
II. Total adjustments	**17 949 063**	**20 879 494**	**19 463 498**	**19 071 798**	**19 398 292**	**19 707 235**	**20 081 366**	**20 493 442**	**21 065 394**	**21 576 187**	**21 987 957**	**22 443 786**
1. Depreciation	18 137 168	18 837 341	18 354 816	17 626 935	17 003 141	17 688 211	18 551 281	19 365 293	20 135 199	20 998 269	21 774 579	22 577 117
2. Profit (loss) due to foreign exchange rate differences												
3. Interest and participation in profit (dividends)	1 511 347	2 136 261	2 165 964	2 125 183	2 975 224	2 604 587	2 233 949	1 863 312	1 492 674	1 122 037	751 399	380 762
4. Profit (loss) on investment activity												
5. Change in provisions	1 202 470	1 879 630	1 988 529	2 071 146	2 149 568	2 231 870	2 324 972	2 423 855	2 516 267	2 611 799	2 711 393	2 814 167
6. Change in inventory	-14 528	-44 549	-35 221	-27 312	-39 168	-39 864	-40 106	-40 817	-41 546	-42 292	-43 057	-43 840
7. Change in receivables	-1 789 114	-1 388 366	-1 896 090	-1 438 472	-1 365 440	-1 432 995	-1 621 036	-1 721 689	-1 609 031	-1 663 347	-1 734 070	-1 789 431
8. Change in short-term liabilities without credit facilities an loans	-468 281	1 291 647	1 395 130	1 332 848	1 376 112	1 434 995	1 494 176	1 558 460	1 625 685	1 695 988	1 769 511	1 846 405
9. Change in accruals and deferred income	-630 000	-630 000	-630 000	-630 000	-630 000	-630 000	-630 000	-630 000	-630 000	-630 000	-630 000	-630 000
10. Other adjustments - fees for White Certificates		-1 202 470	-1 879 630	-1 988 529	-2 071 146	-2 149 568	-2 231 870	-2 324 972	-2 423 855	-2 516 267	-2 611 799	-2 711 393
III. Net cash flow on operating activity (I+/-II)	**15 736 333**	**17 230 146**	**18 702 388**	**19 180 536**	**19 017 635**	**18 793 562**	**19 077 646**	**19 597 554**	**19 465 907**	**19 074 468**	**18 486 712**	**17 776 133**
B. Cash flow on investment activity												
I. Income	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
1. Sale of intangible assets and tangible fixed assets												
2. Sale of investmnets in real property and intangible assets												
3. From financial assets												
4. Other income on investments												
II. Expenditure	**25 206 782**	**23 028 664**	**15 432 000**	**15 428 000**	**15 446 000**	**15 446 000**	**15 446 000**	**15 446 000**	**15 446 000**	**15 446 000**	**15 446 000**	**15 446 000**
1. Purchase of intangible assets and tangible fixed assets												
2. Investments in real property and intangibles												
3. In financial assets												
4. Other investment expenditure	25 206 782	23 028 664	15 432 000	15 428 000	15 446 000	15 446 000	15 446 000	15 446 000	15 446 000	15 446 000	15 446 000	15 446 000
III. Net cash flow on investment activity (I-II)	**-25 206 782**	**-23 028 664**	**-15 432 000**	**-15 428 000**	**-15 446 000**	**-15 446 000**	**-15 446 000**	**-15 446 000**	**-15 446 000**	**-15 446 000**	**-15 446 000**	**-15 446 000**
C. Cash flow on financial activity												
I. Income	**23 476 800**	**12 871 161**	**4 624 750**	**23 000 000**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
1. Net income from distribution of shares and other capital instruments and capital contributions												
2. Credit facilities and loans	20 000 000	3 000 000	3 500 000	23 000 000	0	0	0	0	0	0	0	0
2.1. short-term credit facilities and loans												
2.2. investment credit	20 000 000	3 000 000	3 500 000	23 000 000	0	0	0	0	0	0	0	0
3. Issue of debt securities												
4. Other financial income - EU grants	3 476 800	9 871 161	1 124 750	0	0	0	0	0	0	0	0	0
II. Expenditure	**13 494 682**	**7 361 261**	**8 367 964**	**5 854 816**	**9 292 295**	**8 812 920**	**8 442 283**	**8 071 645**	**7 701 008**	**7 330 370**	**6 959 733**	**6 589 095**
1. Purchase of own shares												
2. Dividends and other payments to owner	4 100 950	0	0	0	0	0	0	0	0	0	0	0
3. Other expenses in respect of profit distribution	1 955 696	0	0	0	108 738	0	0	0	0	0	0	0
4. Repayment of credits and loans	5 797 989	5 070 000	6 035 000	3 533 333	6 208 333	6 208 333	6 208 333	6 208 333	6 208 333	6 208 333	6 208 333	6 208 333
4.1. short-term credit facilities and loans	5 797 989	5 070 000	535 000	200 000	0	0	0	0	0	0	0	0
4.2. investment credit	0	0	0	3 333 333	6 208 333	6 208 333	6 208 333	6 208 333	6 208 333	6 208 333	6 208 333	6 208 333
4.3. upfront instalments of investment credit	0	0	5 500 000									0
5. Repurchase of debt securities												
6. In respect of other financial liabilities												
7. Payments under lease agreements	128 700	155 000	167 000	196 300								
8. Interests	1 511 347	2 136 261	2 165 964	2 125 183	2 975 224	2 604 587	2 233 949	1 863 312	1 492 674	1 122 037	751 399	380 762
9. Other financial expenses												
III. Net cash flow on financial activity (I-II)	**9 982 118**	**5 509 900**	**-3 743 213**	**17 145 184**	**-9 292 295**	**-8 812 920**	**-8 442 283**	**-8 071 645**	**-7 701 008**	**-7 330 370**	**-6 959 733**	**-6 589 095**
D. Total net cash flow (A.III.+/-B.III.+/-C.III.)	**511 669**	**-288 618**	**-472 825**	**20 897 720**	**-5 720 660**	**-5 465 358**	**-4 810 637**	**-3 920 091**	**-3 681 101**	**-3 701 902**	**-3 919 021**	**-4 258 963**
E. Cash resources at the beginning	257 298	768 966	480 349	7 523	20 905 243	15 184 583	9 719 225	4 908 588	988 497	-2 692 604	-6 394 506	-10 313 527
F. Cash resources at the end (E+/-D)	768 966	480 349	7 523	20 905 243	15 184 583	9 719 225	4 908 588	988 497	**-2 692 604**	**-6 394 506**	**-10 313 527**	**-14 572 489**

Source: Own study exemplified in the xls attachment

Table 22 Key performance indicators in the pessimistic scenario

	Units of measurement	2012 r.	2013 r.	2014 r.	2015 r.	2016 r.	2017 r.	2018 r.	2019 r.	2020 r.	2021 r.	2022 r.	2023 r.	2024 r.
Key balance sheet values														
Total assets	thousand PLN	208 138	217 523	222 859	221 395	241 559	235 686	229 451	223 196	217 120	210 400	202 851	194 381	184 824
Net assets (entity's book value)	thousand PLN	133 003	124 734	121 084	120 323	120 432	119 943	119 029	118 025	117 129	115 530	113 028	109 527	104 859
Working capital	thousand PLN	-10 249	-3 113	53	386	21 843	16 234	10 889	6 329	2 696	-877	-4 486	-8 314	-12 503
Credit facilities, loans and lease agreements	thousand PLN	24 250	38 323	36 098	33 396	52 667	46 458	40 250	34 042	27 833	21 625	15 417	9 208	3 000
Key Profit and Loss Account values														
Net income from sales of products, goods and materials	thousand PLN	190 173	185 692	193 747	204 747	213 092	221 013	229 327	238 731	248 719	258 054	267 703	277 763	288 144
Profit (loss) on sales	thousand PLN	6 310	-702	-1 743	1 295	2 322	2 567	1 539	1 060	824	-417	-1 859	-3 247	-4 803
Net profit (loss)	thousand PLN	6 057	-2 213	-3 649	-761	109	-381	-914	-1 004	-896	-1 599	-2 502	-3 501	-4 668
Liquidity ratios														
Current ratio		0,77	0,92	1,00	1,01	1,54	1,39	1,25	1,14	1,06	0,98	0,91	0,84	0,76
Quick ratio I		0,67	0,81	0,88	0,89	1,42	1,27	1,14	1,03	0,95	0,88	0,81	0,74	0,67
Solvency and capital and equity structure indicators														
Debt to total assets ratio	%	36,1%	42,7%	45,7%	45,7%	50,1%	49,1%	48,1%	47,1%	46,1%	45,1%	44,3%	43,7%	43,3%
Golden principle balance sheet ratio	%	94,1%	98,3%	100,0%	100,2%	112,2%	109,1%	106,2%	103,7%	101,6%	99,5%	97,2%	94,5%	91,4%
Durability of financial structure ratio	%	78,2%	81,4%	82,7%	82,1%	83,2%	82,2%	81,2%	80,0%	78,8%	77,4%	75,7%	73,8%	71,5%
Profitability indicators														
Return on sales by profit from sales	%	3,3%	-0,4%	-0,9%	0,6%	1,1%	1,2%	0,7%	0,4%	0,3%	-0,2%	-0,7%	-1,2%	-1,7%
Return on sales by net profit	%	3,2%	-1,2%	-1,9%	-0,4%	0,1%	-0,2%	-0,4%	-0,4%	-0,4%	-0,6%	-0,9%	-1,3%	-1,6%
Return on equity	%	4,6%	-1,8%	-3,0%	-0,6%	0,1%	-0,3%	-0,8%	-0,9%	-0,8%	-1,4%	-2,2%	-3,2%	-4,5%
Financial gearing	percentage point	1,37	-1,32	-2,15	-1,08	-0,67	-1,18	-1,29	-1,21	-1,05	-1,20	-1,43	-1,71	-2,09
Financial covenants														
Credit facilities, loans and lease agreements / Total assets	30% (max)	11,7%	17,6%	16,2%	15,1%	21,8%	19,7%	17,5%	15,3%	12,8%	10,3%	7,6%	4,7%	1,6%
Net debt / EBITDA	3,5 (max)	0,99	2,13	2,06	1,68	1,58	1,58	1,57	1,47	1,32	1,22	1,13	1,04	0,98
Equity / Total assets	50% (min)	63,9%	57,3%	54,3%	54,3%	49,9%	50,9%	51,9%	52,9%	53,9%	54,9%	55,7%	56,3%	56,7%

Source: Own study exemplified in the xls attachment

Conclusion

Heat distributors face a multitude of threats starting from legislative through financial to forces of nature. So far the risk associated with the weather conditions, especially the rise of average external temperature, was known at LPEC. It was obvious that when the temperature rises, the company sells less and less heat to its end users. However, no one managed to measure the influence of a decrease in the average temperature on the bottom line of the Company. The econometric model developed in Chapter 2 was an attempt to correlate the weather conditions with financial indicators. It is almost certain that the model will not fully reflect the reality. However, what counts in this strategy development plan is the awareness at the scale of impact of temperature increase on the Company's ability to continue its activity.

As projected in Chapter 3, the rise of average temperature of more than 1.5 degree of Celsius year on year will probably result in failing to settle Company's liabilities in 2021. It may happen unless the company restructures its fixed costs, extends its credit limits, or finds other sources of external financing. The last solution is quite risky and short-term, because when the core activity in long-term generates losses, taking more and more credits may lead to a situation when interest and principal to be paid in year t are so high that net cash flows are too low to be compensated for cash resources at the beginning of year t. In such a pessimistic scenario it would be impossible without the econometric model to combine forces of nature with financial indicators.

In the near future, the econometric model described in this thesis is planned to be developed. Interestingly, having a density function of the average external temperature and combining it with equation (6b), it is feasible to create Value at Risk analysis that allows board members to objectively estimate the risk that company faces every year.

As stated at the beginning, organisations with risk awareness can safely take higher risk than those that do not have this awareness [Rudnicki 2013].

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Aczel, A.D., 2000, *Statystyka w Zarządzaniu*, Wydawnictwo Naukowe PWN, Warszawa.

Berinato, S., 2005, *Zarządzanie ryzykami*, CIO Magazyn Dyrektorów IT nr 2, Warszawa.

Bizon-Górecka, J., 2007, *Modelowanie struktury systemu zarządzania ryzykiem w przedsiębiorstwie – ujęcie holistyczne*, Towarzystwo Naukowe Organizacji i Kierownictwa, Bydgoszcz.

BusinessDictionary, 2013, http://www.businessdictionary.com/definition/risk.html, [Accessed: 12/01/2013].

Chong, Y.Y, Brown, E.M., 2001, *Zarzadzanie ryzykiem projektu*, Wydawnictwo Oficyna Ekonomiczna, Kraków.

COSO, 2007, *Zarządzanie ryzykiem korporacyjnym - zintegrowana struktura ramowa*, WEWA Wydawnictwo-Poligrafia Sp. z o.o., Warszawa.

CRO Forum, 2009, *Insurance Risk Management Response to the Financial Crisis*, http://www.genevaassociation.org/Portals/0/CRO_Forum_Resp%20Crisis.pdf, [Accessed: 16/01/2013].

Crouhy, M., Galai, D., Mark, R., 2006, *The Essentials of Risk Management*, McGraw-Hill, USA.

Culp, C.L, 2001, *The Risk Management Process: Business Strategy and Tactics*, Wiley & Sons, New Jersey.

Curwin, J., Slater, R., 2008, *Quantitative Methods for Business Decisions*, 6th Edition, Cengage Learning, UK.

Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC.

Eydeland, A., Wolyniec, K., 2003, *Energy and Power Risk Management. New Development in Modeling, Pricing and Heating*, Wiley & Sons, New Jersey.

Fraser, J., Simkins, B.J., 2010, *Enterprise Risk Management. Today's Leading Research and Best Practices for Tomorrow's Executives*, Wiley & Sons, New Jersey.

Griliches, Z., Intriligator, M.D. (eds.), 1983, Handbook of Econometrics, Volume I, Elsevier Science B.V., Amsterdam.

Grocholski, L., Niemiec, A., 2008, *Wdrożenie procesu zarządzania ryzykiem w dużej firmie informatycznej*, w: Hnatkowska, B., Huzar, Z. (red.), *Inżynieria*

oprogramowania – metody wytwarzania i wybrane zastosowania, Wydawnictwo Naukowe PWN, Warszawa.

Gryko, J.M., Kluzek, M., Kubiak, J., Nowaczyk, T., 2008, *Planowanie finansowe w przedsiębiorstwie*, Wydawnictwo AEP, Poznań.

Guzik, B. (red.), 2000, *Ekonometria i Badania Operacyjne, Zagadnienia Podstawowe*, Materiały Dydaktyczne Zeszyt 50, Akademia Ekonomiczna w Poznaniu, Poznań.

Hair, J.F., Anderson, R.E., Tatham, R.L., Black, W.C., 1995, *Multivariate Data Analysis: With Readings*, Prentice Hall, New Yersey.

Hawawini, G., Viallet, C., 2011, *Finance for Executives. Managing for Value Creation*, Fourth Edition, South-Western Cengage Learning, Andover.

Jajuga, K. (red.), 2007, *Zarządzanie ryzykiem*, Wydawnictwo Naukowe PWN, Warszawa.

Kaczmarak, T.T., 2005, *Ryzyko i zarządzanie ryzykiem. Ujęcie interdyscyplinarne*, Difin, Warszawa.

Kendall, R., 1998, *Risk Management*, Gabler, Wiesbaden.

Kowalewski, J., 1996, *Ryzyko ubezpieczeniowe - podstawowe pojęcia i terminologia*, Prawo Asekuracyjne nr 2 (7) 1996, Fundacja „Prawo Ubezpieczeniowe", Warszawa.

Lee, A.C., Lee, J.C., Lee, C.C., 2009, *Financial Analysis, Planning & Forecasting. Theory and Application*, 2nd Edition, World Scientific, Singapore.

Michalak, D., cop. 2011, *Derywaty pogodowe jako instrument efektywnego zarządzania ryzykiem pogodowym*, SDG Pro-Akademia, Łódź, http://www.turyzmdlaregionu.eu/gfx/turyzm/userfiles/_public/artykuly_1/michalak.pdf [Accessed: 20/01/2013].

Michalska-Foryś, K., Mrugała-Konstanciuk, E., 2007, *Termomodernizacja budynków*, SKN ENERDŻAJZER, Turawa, http://www.isomax-terrasol.eu/uploads/media/Michalska-Mrugala_TERMOMODERNIZACJA_BUDYNKOW.pdf, [Accessed: 19/01/2013].

Olszewski, K., Kicińska, B., ca 2008, *Czy w Polsce notujemy wzrost temperatury i inne przejawy ocieplenia klimatu?*, Uniwersytet Warszawski, Warszawa, http://www.ekoedu.uw.edu.pl/rep/pdf/22fe31f808780c906db3ae3df0bb1728.pdf [Accessed: 20/01/2013].

Orlicki, M., 2002, *Umowa ubezpieczenia*, Oficyna a Wolters Kluwer business, Warszawa.

Pritchard, C.L., 2002, *Zarządzanie ryzykiem w projektach. Teoria i praktyka*, WIG – PRESS, Warszawa.

Ranking Spółek Giełdowych, 2013, *Sektor Energetyka. Analiza Finansowa. Analiza Płynności*, http://www.rsg.pl/energetyka/analiza_plynnosci/analiza_wskaznikowa/sektor.html [Accessed: 15/02/2013].

Rozporządzenie Ministra Gospodarki z 4 września 2012 r. w sprawie sposobu obliczania ilości energii pierwotnej odpowiadającej wartości świadectwa efektywności energetycznej oraz wysokości jednostkowej opłaty zastępczej, Dz.U., nr 0, poz. 1039.

Rudnicki, R, 2013, *Zarządzanie Ryzykiem*, http://ryzyko.blox.pl/html, [Accessed: 02/01/2013].

Rutkowski, A., 2003, *Zarządzanie finansami*, PWE, Warszawa.

Sokołowska, E., 2008, *Pochodne instrumenty pogodowe, jako narzędzia ograniczenia ryzyka w rolnictwie*, Roczniki Naukowe Stowarzyszenia Ekonomistów Rolnictwa i Agrobiznesu, tom X, z. 4, Wrocław.

Stabryła, A., 2006, *Zarządzanie projektami ekonomicznymi i organizacyjnymi*, Wydawnictwo naukowe PWN, Warszawa.

The Act of 29 September 1994 on Accounting, Dz.U. 2009, No. 152, item 1223, with subsequent amendments.

The Financial Services Authority, 2006, *Insurance Sector Briefing: Risk Management in Insurers*, London, http://www.fsa.gov.uk/pubs/other/isb_risk.pdf [Accessed: 15/01/2013].

Tracy, J.A., 1994, *Sprawozdania finansowe firm*, Wydawnictwo Naukowe PWN, Warszawa.

Ustawa z 15 kwietnia 2011 r. o efektywności energetycznej, Dz.U., nr 94, poz. 551.

Vanguard Asset Management, cop. 2012, Investment risk. Balancing investment risk and potential reward, UK.

Winiarski, J., 2010, *Ryzyko – Problemy definicji i systematyki*, Uniwersytet Gdański, Gdańsk, http://be.ek.ug.gda.pl/wg/wp-content/uploads/pdf/1.pdf [Accessed: 08/01/2013].

Zemke, J., 2006, *Zarządzanie ryzykiem a zarządzanie organizacją*, Wyższa Szkoła Administracji i Biznesu, Zeszyty Naukowe, Gdynia.