



Risk Management in Heating Industry

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Abstract. The heating industry plays a very important role in countries with cold and temperate climates; together with the power industry, it determines the energy security of these countries. The aim of this article is to examine the risks that threaten the stability of heating companies. The study is based on an analysis of the scientific literature and the macroeconomic environment as well as on interviews with employees from the heating industry. The article identifies the risks and divides them into three groups: general economic, industry, and specific risks. A risk map was drawn, and a qualitative analysis of their impact was carried out for the aforementioned companies. This map is a useful tool for making decisions that are related to risk management and ensuring the stability of the functioning of business entities as well as gaining information for both government and local authorities in the search for effective ways to drive the sector's development.

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1. INTRODUCTION AND METHODOLOGY

The globalization of the world economy has led to the integration of national economies; this makes it possible to not only import goods and services but also penetrate various threats – the number and range of which are constantly growing. The problem of risk is of a particular importance in the case of economic activity. It is known that the success of a business depends on the correctness of the chosen business strategy as well as taking the possibility of hazardous situations into account. It would be naive to think that business is possible without risk; a businessman must take the impact of many threats (risks) into account on any implemented projects (e.g., investments, projects) and determine the probability of their occurrence and the degree of their impact. Such activities are called risk management.

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Risk management must be long-term and consistent with an overall corporate management strategy. To build an effective risk-management strategy, managers need to answer many questions, including which risk-management strategy to adopt, which strategy will be the best under the given market conditions, and whether the adopted strategy will be effective in a dynamically changing environment.

Decision-makers can rely on both their own knowledge and experience as well as on external experts or those companies that advise on risk management. Regardless of who creates the strategy, it must be adapted to an organization's purpose, mission, and vision, its risk appetite, and its attitudes toward risk. Furthermore, modern risk management must be very dynamic. The efficiency of its operation largely depends on the speed of the response to changes in market conditions, the phases of the business cycle, the company's financial condition, and many other external and internal factors.

Many scientific publications have been devoted to research in heat engineering. For example, Edling and Danks (2021) focused their attention on state policies and private programs in the development of local and renewable heating technologies. Schüwer and Schneider (2018) analyzed the possibilities of electrifying industrial-process heat. Nielsen and her coauthors investigated unconventional excess heat sources for district heating on examples in Germany, Spain, and France (Nielsen et al., 2020). Egging-Bratseth et al. (2021) considered the possibilities of seasonal storage and demand management in district-heating networks under conditions of changing demand. Lygnerud and Werner (2018) investigated the risk of industrial excess-heat recovery in district-heating systems. They considered that the recovery of excess industrial heat for use in district-heating systems can be characterized by great political interest, high potential, low use, and often high profitability. These characteristics reveal that there are barriers that inhibit its greater use; an identified barrier is the risk that industries with excess heat can terminate their activities, resulting in a loss of heat recovery (Lygnerud & Werner, 2018).

There are many publications that describe the connection of traditional district-heating networks with renewable energy sources (Sorknæs et al., 2020), including heat pumps (Mirl et al., 2018; Wei et al., 2021) and geothermal and solar resources (Chen et al., 2020). There are also publications that are devoted to analyzing heating systems in countries (Triebbs et al., 2021) or regions (Zhang et al., 2021). However, it is difficult to find publications in which the authors would comprehensively analyze the risk of heating companies' operations.

The purpose of the article is to identify and analyze the risks in the activities of a heating company; these are broken down into three groups: general economic, industry, and specific risks. Three methods were used to achieve this goal: 1) an analysis of the literature and a legal act analysis, 2) an analysis of the macroeconomic environment, and 3) interviews with employees from the heating industry.

2. IDENTIFICATION OF GENERAL ECONOMIC RISK FACTORS

General economic risks threaten all enterprises that operate in the country. The most important of them include the risk of an increase in interest rates, the risk of fluctuations in the exchange rates, and the risk of force majeure.

Interest-rate risk is related to the high sensitivity of financial markets, which translates into fluctuations in the price of money (interest rate) as well as the value of assets and liabilities. Heating companies rarely invest in financial assets (such as, e.g., stocks or bonds), so this part of the risk can be ignored. However, they often use borrowed capital (liabilities) to finance their activities. Borrowed capital may come from the following:

- bank loan,
- issue and sale of debt securities (bonds, promissory notes, commercial papers).

The interest rate on bank loans is usually floating and calculated according to the market interest rate – the amount of which depends on the demand and supply of money at a given time. In turn, money demand and supply depend on many external factors. In Poland, the interest on loans is most often calculated according to the six-month WIBOR 6M (Warsaw Interbank Offer Rate).

As shown in Figure 1, this rate does not change much over a short period time – especially during periods of economic stagnation. On the other hand, the WIBOR rate can increase significantly during periods of changes in the phases of the business cycle, resulting in increases in loan costs.



Fig. 1. WIBOR 6M (vertical axis) during period of January 1, 2001, through August 1, 2021 – source: Bankier.pl, 2021

The same is true for taking out a bond loan. For a bond issuer, the riskiest is a fixed-interest rate. Then, the opportunity costs (the costs of debt service) increase with a falling trend in the interest-rate market. With a floating interest rate along with a decrease in interest rates, however, the cost of debt servicing also decreases. This is why it is so important to build a balanced loan portfolio – it must be diversified in terms of its type (loans and debt securities), term (different periods), and type of interest rate (fixed and variable). Interest-rate risk can also be managed by purchasing derivatives for deposits and bonds as well as by controlling the structures of assets and liabilities.

There are various derivatives that can be used to manage this risk, such as interest-rate swaps, currency interest-rate swaps, options, forward contracts, and futures contracts. The type of interest rate on loans should also be approached with caution. Under the conditions of an increase in the market interest rate, a fixed rate is more profitable; in the case of a downward trend, a variable rate is best.

Exchange-rate risk. The activity of heating companies usually has a regional scope; therefore, it is unlikely that the risk of exchange rates that are related to heat exports will be a threat to them. However, these companies can buy imported fuels (e.g., natural gas or coal).

During the years of 2002–2019, the share of coal fuels in Poland decreased by 10.7%, while the share of gas fuels increased by 5.8% and that of renewable energy sources (RES) increased by 6.6%. In 2019, the heating sector consumed 32,151,990.2 GJ of high-methane gas (which represented 7.54% of the consumption of all of the fuels for heat production), 8,215,813.5 GJ of nitrogen-rich gas (93%), 150,469.5 GJ of biogas (0.04%), and 838,423.7 GJ of other RES (0.20% of consumption). However, the greatest amount of heat was produced with the use of coal fuels – 71.0% (Urząd Regulacji Energetyki, 2022, pp. 13–14). The coal came from both Poland and abroad, as the country has been a net importer of hard coal from beyond its eastern border since 2008 (the settlement currency is most often the US dollar). The largest heating companies balance the purchase of domestic raw materials with imported raw materials; therefore, the risk of the transaction exchange rate increases year by year. For example, coal imports to Poland increased by 60% in 2017 (to 13.3 million tons of coal) according to the Business Insider Polska portal; of this, more than half of the raw material (8.7 million tons) came from Russia (Biznes Insider, 2018).

According to Eurostat data, 8.86 million tons of coal came to Poland after three quarters of 2020 (including 6.52 million tons from Russia). The more than 73% share of Russian coal during this period was the highest in years. For a comparison, this amounted to 67% in 2019 (raw material imports amounted to 11.97 million Mg after nine months, including 8.02 million Mg from Russia). In turn, up to 13.65 million Mg came from abroad during the period of January–September 2018 (including 9.9 million Mg from Russia, which accounted for 72.5% of all coal supplies) (Baca-Pogorzelska, 2021). The year 2018 was a record-breaking year for coal imports to Poland.

The data that was mentioned above shows that heating companies must take the risk of exchange rates into account – especially the risk of an increase in the currency exchange rate of a contract settlement. In addition, there are other threats: the risk of an increase in the fuel price, the risk of its transportation costs (external risks), and the risk of losing financial liquidity (internal risk).

The risk of force majeure is associated with the effects of natural (floods, hurricanes, fires, earthquakes, tornadoes) and human factors (armed conflicts, acts of sabotage, general strikes). The result of these actions may be a temporary suspension of the provision of services and catastrophic damage, completely preventing business activity. An enterprise has no influence on such phenomena; only insurance indemnities can facilitate the process of rebuilding fixed assets.

Identifying and analyzing business risk is an element that determines the possibility of creating enterprise value. This requires one to develop an action strategy to achieve the basic goals of one's economic activity.

3. IDENTIFICATION OF INDUSTRY RISK FACTORS

Industry risk is a risk that is typical for the enterprises that operate in a given industry. The typical risk for the heating industry includes price risk (changes in the prices of raw energy materials and heat prices), the risk of a decrease in demand for heat, competition risk, regulatory and legal risk, and environmental risk.

The risk of changes in the price of energy resources. Thermal energy can be obtained from various sources, ranging from coal and gas to biomass and waste. However, the heating industry in Poland is mainly based on coal.

The increase in the price of coal is influenced by the decrease in its production in domestic mines and the increase in the costs of its exploitation (owing to the need to descend to lower and lower coal seams). Moreover, the prices of energy commodities have become world prices as a result of the globalization of the world economy, and they shape the spot and futures markets. Their variability depends on many factors that are very difficult to identify, as not all are measurable.

For example, raw material prices are influenced by various events such as a change in a political cabinet or the directions of the economic development of the largest coal-producing countries, increased demand from dynamically developing countries (such as China), the collegial and individual decisions of the major fuel suppliers in the world, wars, strikes, earthquakes, volcanic eruptions, and other natural disasters. The economic trends that can be observed on global markets give an impulse for similar phenomena on the domestic coal market and also constitute a reference price for the contracts that have been concluded in Poland.

The increase in fuel prices in the world markets increases the costs of heat production while reducing the revenues of a heating company. If an increase in costs cannot be covered by increasing the price of heat (tariffs are set by Urząd Regulacji Energetyki (URE) (Energy Regulatory Office), the company will face financial risk and, consequently, the risk of losing liquidity.

The risk of changes in the price of heat. Heating companies are characterized by locality: heat is not transmitted over long distances (mainly for economic reasons). Each region is most often served by a heating plant that is the only heat supplier in the area (the so-called natural monopoly). For this reason, the heat market is regulated by the URE, which imposes a method for calculating the heat price according to the prescribed rules. According to the regulation, the price of heat should cover the costs of heat generation, its trading, and its transmission as well as the return on capital that is involved in the activities of entities in the heating industry (*Rozporządzenie Ministra Klimatu z dnia 7 kwietnia 2020 r. w sprawie szczegółowych zasad kształtowania i kalkulacji taryf oraz rozliczeń z tytułu zaopatrzenia w ciepło*, 2020).

This method of calculating the price is intended to motivate companies to invest (in order to modernize and increase operational efficiency), the costs of which will be covered by increasing the price tariff. The regulation of heat prices, however, does

not take sudden changes in market fuel prices, transmission losses, weather risk, and other unexpected changes in the external environment into account.

The risk of falling demand for district heat. There can be many reasons for falling demand for heat, including modern energy-saving trends: the thermo-modernization of buildings, the installation of weather automation in heating nodes, and the installation of heat regulators in rooms.

Currently, many owners of single-family houses install renewable energy devices; e.g., photovoltaic panels, solar panels, and heat pumps. These are used to produce electricity and heat. Public building managers are also increasingly installing such devices because they are often supported by the state. However, for heating companies, reducing the number of users means lowering the revenues on which they originally relied upon when implementing their investment.

In addition, some residents consciously reduce the consumption of district heat due to a worsening economic situation. Another reason is the migration of people to large cities (mainly for work), which has contributed to the depopulation of smaller towns. As a result, the demand for heat has also fallen in such smaller municipalities.

Competition risk. Generally, heating companies have their own heat-sales areas and an infrastructure that is adapted to them. The entry of other entities into the same area will not be profitable; therefore, there is no competition from similar business entities in this industry. However, competition may be created by dispersed heat sources and local gas boiler houses, (especially those operating on the biomethane that is produced in biogas plants – the number of which is constantly growing in Poland). These are produced in landfills, sewage-treatment plants, and in the countryside near farms.

Regulatory and legal risk results from changes in the economic policy of the state. They translate into restrictions of the freedom of economic activity in the forms of granting concessions, conducting constant supervision over the activity, changing the existing law, and introducing new regulations.

In the case of heating, this risk manifests itself mainly in the form of tariffs for heat and the income of energy companies. Additionally, environmental policy (increasingly stringent requirements for greenhouse gas emissions) affects their financial situations due to the need to invest in additional purification filters to capture the by-products from fuel combustion. This risk has an even greater impact on combined heat and power plants, which must comply with the requirements for both activities. In the event that the modernization or installation of modern heating devices that capture emitted pollutants is not feasible, a company will be required to pay high financial penalties or purchase additional emission allowances.

The environmental risk is related to the previous type of risk, because changes in laws and regulations require taking certain actions to meet them. This is connected with the necessity of the deep modernization of heating plants (or combined heat and power plants) or the installation of new devices for the treatment of post-production waste (mainly the gases and dust that are emitted into the atmosphere). In the case of ecological coal combustion, a large one-off expenditure is required for modernization (e.g., for the construction of a wet flue gas desulfurization and denitrification installation, which can reduce sulfur oxide and dust emissions five-fold and nitrogen

oxide emissions three-fold). In the case of natural gas, such installations do not need to be installed, as this is considered to be the cleanest of all of the fossil fuels. The same is true for biomethane.

4. IDENTIFICATION OF SPECIFIC RISK FACTORS

Each company is characterized by an individual set of dangers (specific risks). In the case of the heating industry, the group of specific risks includes the risk of disruptions in fuel supplies, the risk of inadequate fuel quality, technological defects, credit risks, and weather conditions that reduce the heat consumption by users. They also overlap with some types of internal risks (e.g., technological risk).

Risk of fuel supply. The continuity of fuel supplies and their quality determine the stability of heating companies. The Polish heating sector is mainly based on coal fuels, and not much will change in the near future because most of the gas and heating oil (obtained from crude oil) are imported. There is also no possibility of a rapid increase in the share of renewable energy sources, which amounted to approximately 10% of the total consumption in 2019 (Urząd Regulacji Energetyki, 2022, pp. 13–14). Therefore, the focus here will only be on coal.

As in any other business activity, the continuity of supply is a very important issue that can be disrupted by many different factors, from supplier oversight through logistic and atmospheric problems to failures in coal mines and natural disasters. A company should be prepared for such situations by maintaining an emergency coal reserve.

However, the size of such a reserve is unknown; a too-small reserve may cause problems with the continuity of heat production (which is unacceptable), and a too-large reserve may generate additional costs of storing and securing the fuel. Similar threats may also occur in the cases of the supplies of heating oil, biomass, and other fuels (with the exception of gas, whose storage is nearly impossible).

Fuel-quality risk. Another risk may be related to the quality of coal that does not correspond to the contracted parameters. The quality of coal depends on its calorific value and the contents of the admixtures (including ash and combustible sulfur). Low qualities of coal are associated with increases in the emissions of pollutants and the additional costs of their management.

Technological risk includes threats that are related to downtimes as well as failures in the operations of devices. Such events can occur at very low air temperatures when the pipes and valves in district-heating networks burst. Interruptions in heating supplies can lead to the destruction of internal heating systems in buildings, which will likely result in the filing of civil lawsuits against a heating company. Due to the unique role of heating companies, this is one of the most important risks for which one must be prepared.

In this case, insurance will not help; the only solution is to eliminate the cause of the failure as soon as possible. This is why it is so important to modernize old heating networks. To ensure their stable operation (including the maintenance of pressure in networks, the flow through boilers, and the operation of exhaust fans), it is essential to provide automatic backup external power-supply systems and own generators. In

the event of interruptions in heat supplies, clear procedures to reduce supplies are important, taking special-purpose buildings into account.

Credit risk. Sources of credit risk are loans and credit; banks and other financial institutions are the most vulnerable to these. In general, this risk can be defined as the threat of the borrower's failure to meet the terms of a loan agreement. So, how can a heating company be associated with a given type of risk?

Increasing the prices of heat (which is beneficial for the heating sector) may expose the company to credit risk, as the risk of reducing receipts from customer fees (due to their financial problems) increases. In this situation, the heating company may grant them a trade credit.

Weather risk. The heating industry is one of the few industries that are sensitive to weather conditions – especially to air temperature and wind force; this is defined as sensitivity to non-catastrophic weather risk. In this industry, this is associated with reductions of heat consumption during periods of unusually high temperatures during the heating season. The strength of the wind is also important because, with strong winds, heat consumption is higher (and vice versa). Weather risk can be classified as both industry and specific risks; it depends on whether the climatic conditions in the country are the same.

Although the climate in Poland is relatively the same (temperate climate, heat group, transitional type), the following reasons speak in favor of classifying this risk as being specific:

- heterogeneity of terrain (even in same voivodeship, there are lowland and mountainous areas — lower temperatures are most often observed in mountainous areas),
- in Poland, some regions are usually warmer (south and southwest),
- other regions of Poland are colder (north and northeast),
- Baltic Sea region is characterized by stronger winds,
- it happens that temperatures in Poland differ by several degrees at same time.

Currently, the risk of non-catastrophic weather is the result of global climate change; this results in extremely high summer temperatures and mild weather conditions during the heating season. The latter aspect is alarming among the management staffs in heating companies.

Specific risk also includes all types of threats that are related to internal factors in company operations, such as inadequate employee qualifications, low work efficiency, improper work organization, poor management structures, a lack of appropriate control mechanisms, and the improper operations of machines and devices.

5. RISK MAP FOR HEATING COMPANIES

External and internal risk factors can be related to each other, neutralizing or increasing the risks. Therefore, an integrated approach for building a diversified risk-management strategy is important. Table 1 presents the different types of risk (divided into three groups), with attachments to their threats and other types of risk.

Table 1. Risks for heating companies

| Types of risk | Threads | Relationships with other types of risk |
|---|--|--|
| General risks for economy | | |
| interest-rate risk | <ul style="list-style-type: none"> – volatility of financial markets – return on capital – structure of owned loans | <ul style="list-style-type: none"> – credit risk – asset risk – liquidity risk |
| exchange-rate risk | <ul style="list-style-type: none"> – exchange rate change – change in the economic policy of a country of currency – social unrest in the country's currency – sentiment in the capital market | <ul style="list-style-type: none"> – risk of changes in the fuel price – liquidity risk – risk of an increase in transport costs – risk of reducing income |
| force majeure risk | <ul style="list-style-type: none"> – natural disasters – fuel supply blockage – wars and armed conflicts – strikes | <ul style="list-style-type: none"> – technological risk – risk of failure – sales volume risk |
| Industry risks | | |
| risk of changes in fuel prices | <ul style="list-style-type: none"> – domestic coal mining – demand for fuels on the world market – fuel supply on the domestic and world market | <ul style="list-style-type: none"> – risk of an increase in operating costs – risk of reducing profit – liquidity risk – risk of reducing expenditure on modernization |
| risk of changes in prices of heat | <ul style="list-style-type: none"> – tariff policy of the ERO | <ul style="list-style-type: none"> – liquidity risk – credit risk – interest rate risk |
| risk of decreases in demand for district heat | <ul style="list-style-type: none"> – increasing the share of renewable energy sources – thermo-modernization of buildings – economic situation of recipients – population migration | <ul style="list-style-type: none"> – sales volume risk – risk of reducing income – liquidity risk |
| risk of competition | <ul style="list-style-type: none"> – development of distributed energy – biogas plants and biomethane | <ul style="list-style-type: none"> – sales volume risk |
| regulatory and legal risk | <ul style="list-style-type: none"> – privatization and consolidation of enterprises in the industry – changes in environmental standards – introducing additional requirements | <ul style="list-style-type: none"> – risk of changes in the price of heat – structural risk – liquidity risk – image loss risk |

Table 1 cont.

| Types of risk | Threads | Relationships with other types of risk |
|-----------------------|--|---|
| environmental risk | <ul style="list-style-type: none"> – exceeding environmental standards – delivery of inferior quality fuels | <ul style="list-style-type: none"> – risk of paying fines for air pollution – risk of incurring expenses for new purification installations – risk of incurring the costs of purchasing additional emission allowances |
| Specific risks | | |
| risk of fuel supplies | <ul style="list-style-type: none"> – delay in deliveries due to the fault of the seller – reduction in production due to failure – bad weather conditions – delays in deliveries from imports due to the fault of the importer – delays in import deliveries due to other factors | <ul style="list-style-type: none"> – sales volume risk – risk of civil lawsuits |
| fuel-quality risk | <ul style="list-style-type: none"> – fuel calorific value lower than assumed – higher than assumed content of admixtures | <ul style="list-style-type: none"> – technological risk – environmental risk |
| technological risk | <ul style="list-style-type: none"> – faults in the operation of machines and devices – human errors in their operation | <ul style="list-style-type: none"> – risk of failure – risk of production stoppage – ecological risk |
| credit risk | <ul style="list-style-type: none"> – no charges for the delivered heat – delay in charges for heat | <ul style="list-style-type: none"> – interest rate risk – risk of reducing income – liquidity risk |
| weather risk | <ul style="list-style-type: none"> – unusually high temperatures during the heating period – low wind speed – low air humidity | <ul style="list-style-type: none"> – sales volume risk – risk of reducing income – liquidity risk |
| internal risk | <ul style="list-style-type: none"> – inadequate qualifications of employees – bad management system – lack of control mechanisms – deliberate damage to property, plant and equipment – fuel thefts – starting a fire – disruptions to process control systems – hacker attacks on the IT system | <ul style="list-style-type: none"> – financial risk – risk of production stoppage – ecological risk – image loss risk – risk of reducing income |

6. RISK ANALYSIS FOR HEATING COMPANIES AND DISCUSSION

After identifying the risks, they should be analyzed by taking the importance of each into account. Probability and effect are the basic measures in risk analysis; the first can be defined as the possibility of the occurrence of a given threat, and the second as the consequences of its occurrence. Hopkin (2017, p. 22) developed the basic risk analysis with the following parameters:

- time of impact (short- or long-term),
- degree of control entity has over risk (low or high),
- assignment to appropriate risk class (general economic, industry, and specific).

Table 2 presents a qualitative risk analysis for heating companies in Poland. The following designations have been adopted:

- in terms of duration of effect – short-term (+), medium-term (++), long-term (+++),
- in terms of probability, degree of exposure, and degree of control – low (+), medium (++), high (+++) degree of exposure or control.

Table 2. *Qualitative risk analysis for heating companies*

| Type of risk | Duration of effect | Probability | Degree of exposure | Degree of control |
|---|--------------------|-------------|--------------------|-------------------|
| General risks for economy | | | | |
| interest-rate risk | ++ | + | +++ | + |
| exchange-rate risk | +++ | ++ | +++ | + |
| force majeure risk | ++ | + | + | – |
| Industry risks | | | | |
| risk of changes in fuel prices | +++ | +++ | +++ | + |
| risk of changes in prices of heat | +++ | + | ++ | + |
| risk of decreases in demand for district heat | ++ | ++ | + | – |
| competitive risk | ++ | ++ | ++ | – |
| regulatory and legal risk | +++ | ++ | + | – |
| environmental risk | ++ | + | + | ++ |
| Specific risks | | | | |
| risk of fuel supplies | + | + | ++ | ++ |
| fuel-quality risk | ++ | ++ | + | + |
| technological risk | ++ | + | +++ | ++ |
| credit risk | + | + | + | +++ |
| weather risk | + | +++ | ++ | + |
| internal risk | ++ | +++ | +++ | +++ |

According to the criterion of the duration of the respective impacts, the following risks are most dangerous: exchange-rate risk, the risk of changes in fuel and heat prices, and regulatory and legal risk. Taking the probability of the risk into account, the highest rating was the possibility of risk of fuel price changes, weather risk, and the group of internal risks. It was also found that heating companies are most exposed to exchange-rate risk, interest-rate risk, risk of changes in fuel prices, technological disturbances, and internal risks. The last parameter that was evaluated was the possibility of risk control. In this sense, the most difficult to deal with are the following risks: force majeure, risk of decreases in demand for district heat, competition risk, and regulatory and legal risk. It should be emphasized that a company has no influence on the general economic risk, the typical risks for the industry are difficult to control, and specific risks are the most controllable kind of risks (provided that the company's managers are aware of them). This does not mean that they should not worry about other risks. All types of risk should be covered by a coherent management system and integrated with an enterprise management strategy that is aimed at achieving set goals.

So what actions can be taken in relation to the individual risks? Several solutions will be provided below.

To avoid credit risk, the amounts of trade credits should be minimized, and one's credit portfolio should be diversified. There are several solutions for interest-rate risk: not taking out loans unless necessary, applying for fixed interest rates on loans (this enables long-term planning), and using derivatives. In the case of exchange-rate risk, it is recommended to control the structure of foreign currency assets and liabilities, conclude short-term contracts, and use derivatives. In turn, to reduce the exposure to the risk of changes in fuel prices, it is recommended to diversify the the directions of supplies, conclude contracts for short periods, introduce fuel diversification, and maintain emergency reserves of fuels.

7. SUMMARY AND CONCLUSIONS

World population growth, technological development, and urbanization all contribute to increases in the demand for raw materials and energy (electricity and heat). District heating is most-developed in those countries with marked changes in their seasons (including Poland); this determines the energy security of the country during the period from fall to spring. For this reason, the stability of the entities in the heating industry has attracted interest among scientists and practitioners. However, this stability can be disrupted by external and internal threats.

This is why it is so important to develop risk-management strategies in heating companies. The implementation of the strategy will depend on the organizational culture, management style, risk awareness at all levels of management and in all organizational units, speed of the information exchange among them, and information quality. An important role is played by the efficient monitoring and control of the implementation of activities under a strategy (or its newer version) as adapted to new market conditions. This means that a developed strategy may need frequent modifications (even though it covers a long-term perspective). The monitoring team decides when and how the strategy should be modified.

Risk management should support the process of creating value for shareholders and implementing a company's business strategy. This is possible because of the maintenance of the level of risk at a level that is acceptable to the company's stakeholders and the limitation of the impacts of the risk factors on the company's cash flow and financial results. All actions under a risk-management strategy must be proactive; that is, actions that are taken in advance in any event of an incident. They must also be comprehensive; i.e., focused not only on reducing the effects of threats but also on taking advantage of opportunities. The strategy will depend on the general attitude of the managers, who may choose whether to seize opportunities or to reduce threats. Importantly, for a risk-management strategy to be effective, it must be built on the basis of scientific principles and the recommendations of organizations that specialize in this topic.

The qualitative analysis that was carried out here will be the basis for creating strategies for managing various types of risk, using both traditional methods and the most modern ones (e.g., derivatives that are exposed to commodity prices, interest rates, exchange rates, credit risk, or air temperatures).

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