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1. Introduction

In Poland, power generating systems which use natural gas produce approximately 3% of the country’s electricity and consume about 1 thousand million cubic meters of gas per year. In 2010, the energy sector accounted for only about 7% of the domestic consumption of natural gas. The low share of gas in the fuel mix of the Polish electricity sector is a consequence of there having been no economic justification for building gas units in Poland in the past. A few years ago, high gas prices (compared to coal prices) and negligible costs of CO₂ emissions discouraged energy companies from switching to gas and encouraged them to build coal-based units.

Recently, however, the investment climate seems to favour gas-based energy industry. Many companies of the energy sector and other sectors have expressed their interest in building new power plants or combined heat and power plants (CHPs; also called cogeneration plants) powered by natural gas. Some of these units would be built in the places where the construction of coal-fired power plants or combined heat and plants had been planned before. This raises the question: where does this trend come from, and is it based on sound economics?

In comparison with coal-based sources, gas units have many advantages, which increase their investment attractiveness. These include, for instance, relatively low investment costs, short construction time and high flexibility in operation (except for the cogeneration plants). However, gas sources have disadvantages as well; for example, a relatively short operational life and high fuel costs. The main reason for the increased interest in gas energy, at the expense of coal, is probably the climate and energy policy of the European Union, which aims at reducing CO₂ emissions. Another factor that encourages companies to consider this option is the prospect of extracting unconventional gas in Poland. Nonetheless, it should be emphasized that the possibilities of extracting this fuel have not yet been sufficiently investigated or confirmed, and therefore, the role it may play in the Polish energy sector must be considered with caution. The real trend in the gas sector is liberalization, which may have a beneficial effect on gas prices in the Polish market.

The profitability of investments in gas sector, especially in the system power plants, will depend on the actual impact of the above events on the prices of CO₂ emission allowances and the prices of gas in comparison with electricity prices. Since the emissions of gas units are significantly lower than of coal units, their position will be better, the higher the prices of CO₂ emission allowances. Currently, however, it is difficult to predict them even in the near future. A year ago, it was forecast that in 2012 the price of allowances would reach the level of EUR 15-20, while at present it equals about EUR 7. It is also difficult to state explicitly what impact the liberalization of the market and the possible extraction of unconventional gas will have on the gas price. An additional problem in the planning of system power plants is the unsettled issue of the costs of such power plants connected with the necessity of gas off-take under take-or-pay contracts in a situation of constraints on electricity production resulting from the requirements of the National Power System. To solve this problem, agreements between the entities planning to build gas-fired power plants and the PSE Operator (Polish Transmission System Operator) are necessary.

Today, because of a number of significant risks associated with investments in gas-fired system power plants, it seems worthwhile deferring making a decision on the construction of such sources, at least until 2013. Next year the third phase of the European Emission Trading System will begin; therefore, there will be greater clarity regarding the cost of CO₂ allowances. In 2013, also, other issues relevant to the gas power stations might become clearer. Because a gas power plant operates for a long period of about 25 years, the decision concerning its construction should have a solid foundation. However, postponing the final decision to build a power plant does not mean that one should refrain from the preparations for the investment. For locations where it is possible to build both a coal-fired power plant or a gas-fired power plant, it is worth preparing two variants of the investment concept. The additional cost will be small compared to the possible losses, or benefits lost, as a result of a misguided investment decision, and the benefit will be huge, in the form of the opportunity for a prompt start of the investment.

Nonetheless, it is worth remembering that in the case of entities with primarily coal units, investment in gas power plants is an element of diversification of the generating portfolio. For them, the decision to build a gas power plant is not merely an element of a unitary economic calculation for an individual investment.

In contrast to the investments in gas-fired system power plants, investments in gas combined heat and power plants appear to be a safe option at the moment. The climate and energy policy of the
European Union anticipates a development of cogeneration, and Poland – under EU directives – is obliged to support these trends, which means that we must create conditions appropriate for new investments in cogeneration plants. An expression of the EU preference for energy production in cogeneration (especially high efficiency cogeneration) is, for example, the possibility for high efficiency cogeneration units in the whole EU to obtain free CO₂ allowances for the production of heat until 2027. One should not forget that the efficiency of energy conversion in cogeneration plants is much higher than in regular power plants. Moreover, heat sales cover not only the fuel costs but also, to some extent, the fixed costs which are similar in gas-fuelled power plants and combined heat and power plants.

The two most promising sectors among the gas cogeneration plants are utility combined heat and power plants (producing heat for municipal heating systems) and industrial combined heat and power plants (autoproducers). The attractiveness of the utility cogeneration plants results, for example, from a stable and (largely) predictable heat consumption by the urban heating system. At the same time, the disadvantage here is the seasonality of heat production. The situation of an industrial cogeneration plant is quite different as it supplies heat and electricity for a factory, so the heat is consumed throughout the whole year. However, dependence on one customer poses the risk of the financial collapse of a combined heat and power plant in the case of the liquidation of the factory which is the main recipient of its products.

The development of the gas-fired generation units is determined not only by gas prices and CO₂ allowances, but also by the ability to provide gas supplies at the required level and on attractive terms for a longer period. Because of the current gas monopoly in the Polish market (dominance of PGNiG), customers are forced to accept unfavourable terms of supply (take-or-pay type agreements). The predicted gas market liberalization should positively impact the investments in gas-fired generation units. However, a full market opening is not possible without major investments in interconnections, for example. Investment in gas infrastructure is also necessary to provide the required transmission and storage capacities.

Debt ratios of entities from the electricity industry and from the gas sector, such as net debt to interest-bearing debt or equity-to-liability ratio, are currently at relatively safe levels, but gas-based energy generation development along with the construction of the necessary infrastructure will require major investment outlays, and consequently, external sources of financing. At present, banks perceive the risks associated with the activity in these sectors as acceptable and report their interest in the financing of the planned projects. Today, most of the bank loans are structured in the form of corporate credit, where the funding largely depends on the results generated by the currently conducted business activities including the potential impact of the planned investments on the company’s condition. This is the most flexible form of long-term financing accepted by banks because of the good financial standing of the borrowers.

With the increase of debt, it will be necessary to use, also, other, less flexible, funding formulas, such as „project finance“, where both the financing and its repayment are closely linked to the implemented investment project and to the cash level generated by the project. This funding formula is connected with numerous restrictions imposed on the borrower, but on the other hand, there is the possibility of providing a longer period of financing, even up to 15 years. In practice, various elements of balance sheet financing and project financing are often combined depending on the situation and needs of the borrower.

Taking into account the amount of investment outlays for gas-fired generation units, the value of investments planned in the conventional energy sector, and the value of investments in the gas sector, one has to be aware that the Polish banking sector might not be able to finance all the investment needs. This results from the applicable legal restrictions as well as from the principles of credit portfolio diversification used by banks. An alternative for the banking sector may be the issuing of bonds (both domestic as well as Eurobonds), financed by international financial institutions and aid funds. This sector’s conservative policy regarding the payment of dividends, which aims at strengthening the opportunities of financing investments within its own resources, will also be very important. The biggest players in the electricity industry and in the gas sector tend to combine various forms of financing in order to diversify them.
2. The present position of the Polish gas energy sector
In 2010, natural gas consumption in the Polish energy sector amounted to about 1 thousand million cubic meters, accounting for approximately 7% of the domestic consumption of this blue fuel\(^1\). At present, the main fuel used for electricity production in Poland is coal (hard coal and lignite). The total power of the sources using coal as a primary fuel represents about 82% of the net generation capacity in the national energy system. Gas sources account for 3% in the capacity structure, and they are only combined heat and power plants. At present, power plants using natural gas are missing in the Polish power system. The dominance of coal-based sources and the small share of gas-based sources result from the owned natural resources, where coal predominates, and from the lack of economic justification for the construction of gas-based sources in the past.

The generally available forecasts regarding electricity production indicate that the importance of gas in the structure of fuels used by the Polish power sector will grow. According to the forecasts of the Energy Market Agency developed for the Ministry of Economy, the share of electricity produced from natural gas is expected to increase from the current approximate 3% to about 10% in 2030. The production growth will mainly concern cogeneration plants.

\(^1\) Report on the activities of the President of the Energy Regulatory Office in 2010.
3. The most important factors determining the attractiveness of investments in the gas-based power generation
3.1. The investment process and construction costs

The physical process of building a combined cycle gas turbine (CCGT) unit differs from the construction of hard coal or lignite-fuelled units. This is reflected, inter alia, in the level of a unit capital expenditure as well as in the length of the investment process. For example, the process of building a CCGT unit of 190 MW in Elektrociepłownia Zielona Góra S.A. (from the date of signing a contract with the contractor until the beginning of commercial operation) lasted 2.5 years. The length of the process of building a CCGT unit is estimated at about 3 years. In the case of a coal-based unit, it usually takes about 5 years.

Investment outlays for gas-based sources are lower than the expenditures for coal-based units. Unit capital expenditure (CAPEX) for the construction of a CCGT unit range from EUR 0.80-0.95 million / MWe, while unit CAPEX for the construction of a coal-based unit amount to about EUR 1.5-1.6 million / MWe. However, analysing the cost of the two types of sources, one should bear in mind the much shorter operation period of the gas-fuelled unit (about 25 years) compared to the coal-fuelled units (up to 35 years), which partially reduces the effect of lower CAPEX.

The cost of the construction of power units depends not only on the economic situation that affects the price of investment goods, but also on the location. In the case of replacement investment (known as brownfield investment), unit CAPEX may be much lower (mainly owing to the possibility of using the already existing infrastructure) than in the case of new locations (the so-called greenfield investment).

The level of CAPEX is also affected by the method of implementing the investment (an EPC contract or a package-based model). Currently, most investments in the Polish energy sector are carried out in the EPC formula (Engineering Procurement & Construction), which implies the choice of a general contractor responsible, among other things, for the design, delivery, implementation and commissioning of the power plant. The biggest advantage of an EPC contract involves the transfer of all risks associated with the conducting of the investment process to the general contractor, which is a solution preferred by financial institutions. A disadvantage, on the other hand, is the increased costs of the implementation of the investment (the so-called EPC margin) compared to the package-based model. In the package-based model the individual elements of the power generation unit are ordered separately. Its advantage is the investor’s influence on the specifications of technical solutions (which are optimal from the economic and technical point of view) and no margin of the general contractor. In the package-based model itself, the investors may directly supervise the construction process or have it done by an external entity. The shortcoming of the package-based formula is a higher risk that the design parameters will not be achieved and the schedule will not be fulfilled. In order to minimize the risks associated with the package-based model, strong competencies in the supervision of the investment process must be built in the energy groups.

Gas-fuelled sources are characterized by lower construction costs and a shorter implementation time than coal-fuelled sources. However, their anticipated operation time is much shorter.

3.2. The price of gas fuel

Taking into account the absolute fuel price (without the cost of transport), natural gas is now twice as expensive as hard coal. On the Polish market the average price of the blue fuel per GJ of chemical energy amounted to PLN 26 / GJ in 2011, while the average steam coal sale price of the Polish mines was PLN 13 / GJ. Given the estimated costs of transport which are based on the tariffs of PKP Cargo and Gaz System S.A., the fuel price at the gate of a power station equals about PLN 28 / GJ for natural gas and PLN 16 / GJ for hard coal.

Assuming the efficiency of the new coal and gas power stations to be respectively at net 45% and 58%\(^2\), the unit cost of fuel per 1 MWh of electricity amounts to about PLN 128 in the case of hard coal and PLN 175 in the case of natural gas. Today, the resulting difference in the unit fuel costs for the new gas and coal power stations would be around PLN 47/ MWh.

\(^2\) Based on ARE S.A., Update of Fuel and Energy Demand Forecast until 2030
Given the current gas fuel and hard coal costs, the efficiency indices obtained in the newly built power plants (indicated above) and the typical emission rates for gas and coal, the price of allowances to emit carbon dioxide should be approximately PLN 115 per ton (about EUR 28/ton) for the variable unit costs of electricity generation in gas power plants to be equal to the variable unit costs in coal power plants. Now, the price of CO₂ allowances is at the level of about EUR 7 per ton.

It should be emphasized that the above calculations apply only to new gas and coal power plants. In the case of cogeneration plants, the calculation should take into account the whole range of additional factors, such as the sale of heat and the cogeneration support system.

3.3. Climate and Energy Policy of the European Union

The directions of the climate and energy policy

Strategic directions of the EU energy and climate protection policies include: reduction of carbon dioxide emissions, increase of energy efficiency and greater use of renewable energy sources.

In terms of carbon dioxide emission, the present EU’s goal is to reduce it before 2020 by 20% compared to 1990. However, the European Commission aims to tighten the emission targets for CO₂. It proposes to modify the climate and energy policy, namely, to reduce CO₂ emissions by 2020 by 30%, by 2030 by 40%, and by 2050 by 80% compared to 1990. The development of gas-fuelled sources, which are characterized by lower carbon emissions than the coal-based sources, is consistent with these objectives.

One of the activities of the European Union aimed at increasing energy efficiency is the promotion of high efficiency cogeneration. According to Directive 2004/8/EC, Member States are obliged to support the development of cogeneration. This obligation is reflected in the “Polish Energy Policy until 2030”, adopted by the Council of Ministers in November 2009, which anticipates a twofold increase of electricity produced from high efficiency cogeneration by 2020 as compared to 2006, and in the Polish high efficiency cogeneration support system. In the third phase of the European Union Emission Trading Scheme (EU ETS), support for high efficiency cogeneration will also be provided in the form of free CO₂ allowances for the production of heat. The number of free allowances will decrease reaching zero in 2027. The promotion of cogeneration supports investment in gas-fired cogeneration plants. It should also be stressed that gas-fired units are characterized by higher efficiency than coal-fired sources (in case of gas-fired power plants the generation efficiency may reach 57-60%, while in the case of coal power plants about 45%), and therefore, the development of gas-based energy in the case of power generation (not only combined heat and power plants) would support the efforts to improve the energy efficiency of the economy.

In the field of renewable energy sources (RES), the European Union seeks to achieve in 2020 a 20% share of renewables in the final gross energy consumption. Although gas-fired sources are not included in RES, their development may be necessary to ensure a flexible reserve for the rapidly growing wind energy sector. Wind turbines are characterized by high volatility of production in a short time span, which requires a reserve capable to cover the temporary losses of power in the system. Gas power plants can successfully fulfil the role of such sources. Whether this role can be played by CCGT power plants, or whether an open cycle power plant will be necessary might be arguable.
The development of the gas-based power generation is consistent with the objectives of the energy and climate policy of the European Union, whose main directions are: reduction of carbon emissions, increase of energy efficiency and greater use of renewable energy sources.

Costs associated with carbon dioxide emissions

In the third phase of the Emission Trading Scheme, which will start in 2013, rules of allocation of CO₂ allowances (European Union Allowances – EUA) will be modified. According to the general regulations resulting from Directive 2009/29/EC, the energy sector in the European Union will be forced to purchase 100% of CO₂ emission allowances. Poland has been provided with transition period during which part of allowances for the electricity industry will be granted free of charge until 2020 (however, this does not apply to the new sources, the construction of which began after 2008). In 2013, Polish electricity producers will have to purchase at least 30% of the necessary allowances. This percentage will grow from year to year, reaching 100% in 2020.

A comparison of CO₂ emissions per 1 MWh for high efficiency power plants using selected fuel is presented below. The graph shows that gas-fuelled sources emit two times less carbon dioxide than coal-fired sources, which – in the case of high prices for CO₂ allowances – would significantly improve the competitiveness of gas-fired units.

The market price of CO₂ allowances amounts currently approximately to EUR 7 / ton (as of early April 2012). This price is significantly lower than the European Commission would expect, therefore, market participants expect the Commission’s intervention to correct the EUA price. These expectations are confirmed by proposals put forward by the Commission to increase the current 2020 target of CO₂ emission reduction (up to 30% - a proposal vetoed by Poland) and by the proposed amendment to the draft of the new directive on energy efficiency suggested by the Commission for Environmental Affairs of the European Parliament regarding the set aside of 1.4 thousand million EUA from circulation.

CO₂ market analysts expect that if the intervention on the EUA market is successful, the prices of emission allowances may reach the level of about EUR 20-25 /ton. Such a situation on the allowances market would significantly reduce the profitability of coal-fired sources, and relatively improve the situation of gas-fired units.

Analyzing forecasts concerning CO₂, it should be remembered how large the discrepancy is between the actual currently observed EUA prices and the prices forecast for 2012 a few years ago, as well as how big the differences are between the forecasts made in different periods. The chart below presents the EUA prices on the spot BLUENEXT market and in future contracts entered into on this market in the years 2008-2011. The table on the page 17 shows the forecasts of CO₂ allowances price from April and September 2011, prepared by financial institutions.
Comparison of the actual EUA prices and prices in the future contracts concluded in the period 2008-2011 on the BLUENEXT market

Prices of the EUA units with delivery in 2012 in the contracts concluded in 2008 on the French BLUENEXT exchange exceeded EUR 30. The contracts concluded in 2010 and 2011, with delivery in 2012, had much lower prices than it had been expected in 2008, but their level was still much higher than the current market prices.

**Forecasts of financial institutions on EUA prices**

<table>
<thead>
<tr>
<th>Institution</th>
<th>Forecast from April 2011</th>
<th>Forecast from September 2011</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Forecast for December 2011</td>
<td>Forecast for Phase 3</td>
</tr>
<tr>
<td>BarCap</td>
<td>28,00</td>
<td>40,00</td>
</tr>
<tr>
<td>Deutsche Bank</td>
<td>21,85</td>
<td>26,20</td>
</tr>
<tr>
<td>Point Carbon</td>
<td>22,00</td>
<td>30,00</td>
</tr>
<tr>
<td>Nomisma Energia</td>
<td>20,10</td>
<td>24,80</td>
</tr>
<tr>
<td>UniCredit</td>
<td>19,30</td>
<td>25,00</td>
</tr>
</tbody>
</table>

Source: Pravda Capital Partners AG.
In April 2011, financial institutions still expected that in the third phase of EU ETS the EUA prices would be in the range EUR 25-40 per ton. In September, these forecasts were adjusted to EUR 21-28 per ton. Significant changes of forecasts in such a short period prove a great uncertainty as to the level of CO₂ prices in the coming years.

The chart below shows the effect of different EUA price levels on the estimated cost of carbon dioxide emissions for high efficiency coal and gas power plants, taking into account the emission levels calculated on the basis of data presented by the Energy Market Agency and assuming the necessity to purchase 100% of emission allowances.

If the CO₂ allowances price rises significantly in comparison with the current levels (in line with the efforts of the European Commission), the more than two times lower level of CO₂ emissions in high efficiency gas-fired sources (compared with coal-fired sources) will give them a significant competitive advantage. Today, it is difficult to predict how, in fact, prices for emission allowances will develop in the third phase of the EU ETS.

**Support system for energy production in high efficiency cogeneration in Poland**

In order to accelerate the development of cogeneration, in accordance with the requirements of the European Union, in 2007, Poland introduced a support system for cogeneration plants. In the case of gas CHPs, the support is provided in the form of the so-called “yellow certificates”. In order to obtain support, the criterion of high efficiency cogeneration (the achievement of primary energy savings in relation to the separate generation of electricity and heat at least at 10%) must be met. The system of “yellow certificates” has a significant impact on the profitability of gas-fired cogeneration units, but the effect dependents on the efficiency of a particular source.

The “yellow certificates” are awarded for 100% of produced gross electricity if the source reaches a minimum efficiency of production as set out in the Energy Law (75% or 80% depending on the technology). If the source does not reach above border efficiency but satisfies the condition of high efficiency cogeneration (10% of primary energy savings), it gets “yellow certificates” for part of the produced electricity (according to an algorithm specified in the implementing provisions of the Energy Law).

The “yellow certificates” are sold to entities which are required to obtain them, i.e. to entities selling electricity to end customers, end users who buy energy on the wholesale market and commodity brokerage houses buying energy on behalf of their customers. The level of the above obligation is set out in a regulation of the Minister of Economy of July 2011, and for 2012 it is 3.5% in relation to the volume of electricity sold to end customers or purchased directly by customers or commodity brokerage houses.

The price of “yellow certificates” depends on the demand and supply of certificates and on the compensation fee, which obligated parties must pay if they do not have...
enough of these certificates of origin of electricity. The compensation fee is determined by the President of the Energy Regulatory Office in the range from 15% to 110% of the average electricity price on the competitive market. The replacement fee for 2012 equals PLN 128.80 / MWh. The chart below shows the average price of “yellow certificates” on the exchange (run by the Polish Power Exchange – Towarowa Giełda Energii S.A.) and the replacement fee level since 2008.

### Market prices of “yellow certificates” and the compensation fee

![Graph showing the average price of “yellow certificates” on the exchange and the replacement fee level since 2008.](chart)

**Source:** PwC analysis based on publicly available information.

Under the applicable regulations, the system of “yellow certificates” shall expire on 31 March 2013. The draft of the new Energy Law, published by the Ministry of Economy in December 2011, provides for an extension of the above mechanism until 31 March 2021. But because of no proposals for the new implementing provisions, the obligatory level of “yellow certificates” is not known. It is also not certain whether the current rules of granting such certificates and their prices will still be valid.
4. Prospects for investment in gas energy
4.1. Investment declarations of companies in the gas-based power generation

Analyzing investment strategies of the energy companies in Poland, a growing interest in gas can be observed. In 2008, new sources using natural gas represented only 16% of the planned investments in new conventional capacities (with the exception of nuclear power plants), while in 2012, the share of gas-fired sources in the investment plans of energy companies is already at 37%.

The construction of gas-fired sources is planned by the biggest Polish energy companies. According to the “PGE Group Strategy for the years 2012-2035”, the share of gas in the fuel mix of this group will increase from 4% in 2012 to 12% in 2030 (approximately to 22% excluding nuclear energy and renewable energy). PGE plans to build 1.5 GW of new capacities based on gas. The Tauron Group plans to increase the share of gas in its fuel mix from 3% in 2009 to 7% in 2020. This means the construction of more than 1.3 GW of new capacities based on gas. The Energa Group has placed on its agenda a new 900 MW gas-fired unit in Grudziądz.

<table>
<thead>
<tr>
<th>Investor</th>
<th>Location</th>
<th>Planned electric capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>PGE</td>
<td>Pomorzany (CHP)</td>
<td>240 MW</td>
</tr>
<tr>
<td>PGE</td>
<td>Bydgoszcz (CHP)</td>
<td>240 MW</td>
</tr>
<tr>
<td>PGE</td>
<td>Gorzów (CHP)</td>
<td>135 MW</td>
</tr>
<tr>
<td>PGE</td>
<td>Lublin (CHP)</td>
<td>231 MW</td>
</tr>
<tr>
<td>PGE + ZA Puławy</td>
<td>Puławy (CHP)</td>
<td>840 MW</td>
</tr>
<tr>
<td>Tauron</td>
<td>Katowice (CHP)</td>
<td>135 MW</td>
</tr>
<tr>
<td>Tauron + KGHM</td>
<td>Blachownia (PP)</td>
<td>850 MW</td>
</tr>
<tr>
<td>Tauron + PGNiG</td>
<td>Stalowa Wola (CHP)</td>
<td>400 MW</td>
</tr>
<tr>
<td>Energa</td>
<td>Grudziądz (PP)</td>
<td>900 MW</td>
</tr>
<tr>
<td>PKN Orlen</td>
<td>Włocławek (CHP)</td>
<td>460 MW</td>
</tr>
<tr>
<td>ZE PAK</td>
<td>Adamów (n/a)</td>
<td>400 MW</td>
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<tr>
<td>ZE PAK</td>
<td>Konin (n/a)</td>
<td>120 MW</td>
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<tr>
<td>Fortum</td>
<td>Wrocław (CHP)</td>
<td>400 MW</td>
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<tr>
<td>PGNiG Termika</td>
<td>Warszawa (Zerań) (CHP)</td>
<td>456 MW</td>
</tr>
<tr>
<td>PGNiG Termika + ZAK SA</td>
<td>Kędzierzyn-Koźle (CHP)</td>
<td>170–400 MW</td>
</tr>
<tr>
<td>PKN Orlen</td>
<td>Płock (CHP)</td>
<td>400 MW</td>
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<tr>
<td>KGHM</td>
<td>Polkowice, Głogów (CHP)</td>
<td>2 x 45 MW</td>
</tr>
</tbody>
</table>

Total - 6467–6697 MW

Source: PwC analysis based on publicly available information.

6 Construction of a power plant, but conversion to a CHP plant is possible.
Investment plans in gas-based power generation have increased in recent years at the expense of investment in new coal-fired sources and despite the decline in the total volume of the planned new conventional capacities.

A summary of the planned investments in new conventional generation capacities for 2008 and 2012

<table>
<thead>
<tr>
<th>Investor</th>
<th>Plan 2008</th>
<th>Plan 2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>PGE</td>
<td>7158 MW</td>
<td>3946 MW³</td>
</tr>
<tr>
<td>Tauron</td>
<td>5025 MW</td>
<td>4255 MW</td>
</tr>
<tr>
<td>ENEA</td>
<td>1800 MW</td>
<td>1000 MW</td>
</tr>
<tr>
<td>Energa</td>
<td>1760 MW</td>
<td>1925 MW</td>
</tr>
<tr>
<td>Vattenfall</td>
<td>3660 MW</td>
<td></td>
</tr>
<tr>
<td>RWE</td>
<td>800 MW</td>
<td></td>
</tr>
<tr>
<td>CEZ</td>
<td>430 MW</td>
<td></td>
</tr>
<tr>
<td>EdF</td>
<td>900 MW</td>
<td>900 MW</td>
</tr>
<tr>
<td>Lotos</td>
<td>250 MW</td>
<td></td>
</tr>
<tr>
<td>GdF</td>
<td></td>
<td>1005 MW</td>
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<tr>
<td>PKN Orlen</td>
<td>860 MW</td>
<td></td>
</tr>
<tr>
<td>Kulczyk</td>
<td>2000 MW</td>
<td></td>
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<tr>
<td>Investment</td>
<td>520 MW</td>
<td></td>
</tr>
<tr>
<td>ZE PAK</td>
<td></td>
<td>530 MW</td>
</tr>
<tr>
<td>Fortum</td>
<td>90 MW</td>
<td></td>
</tr>
<tr>
<td>KGHM</td>
<td></td>
<td>626–856 MW</td>
</tr>
<tr>
<td>PGNiG Termika</td>
<td></td>
<td>17 907–18 137 MW</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>21 533 MW</td>
<td>17 907–18 137 MW</td>
</tr>
</tbody>
</table>

The increase in planned investment in the energy of the gas by 91%.

The change in the level of planned investments in conventional power generation in 2012 compared to 2008 is a consequence, among other things, of changes in the strategic plans of some energy groups (e.g. the withdrawal of the Vattenfall Group from the Polish market, adjustment of the investment plans by CEZ, limitations of the planned coal projects by PGE). Revision of investment plans is also reflected in the revised forecast of the demand for generation capacity. The document „Polish Energy Policy until 2030” of November 2009 assumed that the level of installed capacity in the National Power System in 2030 would exceed 51 GW. However, in the „Updated Forecast of Demand for Fuels and Energy until 2030”, a document of 2011, the forecast was revised and shows that the installed capacity in 2030 will reach about 46 GW. The revision of the forecasts is a consequence of changes in Poland’s economic environment.

In recent years, gas-fired sources (especially CHP plants) began to partially displace coal-fired sources in the investment plans of energy. 

³ In addition, a construction of a 1800–2700 MW power plant in the area of Olsztyn is considered in the PGE Group Strategy if the project has economic justification in light of the climate policy.
4.2. The main directions of investment in gas-based power generation

The considered investments in the gas-based power industry regard four main segments: the utility energy generation sector, load following units, distributed energy and industrial combined heat and power plants.

**Utility power plants and combined heat and power plants**

The current investment declarations of energy companies aim to build utility gas-fired sources with a total capacity of about 6500 MWe before 2020, with most units operating in cogeneration.

The most advanced investment project in the gas-based power generation is the construction of a CCGT unit of 400 MWe with a heating module in Stalowa Wola, carried out jointly by PGNiG and Tauron. In 2012, Abener Energia S.A. was chosen as a general contractor for the investment. Given the duration of the construction of the CCGT unit of about three years, the expected commissioning of the plant will fall at the turn of 2014. The launching of the cogeneration plant in Stalowa Wola will increase natural gas consumption in the electricity industry by about 0.5 thousand million m³ per year.

One of the biggest investments planned for launching in the coming years is a 900 MWe CCGT unit in Elektrownia Blachownia realized by Tauron and KGHM. The estimated gas consumption by this unit will be around 1.1 thousand million m³ per year. The completion of the investment in Elektrownia Blachownia is planned for 2015. In addition to Tauron and KGHM, Polska Grupa Energetyczna together with Zakłady Azotowe Puławy (840 MWe) and ENERGA Grudziadz (900 MWe) declare the building of CCGT units. Gas fuel consumption by each of these plants will exceed 1 thousand million m³ per year. The commissioning of the units in Grudziądz and Puławy is planned for the years 2016-2017. In the period 2014-2017, the commissioning of CCGT units in Włocławek (460 MWe), Gorzów (240 MWe), Adamów (400 MWe), Konin (120 MWe), Warsaw (456 MWe), Wrocław (400 MWe), and Bydgoszcz (about 240 MWe) is also planned.

The total fuel consumption of all these sources is estimated at about 7 thousand million m³ per year. Given the small degree of advancement of some projects, it is unlikely that all of the above investments will be completed within the stipulated time limit.

**Load following units**

In view of the dwindling power reserves in the National Power System and the dynamic development of wind energy in Poland, the Transmission System Operator is considering the building of load following units able to meet temporary power deficits in the system. According to PSE Operator, the estimated capacity of the planned load following units is about 500 MWe, and the commissioning of these units is planned for the years 2014-2017. Given the relatively low estimated time of using load following units (in practice, a few hundred hours a year), the operation of these sources should not significantly affect the structure of gas fuel consumption by the domestic energy sector.

**Distributed energy sector**

For the purpose of this document, distributed energy generation denotes local energy sources supplying energy to a small group of customers (e.g. local district heating plants). Construction of new units of this type or reconstruction of the existing ones (combined with fuel change) is another area of investment within the gas-based power generation sector. Local cogeneration plants based on gas engines are an attractive alternative to coal-fired plants, mainly due to: lower investment costs, lower greenhouse gas emissions, higher efficiency of transformation, as well as additional revenue from the sale of certificates of origin from high efficiency cogeneration (“yellow certificates”). The potential for possible investments in gas-based power generation for this segment is difficult to estimate precisely, because of substantial dispersion and small unit scale of investment projects, however the future consumption of gas by this sector will not have a significant impact on the gas use by the whole power industry.

**Industrial combined heat and power plants, including autoproducers**

Although the term autoproducer is not defined in legislation, it is most often used in relation to units generating power directly for the needs of end-users without the sales process. Construction of a gas-fired cogeneration plant that delivers energy to an industrial plant in its immediate vicinity, omitting the purchase process, can be
an extremely advantageous option for the recipient, because the energy produced and delivered in this manner is exempt from distribution/transmission charges and the cost of support mechanisms for renewable energy sources and high efficiency cogeneration.

In 2010, 89 industrial cogeneration plants, most of which based on coal fuels, operated in Poland. The advanced age of the generating equipment, on the one hand, and strict standards for the emissions of sulphur and nitrogen oxides as well as particulate matter after 2016, on the other hand, are decisive factors regarding the necessity to modernize the operated property or to replace it. One of the investment options in the sector of industrial power generation plants is the construction of CCGT units. The construction of such facilities is considered by, inter alia, KGHM (2 x 45 MWe/40 MWt in Polkowice and Głogów), PKN Orlen (400 MWe in Płock) and Zakłady Azotowe Kędzierzyn which, together with PGNiG, intends to build a facility with a capacity of 170-400 MWe. The estimated natural gas consumption by these systems may be about 1 thousand million m³ per year. In addition to the large industrial generation units, also smaller enterprises consider the construction of generating units powered by natural gas. However, as in the case of the distributed energy industry (except for units with big capacity), the scale of gas consumption by these units is difficult to estimate.

The impact of planned investments on the demand for gas

The implementation of all the declared investment projects in the utility and captive energy sectors would increase the demand for gas fuel by around 7.7 thousand million m³ per year by 2020. However, considering the current level of implementation of investment declarations of energy companies, this option does not seem real. Cogeneration projects with a commenced tender procedure have the best chance of realization. Assuming the construction of these units only, the annual gas consumption in the 2020 perspective might increase by about 2.5 thousand million m³.

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7 Catalogue of industrial captive power plants and combined heat and power cogeneration plants as of 31 December 2010, Agencja Rynku Energii S.A.

Estimated consumption of natural gas based on investment declarations of energy companies and industrial enterprises (in thousand millions m³/year)

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<td>1.1</td>
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</table>

Utility and gas-fired cogeneration plants will remain the largest consumers of gas fuel in the energy sector. In the case of load following units and distributed energy sector, the consumption of gas will have little impact on the fuel mix of the national power industry.

Source: PwC analysis based on publicly available information.
5. Effect of changes in the natural gas sector on the gas-based power generation sector
5.1. Liberalization of the natural gas market in Poland

The biggest challenge for companies ready to invest in the electricity industry based on natural gas has been ensuring long-term contracts for the supply of gas fuel under conditions that guarantee economic viability of the projects. The monopolistic nature of the gas market in Poland, and thus - no competitive gas sales offers or possibilities of negotiating the terms and conditions of delivery - often turned the scales of cost-effectiveness of such an undertaking in the favour of other energy sources. Furthermore, the lack of intersystem infrastructure and lack of access to storage facilities for mandatory reserves effectively limited the possibility of importing natural gas for own needs.

In recent years Poland has witnessed an increased activity of entities from the energy sector and legislative bodies targeted at fulfilling the European Union directives in the area of the gas market. One of the most visible signs of efforts to open up this market is the Polish investment program of building intersystem connections with the neighbouring countries, implementation of the LNG terminal project and expansion of the national system by the transmission system operator OGP Gaz-System. Since the end of 2011, the industry has held discussions on defining the optimal shape of the gas release program (“GRP”) and the paths leading to a free gas market.

Below are the most important, from the perspective of the electricity industry, directions of liberalization of the gas sector.

**The gas release program (GRP)**

The essence of GRP is the resale, in a selected form, of a part of the natural gas owned by the entity which dominates on the local market. In this way, independent entities will have access to the gas fuel volume which will enable them to trade on a wider scale than ever before, and at the same, ensure customers a choice from a bigger number of suppliers. This should mean that in a short time alternative gas fuel suppliers will appear in the sector. GRP will not, however, have a significant effect on the price level of natural gas in Poland, because the draft proposal of the program anticipates that the starting auction price will be based on the current supply portfolio of natural gas supplies to Poland.

**Infrastructure development**

The experience of European countries, such as the UK and Denmark, show that the gas release programs were a powerful driving force for the free market development. But from the point of view of the development of the energy sector based on natural gas, which is important for Poland, the most crucial is the opening of the Polish transmission system to supplies from new directions that will allow the sales of natural gas to new suppliers and the creation of real competition. The construction of new intersystem connections and the LNG terminal opens for the energy companies the way for independent gas fuel imports to Poland without the participation of national trading companies.

**Trading node and gas exchange**

A natural step for the development of a gas market is the creation of trade mechanisms in the national transmission system, a virtual point of the transmission system, and ultimately an exchange trading platform. Currently, the transmission system operator, i.e. the company called Operator Gazociągów Przesyłowych GAZ-SYSTEM, and the Polish Power Exchange are preparing for the implementation of trade mechanisms in Poland. Access to the trading node and gas exchange will increase the flexibility of gas purchases by market participants. The gas hub should also lead to the reference price of natural gas, which can significantly simplify the design of the pricing formulas in long-term contracts (by resigning from the indexation of petroleum-derived products in favour of the market reference price), and it will also be used for the purposes of a profitability analysis of investments linked to natural gas.

An additional benefit of the trade platform is the flexibility thanks to which the gas power plant can make gas purchases adjusted to the current needs of the entity because gas units are capable of adapting gas import to the changing demand for electricity.

**Access to storage facilities**

So far, the import of natural gas has been hindered by the rules of mandatory reserves with simultaneous lack of free storage capacity in the country. In accordance with the guidelines of the European Union, management of gas warehouse has been transferred to a company which is not trading – to the Storage System Operator. At the same time, a mechanism is implemented regarding third party access
to the warehouses, and the current draft of the Gas Law also provides for the possibility of storing compulsory reserves in other European countries. Consequently, it is to be expected that if an energy company is subject to the mandatory reserves, the above solutions will make it easier to fulfil this obligation.

**Settlement of gas in energy units**

Another convenience for both producers and energy users will be the solution planned by the Transmission System Operator, i.e. shifting from settling gas in the transmission system in gas volume units (m³) to an equivalent of the gas energy value (MWh). This will allow a direct energy and economic comparison of electricity and natural gas.

Nevertheless, it should be emphasized that none of the above-mentioned elements of the liberalization process will produce the desired effects if they are not accompanied by other parallel activities. Only a full infrastructure opening of the Polish gas system together with a provision of market mechanisms of pricing and trading will result in free market development and allow real competition. This will be possible thanks to an increasing number of suppliers and access to fuel from other directions than the traditional one (e.g. from the Czech Republic, Germany, Slovakia, or through the LNG terminal), as well as from a freely chosen liquefied gas producers in the world. These new possibilities will change the framework of the functioning of gas market participants, including the gas based energy sector.

**5.2. Investment needs in the gas sector**

In the coming years, the main driver of gas consumption in Poland will probably be electricity produced from gas. The increase in gas consumption in other sectors of the economy and by individual consumers will not be as dramatic, but it will gradually increase. First of all, because some customers will want to switch to a more environmentally friendly fuel, i.e. natural gas (compared to coal and / or liquid fuels), and secondly, as a result of gradual development of gas infrastructure in the area not connected to the gas network. It is anticipated that as a consequence of these changes natural gas consumption in Poland may increase up to 25 thousand million m³ before 2020, and by the end of the next decade, it may exceed the level of 30 thousand million m³ per year.

To ensure the supply of the gaseous fuel on the market, assuming the increase in the demand for natural gas, many infrastructure investments in the logistics chain of natural gas - from intersystem connections, natural gas storages, and transmission system to the gas distribution pipelines- must be implemented.

**Expansion of Intersystem Connections**

In the situation where substantial increase in gas consumption is forecasts, especially for electricity production, ensuring security of supply of this fuel starts to play a special role. Security of supplies depends on many factors but the most important ones are: diversification of contracts, extending the range of suppliers and diversity of the directions of gas fuel supply. Currently, the capacity characteristics at the entry points to the national system does not guarantee security of supplies in crisis situations. The total capacity of the existing intersystem connections allows the import of about 19.2 thousand million of natural gas per year, but because of historical conditions most import points for natural gas are located on the eastern border or are adjusted to receive gas imported from the eastern direction.
There are two points of entry into the national gas system, which allow to import gas from the markets in Western Europe, but their total transmission capacity is relatively small, after the extension of the connections with Germany in Lasów and with the Czech system in Cieszyn, opened at the turn of 2011, the total transmission capacity is only about 2 thousand million m$^3$ of natural gas annually. In a crisis situation, if the gas supplies from one direction were suspended, the national gas system would have very limited possibilities of supplementing the resources from the west direction (no free transmission capacities). It is worth mentioning here that in 2011 the network code was adjustment to the Yamal-Europe transit gas pipeline, as a result of which it is possible to render the so-called virtual reverse service. This service makes gas imports from Germany possible, though its physical delivery still takes place from the East. Gas import capabilities within the virtual point amount to around 2.5 thousand million m$^3$ and are limited by physical transmission capacity at entry points to the national system in Łowce Śląsk and in Włocławek and by the contracted gas supplies to these points from the East. However, the suspension of gas supplies through Belarus also means a failure of the virtual reverse solution.

Changing the above-mentioned situation requires the implementation of numerous infrastructure projects. As part of its activity, GAZ-SYSTEM analyzes the various options of infrastructure development. Currently, an LNG regasification terminal is being built in Świnoujście, which will serve as a new entry point into the national system with a capacity of 5 thousand million m$^3$ and with the possibility of being extended to 7.5 thousand million m$^3$. Launching the terminal is scheduled for mid 2014. It will be a "safety valve" allowing diversification of the supply sources as well as a potential increase of gas supplies in a crisis situation. Many other projects are at the stage of analysis, namely, the extension of the connection with Germany in Lasów from 1.5 thousand million m$^3$ to 2.5 thousand million m$^3$ per year, the extension of the intersystem connection with the Czech Republic to about 2.5 thousand million m$^3$ per year, or the construction of a new connection with Slovakia whose target transmission capacities – thanks to a connection of the Polish system with Europe’s largest gas hub (Velikie Kapusany) - may amount to, depending on the needs, from several to a dozen or more thousand million m$^3$ per year. Other projects, like the connection of the Polish and the Lithuanian transmission system or a new pipeline connection with Germany in the vicinity of Szczecin, have a smaller impact on the security of gas supplies to Poland or remain at the conceptual stage.

The development of intersystem connections is in line with the policy of the European Union, which makes efforts to construct an integrated natural gas market within the EU as well as promotes initiatives to improve the energy security of Member States. These programs include:

- construction of a north-south corridor in the area of Central Europe, which includes the connections Poland-Czech Republic and Poland-Slovakia;
- integration of the markets of the Baltic countries (building a connection between Poland and Lithuania);
- aiming to implement the N-1 principle, which says that the interruption of supplies by the largest point of entry to the gas system may not cause interferences of the system as a whole;
- obligation to ensure a reversible operation of the intersystem gas pipelines.

Another element that has a significant impact on the development of the gas energy sector is the possibility to ensure gas supplies at prices that are shaped by market forces.

### Entry points to the national transmission system

<table>
<thead>
<tr>
<th>Location</th>
<th>Transmission Capacity (m$^3$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LNG terminal</td>
<td>5 thousand million m$^3$</td>
</tr>
<tr>
<td>from June 2014</td>
<td></td>
</tr>
<tr>
<td>Włocławek</td>
<td>3.1 thousand million m$^3$</td>
</tr>
<tr>
<td>Łowce Śląsk</td>
<td>2.4 thousand million m$^3$</td>
</tr>
<tr>
<td>Wysokoje</td>
<td>5.5 thousand million m$^3$</td>
</tr>
<tr>
<td>Hrubieszów</td>
<td>0.26 thousand million m$^3$</td>
</tr>
<tr>
<td>Drozdowicze</td>
<td>5.7 thousand million m$^3$</td>
</tr>
<tr>
<td>Cieszyn</td>
<td>0.5 thousand million m$^3$</td>
</tr>
<tr>
<td>Lasów</td>
<td>1.5 thousand million m$^3$</td>
</tr>
<tr>
<td>Tietierówka</td>
<td>0.19 thousand million m$^3$</td>
</tr>
</tbody>
</table>

Source: PwC analysis based on publicly available information.
At present, the price of natural gas in Poland is shaped by a tariff approved by the President of the Energy Regulatory Office (URE), which does not reflect the price of gas on the liquid markets of Western Europe, significantly increasing the business risk of investments. It should be stressed that the measures taken to release gas prices (the introduction of a virtual point, the construction of exchange mechanisms in the area of natural gas, the gas release program) may lead to the liberalization of the domestic market and the abolition of tariffs, but they will not affect in an effective way the standardization of gas prices in the markets of Europe. Also in this area, the most effective way to standardize the operating conditions for businesses on both sides of the Oder is the construction of intersystem connections that will allow efficient transmission of gas from one market to another.

**Transmission infrastructure**

The construction of intersystem connections requires parallel investment in the development and/or modernization of the transmission network, which will enable efficient distribution of additional quantities of imported gas fuel and its supply to end users. To highlight the scale of the necessary investment, one should mention that for the LNG terminal in Świnoujście and the connection between Poland and Germany in Lasów, GAZ-SYSTEM had to build about 1000 km of new gas transmission pipelines.

If there is a dynamic development of the gas energy sector, it may turn out that there is a need to continue to develop and modernize the transmission and/or distribution infrastructure to adjust network parameters to the large offtake of gas fuel at one point in the system. It shall suffice to mention that the demand for gas fuel of a power unit of 800 MW is more than 1 thousand million m³ of gas per year, which is about 7% of the total demand of Poland.

The investment needs in the area of transmission infrastructure also result from the necessity of further gasification of the Polish territory. The low availability of the fuel gas may be proved by the level of consumption, which is less than 400 m³ per person (according to statistics for 2010). For comparison, the level of gas consumption per capita in the Czech Republic in the same year was nearly 900 m³, in Slovakia it reached more than 1 thousand m³, and the statistical Dutchman consumed over seven times more blue fuel than a Pole.

In addition, the national transmission system requires significant outlays for modernization resulting, to a large extent, from the large depreciation of network assets.

According to the data of the President of the Energy Regulatory Office (Urząd Regulacji Energetyki - URE), nearly 60% of the transmission network in the country is more than 25 years old and requires major investment in its maintenance and restoration, and the currently built pipelines are not able to reproduce the aging transmission network.

**Natural gas storage facilities**

Gas storage facilities are another link in the security chain of gas supplies to end customers, which is particularly important for producers of electricity based on gas fuel. The security is ensured by, among other things, storage capacities needed to collect and maintain compulsory reserves, corresponding to a 30-day average level of gas supplies from abroad, to which importers selling natural gas in the country are obliged.

The problem in the domestic market is the too small gas storage capacity, much lower than in many European countries. For the methane-rich gas in Poland it is about 1.66 thousand million m³, compared to over 20 thousand million m³ of storage capacity in the German market. Despite lower gas consumption in the Czech Republic and Slovakia, also in these markets the total gas storage capacity significantly exceeds the capacity available in Poland and amounts to 3.3 thousand million m³ for the Czech Republic and more than 2.8 thousand million m³ for Slovakia.

<table>
<thead>
<tr>
<th>Country</th>
<th>Storage Capacity (m³)</th>
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<tbody>
<tr>
<td>Austria</td>
<td>226</td>
</tr>
<tr>
<td>Hungary</td>
<td>238</td>
</tr>
<tr>
<td>Slovakia</td>
<td>114</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>104</td>
</tr>
<tr>
<td>Germany</td>
<td>99</td>
</tr>
<tr>
<td>France</td>
<td>86</td>
</tr>
<tr>
<td>Italy</td>
<td>82</td>
</tr>
<tr>
<td>POLAND (2020)</td>
<td>61</td>
</tr>
<tr>
<td>POLAND (2011)</td>
<td>48</td>
</tr>
</tbody>
</table>

**The ratio of storage capacity to an average daily level of natural gas import**

Source: PwC analysis based on publicly available information.
Therefore, plans anticipate constructing approximately 1.5 thousand million m$^3$ of gas storage capacity in Poland before 2020. If, however, it will not significantly improve the balance of storage capacity, taken into account the planned increase in gas consumption.

Taking into account the capacities required for the storage of mandatory reserves, as well as the capacity for increased natural gas consumption in the winter months, and for the purpose of balancing the system, it will become apparent that the storages no longer have available capacity that could be used for other needs, particularly important in the case of large customers competing with entities which have access to gas measured based on the market and having a non-linear profile of fuel consumption. Such additional needs also include the storage of gas in order to optimize the cost of its purchase or to provide flexibility of supplies, which is particularly important in the case of gas energy sector.

To satisfy all those needs, in the first place, the gas storehouses in Poland must be extended, especially, those facilities which are characterized by a high flexibility of storage installations (big capacities of pressing fuel into installations and off-taking from the installation), which enables effective balancing of the daily demand. The construction of storage facilities requires big financial means.

**The potential in the area of gas extraction from unconventional deposits**

Increased interest in gas from unconventional deposits has been noticeable in Poland since 2009, when first estimates of the size of gas reserves from unconventional deposits were published. The estimates made before 2012 were highly diverse and ranged from 1.37 billion m$^3$ (Translator’s note: the term ‘billion’ is used here in the British meaning, i.e. 1,000,000,000,000) (Wood Mackenzie, August 2009) to 5.29 billion m$^3$ (EIA, April 2011).

The first accurate data on the Polish unconventional gas resources, containing more detailed geological information, were published in March this year by the Polish Geological Institute. According to the PGI report, the natural gas resources from shale formations for the Polish part of the Baltic-Podlasie-Lublin basin most likely range between 346 and 768 thousand million m$^3$. It should be noted that these figures still represent only an estimate of the domestic deposits.

At this stage of analysis it is not possible or feasible to estimate either the size of the gas reserves from unconventional deposits or the economic cost-effectiveness of their extraction. Reliable results will be possible only after several hundred exploratory bore-holes located in various parts of the country are made and after analyzing the results of these surveys. So far, over a dozen holes have been made. Moreover, according to the announcements of companies holding concessions, several new holes will be drilled and their richness analysed in 2012. The ability to extract gas from unconventional deposits may be confirmed within the next few years, but if profitability of gas production is proved, it may be started at a level essential on the national scale within 5-10 years.

Owing to the limited amount of information, all existent approximations for the extraction of gas from unconventional deposits in Poland should be regarded as purely illustrative estimates.

**Obstacles to the development of infrastructure**

Thanks to the compliance of the initiatives for development of gas infrastructure with the European Union policy, the companies implementing individual investment projects can count on obtaining partial EU funding. This, however, does not change the fact that the implementation of investment projects in the gas infrastructure only will require dozens of thousands of millions of Polish zlotys over the next several years.

An additional difficulty in infrastructural investments is the long period of their implementation. Investment activities taken with a view to satisfy future needs of the market entail a risk of inaccurate estimate of the demand for gas fuel. The risk is typical of this type of activity, but one should seek to minimize it (e.g. by providing a stable regulatory environment as well as by adjusting the law so as to shorten the investment process).

Investment in the gas sector infrastructure is necessary to ensure the required supply of fuel in the long run and to improve the competitiveness of the gas market. In addition, the development of the electricity industry based on gas fuel will also be a big challenge because of the necessity of expanding and modernizing the gas infrastructure.
6. External financing of investment
6.1. Balance sheet financing

Balance sheet (corporate) financing is mostly an investment credit (though other forms of credit are often used, too). It is granted on the basis of the results generated by the current company’s business activity, including the impact of the planned investment on this activity, and assuming that the investment will not fundamentally affect the existing performance of the company. The borrower presents a project in its balance sheet and is liable to the lender with all its assets. This credit is usually repaid according to an agreed schedule, where the loan term depends on the projected cash flows of the company. It is usually shorter than the formula of “project finance” (referred to more broadly in point b) and rarely exceeds 5-7 years. The cost of funding depends on the funding period, as well as the financial condition of the borrower and the collateral. This form of financing is perceived by banks as less risky than „project finance” and is, therefore, cheaper and easier to arrange. Moreover, it also allows greater flexibility in the use of the means and hampers the company’s activity by restrictions imposed by the bank to a relatively small extent.

In the event of long-term financing, banks use a variety of contractual clauses which make it possible for them to control the credit risk and limit the freedom of the borrowers, e.g. imposing on them limited possibilities of incurring new credit liabilities, providing guarantees or charging the property of the company. Among the elements of the lending structure may be provisions defining an acceptable level of financial ratios of the company. The most commonly used one is the ratio of net debt / EBITDA, where net debt means credit liabilities and other interest-bearing liabilities of the company less cash held, while the EBITDA (Earnings Before Interest, Taxes, Depreciation, and Amortization) is the operating income plus depreciation which allows to determine a company’s ability to generate cash. The limits of financial ratios are determined on the basis of financial projections, but the limit for the net debt / EBITDA ratio usually does not exceed 3.0, which means that during the lending period the value of the company’s interest-bearing debt less cash held should not be higher than three times the company’s operating profit plus depreciation.

Given the relative ease of obtaining funding, the lowest cost and the relatively low current level of indebtedness of entities in the gas and electric power sector, those entities usually prefer balance sheet financing. However, taking into account the size of the planned investment in the electric power industry and keeping in mind that all the indicated projects are characterized by high capital intensity, we can expect that in the next few years, the capacity limit of further increase of funding in this formula will be reached. Limits of concentration of exposure (discussed in more detail in point c) imposed on banks by regulations should be considered here, as well concentration limits in different sectors, determined individually in particular banks, which, in the future, will make it difficult for the biggest entities from the two sectors to obtain financing from Polish banks. The biggest entities are aware of this, and parallel to a bank credit, they use alternative forms of financing, such as bonds issuing. An issue of euro bonds in the amount of EUR 500 million by PGNiG in February 2012 is a good example.

Another possible variant of balance sheet financing is bridge financing, used during investment implementation. This credit is treated as interim financing until long-term financing is arranged, which depends, for example, on the completion of investment. The investment implementation involves additional risks, so the banks would like to have a broader recourse (vindication of claims) to an entity with a stable market position and able to repay the incurred liabilities. After completion of the investment and elimination of the risks associated with the start of operations, the form of funding can be changed, for example by refinancing the credit.

6.2 Funding in the “project finance” formula

Investments which require high capital compared to the existing scale of operations require project finance. This funding formula is also chosen to minimize the risk of the project sponsor (the originator, the owner) or in the case of a larger number of investors. This enables easier sharing of responsibilities and accountability of individual entities, and – owing to transparency – creates an opportunity to better manage the financial risk of the project. Project finance is based on the assumption that it will be fully repaid with funds generated by the project, without recourse or with a limited recourse to the investors. So far in the Polish gas and electric power sectors, the formula of “project finance” has been rarely used and only in the case of financing wind farms. Meanwhile, it can be useful also...
for financing the construction of gas storage facilities, any generation unit or separated part of a gas pipeline infrastructure, if they are separate business undertakings. With the increase of indebtedness of entities in the electricity and gas sectors, this formula will be applied more often. The choice of financing of an activity is often a consequence of the adopted financial strategy, encompassing all activities of an entity. Such a document is often prepared in cooperation with a professional financial adviser.

In the case of project finance, both the investor and the banks cooperate with specialized companies that carry out an analysis of the project (due diligence). This analysis includes, among other things, environmental audit, market audit (if such project is susceptible to market risk), financial model audit, insurance audit, and legal audit. It is also important that the project be implemented on the basis of a tested and reliable technology. Where projects are technically complex, and such are the projects we usually do in the discussed sectors, funding agencies must also perform a technical analysis of the project.

In structuring the transactions organized in the “project finance” formula, the risks occurring during the construction phase and in the operational phase of the project are divided among the investor, the general contractor and the funding institutions. When analyzing a project to be financed on the “project finance” basis, banks assess the risks taking into account many factors, including, but not limited to:

- the structure of contracts for energy and heat reception, the adequacy of the period for which they are concluded in relation to the funding period, the reliability of energy consumers, and the amount of market risk which is part of the project;
- terms and conditions of contracts for the supply of fuel;
- basic provisions of the contract with the main contractor, including the level of performance guarantees and contractual penalties, and the credibility of the principal contractor, its financial standing and experience in implementing similar projects;
- technology for power generation units and experience in its use in similar projects in the world;
- environmental aspects of the investment, its impact on the environment and local community;
- regulatory aspects;
- project investor’s experience in similar investments;
- location of the project and access to transmission infrastructure for electricity, heat and gas.

Funding in the “project finance” formula may be obtained without a recourse or with a limited recourse to the investor, also as a commitment to cover unexpected costs of construction, contract for the supply of fuel and/or reception of energy. There are also other forms of support from the investor, especially during construction. Depending on the sensitivity and risk analyses of a project, the required level of equity is determined, which usually varies between 20% and 40% of the total investment cost.

The property of the special purpose vehicle (SPV) carrying out an investment, pledges on its shares, and assignments of major contracts constitute a collateral for “project finance” transactions. Financial institutions also conclude direct contracts with key parties to a project, allowing succession to the rights of the SPE and the continuation of the project in the event of violation of the provisions of a contract.

Financial records for projects in the case of “project finance” are more restrictive and more extensive compared to those for corporate finance. In addition, in project funding – as opposed to corporate loans where the financial indicators are based on the balance sheet and income statement of the company – indicators determining the cash flows generated by the project are used, such as projected and historical, minimum and average debt service coverage ratios (ratio of operating cash flows to the sum of principal and interest repayments of the loans taken). Preparation of the financial model of the planned investment is a key stage in the “project finance” funding. Today, the difficulties in building such models for the discussed projects result, among other things, from:

- uncertainty about the costs associated with CO₂ emissions;
- no decision on the introduction of mandatory solutions to reduce the emissions of coal installations (e.g. the currently very expensive CCS - carbon capture and storage-technology, which would improve the profitability of gas projects vs. coal projects);
- changing legal regulations in the energy and gas industry, with particular emphasis on changes in the support system;
- uncertainty about the actions of the Regulator (URE), resulting in increased unpredictability of gas prices;
• difficulty in determining the future price of natural gas, with particular emphasis on the relationship of gas prices to the competitive bituminous coal and lignite, and also the future price of electricity;

• risks associated with the necessity to sign long-term gas supply contracts with short-term contracts for the sale of electricity existing on the market.

Periods of credit for project finance are usually from 8 to 15 years, and the repayment of financing is generally matched to the flows generated by the project.

Polish banks are prepared to finance projects in the “project finance” structure. There are also competent consulting firms in the market. This formula is indeed often used in such sectors as real estate or in infrastructure projects.

In practice the two described forms of financing are often combined, which results in the formation of various intermediate forms depending on the situation and needs of a particular borrower. It also depends on the scale of the carried out investment in relation to the current activities. In the case of energy industry projects, new generating capacities often replace the existing infrastructure and, consequently, the financial flows generated by the earlier activity gradually expire. In such a situation it is difficult to rely on the previous financial condition of an entity. Adding elements typical for “project finance” to the financing structure might be an alternative solution.

A model structure of a project implemented in the formula of “project finance” in the energy sector

In the diagram, the flowchart illustrates the relationships between the main parties involved in project finance. The investment (Investor) is connected to General contractor, Operator, Financial institutions (Commercial banks, Multilateral institutions, ECA), Energy customer, Fuel supplier, and Network operator. Each party is involved in specific agreements and contracts, such as EPC Contract, O&M Agreement, Direct agreement, and agreements related to energy off-take, fuel supply, credit, connection, and fuel supply. The flowchart emphasizes the complex nature of project finance and the interdependencies between the different parties involved in the project.
6.3. Limitations in the availability of bank financing

The most important legal provision for limiting loan concentration is in Article 71 of the "Banking Law". According to Paragraph 1 of the Article, the sum of a bank's debts to one entity or related entities, organizationally bearing joint economic risk, may not exceed 25% of the bank's own funds. This refers to the sum of granted credits, cash loans, bonds and securities of the entity, other than shares and guarantees, purchased by the bank, i.e. the sum of transactions that may cause losses to the bank. Detailed guidelines in this regard have been prepared by Komisja Nadzoru Finansowego (the Financial Supervision Commission), which also supervises the banking sector.

The rules of capital adequacy under the New Basel Capital Accord, also known as Basel II, sanctioned by law in all EU countries by two directives: the Directive of the European Parliament and of the Council No. 48/2006 and the Directive of the European Parliament and of the Council No 49/2006 constitute another limitation for the entire banking sector. The purpose of the regulation is to increase the security of business activity, and one of the control elements is the solvency ratio, calculated as the ratio of net own funds (less certain items) to risk-adjusted assets (those ingredients that are associated with a certain risk, determined in percentage by banking supervisory authorities, and arising from the possible loss of funds involved, such as loans). Under the Banking Law, the level of this ratio may not be less than 8%. In the case of the Polish banking sector, the solvency ratio at the end of 2011 amounted to 13.13%, which is significantly higher than the specified minimum level, indicating a strong financial condition of Polish banks and their resilience to global economic turbulences. The situation could change if a significant economic downturn and an increase in the level of problem loans occurred in Poland.

Currently, the legislative procedure for new prudence regulations for credit institutions (Basel III) is in progress. The new directive of the European Parliament and of the Council aims to improve the safety of the financial sector in the European Union. Improvement of capital and liquidity indicators is a key element of the new regulation. The new requirements will be introduced gradually until January 2019. It is estimated that in order to fulfil the requirements of Basel III, controlled entities in the EU will be forced to increase their own funds by EUR 460 thousand million. The introduction of capital buffers will increase borrowing costs and may have a negative impact on credit availability and, consequently, on economic growth. According to a study on the impact of Basel III on the Polish banking sector, conducted by PwC by order of the Polish Bank Association, new indicators of liquidity, in particular long-term liquidity, will be the biggest challenge for banks in Poland. The analysis covered the banks which manage 60% of the assets of the banking sector. Among this group, 17 banks do not meet the minimum threshold for the stable funding ratio (Net Stable Funding Ratio). It is estimated that the shortage of stable financing in those banks amounts to PLN 41.2 thousand million. In accordance with the guidelines, the banks have time to adjust to the requirements till the end of 2017. This will involve the need to obtain long-term financing, e.g. in the form of bonds. Access to external sources of long-term financing and the cost of such financing will be translated into the availability of credits and their costs.

Banks also control the risks arising from exposures to entities in the same industry, the same economic sector, conducting the same activity or trading in similar goods. Adherence to these principles requires an analysis of each borrower according to different criteria, and assigning them to different exposure groups. Concentration risk is limited through diversification, which can be measured and calculated with a certain probability of its impact on the potential volume of financial losses in the loan portfolio.

6.4. Debt securities market

Ordinary bonds issued under the Bonds Act of 29 June 1995, are debt instruments most frequently used by Polish companies. The choice of this instrument by corporate entities is determined by its strong legitimacy in legal regulations. A bond issuer (the party incurring liability) states that it is indebted to the bondholder (the party holding bonds) and undertakes to fulfil a specific monetary or non-monetary performance for it. The principles of issuing, disposal, acquisition and implementation of performances, regulating the duties of the issuer and the rights of investors, are set out in the terms and conditions of the bond issue.

Debt instruments can be used to finance both current expenses and capital expenditures of the issuer. Maturities of the bonds are adjusted to the current needs.
of the issuer, and the longest (of the currently traded) ones are more than 10 years. Most often, however, the maturities are of 3 to 5 years.

Corporate bonds offered on the Polish market are mostly unsecured. As opposed to bank financing, the catalogue of contractual clauses of credit character is also very limited. This gives the issuer more flexibility in the conducting of current business and investment activity.

In the case of bonds offered to market investors, the sale of debt instruments is conducted on the principle of due diligence by the offering party. Therefore, the success of an issue depends directly on the demand, which, in turn, depends on the market position of the issuer, its economic and financial situation and the offered bond yield. Among the factors that affect the cost of raising funds on the capital market, assessment of the issuer’s credit risk, maturity date, and the current market conditions (including supply, return on the State Treasury securities, and other corporate securities) must be mentioned.

Issuance of bonds is an attractive source of capital, primarily for those with a strong and stable market position, high credit worthiness, and good prospects for growth. Full benefits of this method of financing are obtained at the appropriate scale of the issue. In order to ensure the success of an issue, a bank may commit itself to take up part or all of the issues on the terms previously agreed with the issuer (under the so-called underwriting).

Additional benefits of bond issue are the following:

- broadened and diversified group of creditors (obtaining financing from outside of the banking sector),
- access to the capital market - prestige for the issuer resulting from presence on this market,
- limited information requirements, particularly in the case of non-public issues,
- exemption of the services in the range of bond issue from the rigors of the Public Procurement Act.

The structure of corporate debt shows that only about 15% of companies’ debt comes from the issuance of debt securities. Bank loans are still the main sources of financing economic entities. As of the end of February 2012, the total value of the Polish market of non-treasury debt instruments (which includes issues of enterprises, local government units and banks) amounted to PLN 103 thousand million, out of which 26.6% (i.e. PLN 27.3 thousand million) was attributed to corporate bonds with maturity of over one year.

Polish issuers finance themselves mainly by issuing bonds on the local market. Currently, only a few entities decide to issue bonds on the Eurobond market, mainly owing to the expected scale of such issue. In order to achieve a positive economic effect, issue’s value on the Eurobond market should be worth at least EUR 200 million (most often EUR 500 million), and the issue should have investment rating given by at least one of the top three agencies (i.e. Moody’s, S&P or Fitch). In the case of a worse rating, the financing cost is significantly higher. However, longer maturities possible to obtain on the Eurobond market, up to 10 years for issuers from the energy and gas sectors, weigh in favour of the Eurobonds. Additionally, currency risk arising from a mismatch of the currency of liabilities and the currency of the issuer’s revenues should also be taken into account. This risk, however, can be eliminated by appropriate market instruments.

For several years now, companies of the Polish energy and gas sectors have been using bond issues to externally finance their needs and reallocate resources within corporate groups. Currently, the group of bond issuers include the PGE Group, the Tauron Group, the Energa Group, and the PGNiG Group. Each group has bond issue programs worth many thousands of millions. It is worth repeating here that the issue of five-year Eurobonds by PGNiG for the amount of EUR 500 million was closed successfully in February of this year. Bond programs may complement the financing provided by banks. If, for reasons mentioned in section c, the credit debt of very large entities goes up, banks may find it difficult to further increase their participation in the financing. In this situation, a diversification of funding sources might be a solution.

### 6.5. Other external sources of funding

Commercial banks and bondholders may be sources of financing of large infrastructure projects, but only to a certain extent, because they are limited both legally and internally in terms of the risk of a single project.

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4 Including the infrastructure bonds of the National Road Fund (Krajowy Fundusz Drogowy).
In such a situation, companies may also obtain funding from international financial institutions, such as the European Investment Bank (EIB), the European Bank for Reconstruction and Development (EBRD) or the Nordic Investment Bank (NIB).

The financial support offered by the EBRD, the EIB, and the NIB - in addition to lower cost - is usually granted for a period longer than that offered by commercial banks. Thus, participation of these institutions in the financing extends the average period of investment financing, without significant raising of costs associated with such an extension. Moreover, these institutions may accept a higher credit risk than commercial banks do, but their involvement is limited to the financing of projects in accordance with their own policies.

- The EIB operates mainly in the European Union. In addition, to a limited extent, it is involved in projects located in other regions of the world. According to the information posted on the Internet, in 2011 the EIB signed financing agreements for a total value of EUR 61 thousand million, including EUR 10.6 thousand million in the energy sector, which accounts for 17.3% of all credits. Currently, the EIB has 241 approved projects (including 43 in the energy industry, of which three are in Poland) whose funding is planned in the coming years. Other 260 projects (including 43 in the energy industry, of which two are located in Poland) are currently being evaluated. These include: the construction of a distribution network in north-western Poland in 2012-2015 carried out by a subsidiary of ENEA SA (the investment is worth PLN 3.2 thousand million, where the planned financing from the EIB will amount to about PLN 950 million) and the modernization and expansion of the power grid in southern Poland by Tauron Polska Energia SA (the value of the investment is PLN 1.8 thousand million, with PLN 900 million coming from the EIB).

- In December 2011, the EIB signed an agreement with Polskie LNG SA to finance the construction of a gas terminal in the amount of EUR 150 million, and in February 2012, the EIB approved a proposal to finance the construction of a power plant in Stalowa Wola in the amount of EUR 162 million.

- The EBRD operates in 29 countries of Central and Eastern Europe, the Balkans, and Asia. The energy sector is one of the EBRD’s priorities in the region of Central and Eastern Europe. The bank puts special emphasis on financing projects which have a positive impact on the environment and on energy efficiency, such as renewable energy, distribution of gas and electricity, improving efficiency in energy production, and construction of cross-border connections. Until now, the EBRD has supported projects in Poland with the total amount equal EUR 5.5 thousand million, while the value of investment (credits granted and equity investments) in 2011 was EUR 900 million, which is the highest level in the history of the EBRD. In 2012, the EBRD is planning investments in Poland at the level of EUR 500-600 million. One of the projects that seeks to be financed by the EBRD is a gas terminal built by Polskie LNG S.A.

- The NIB invests in the European Union countries and on the emerging markets. In 2011, it signed 47 credit agreements totalling EUR 2.6 thousand million. As much as 90% of these funds was allocated to support competitiveness and environmental protection. In 2010, the NIB granted Energa SA a credit for the amount of PLN 200 million for the period of 12 years to finance the modernization and expansion of the distribution network.

Another source of funding are export credit agencies, which promote exports of their countries by providing insurance and loans to foreign purchasers of products manufactured in those countries. One such institution is Korporacja Ubezpieczeń Kredytów Eksportowych S.A. (Export Credit Insurance Corporation, Joint-Stock Company) which offers export insurance. And vice versa - a Polish company can gain support and receive credit from this type of an agency, if it imports equipment from a country outside the European Union (the existence of the EU common market eliminates the issue of export among its Member States) where an export credit agency operates (such as South Korea with Korea Eximbank). Export credit agencies are usually willing to accept higher risks than commercial banks, thereby increasing the overall volume of debt financing available to businesses.

The EU aid funds are considered the best source of funding (in terms of cost). Such means may be used for investment in renewable sources, as well as investments to improve production efficiency, and the efficiency of transmission and distribution of energy and energy carriers. It should be noted, however, that the pool of EU funds available to energy companies, as planned for the years 2007-2013, is nearly exhausted. In addition, the aid does not usually cover 100% of the investment costs. Beneficiaries must cover part of the cost from other sources, such as credits.
6.6. Conclusions

Depending on the financial situation and the needs of the investor, various options of external funding can be used. Each of the previously mentioned forms of financing has its pros and cons. Balance-sheet financing is the most flexible one, but it has a relatively short period. In the case of project finance the funding period may be longer. However, limitations on the side of the borrower are much more restrictive. In practice, indirect solutions are usually used. In the case of bonds, the conditions of financing depend on the interest of potential investors and on the current market situation, but mostly the funding structure is less restrictive than a bank loan. Loans granted by the EBRD, the EIB and the NIB are attractive in terms of price and in terms of the loan term; nonetheless, funding is only possible if the project falls within the area of interest of the creditor. In the case of the largest companies in the energy and gas sector, one can observe a tendency to combine different forms in order to diversify the funding sources. Currently, these entities are not excessively indebted, and the risk of their activities is seen as small, and therefore, financial institutions are interested in a continuation of the financing.
Current market trends indicate that in the coming decades, gas may play a significant role as fuel for the domestic power industry. The investors’ plans show a clear desire to diversify the production portfolio, which translates into an increase in interest in investments in new power plants and cogeneration plants that use gas. Both energy groups (PGE, Tauron, Energa) and players from outside the power sector (PKN Orlen, PGNiG, KGHM) show growing interest in the construction of gas-fired power generation units.

However, the use of gas as a fuel for power generation will be strongly influenced by the future price of gas and, to an equal extent, by the price of CO₂ allowances. The level of competitiveness of natural gas units in relation to coal-based sources (in particular to the modern units currently being built) will be determined by the relation of the unit cost of gas to the cost of coal and the purchase price of CO₂ allowances. Nevertheless, the future of the gas-based power industry in Poland is conditioned by the availability of fuel, and in particular, by the achievement of such diversification of supply, as will provide adequate national security while meeting acceptable economic parameters.

Today, the considerable uncertainty regarding the price of CO₂ allowances in the third phase of EU ETS, together with the uncertainty of gas prices, makes investments in the gas-based power plants seem to be a high-risk undertaking. Therefore, if possible, it is worth waiting before taking a final decision on the construction of such a source until the situation on the market of CO₂ emission and on the gas market in Poland is clear enough.

Today, in contrast to gas-fired power plants, gas-fired combined heat and power plants seem to be a safe investment thanks to their higher efficiency and the necessity to support the development of cogeneration by the EU countries.

Moreover, the indicated risks have a significant impact on the approach of banks to financing this type of projects. Lack of clarity regarding the price of CO₂ allowances, gas prices or the rules for CHP support after 2012 makes project finance impossible without the support of powerful sponsors of the project. This is the reason why most entities interested in investing in the energy sector use balance sheet financing. Diversification of the sources of financing will be justified given the huge scale of the investment planned in the energy and gas sectors as well as the uncertainty connected to the fear of the consequences that the introduction of the principles of Basel III will have on long-term financing.