FORUM FOR
ENERGY ANALYSIS

ELECTRICITY AND INDUSTRIAL COMPETITIVENESS

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Forum for Energy Analysis

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based on a study prepared by
Warsaw Institute for Economics Studies
for the Forum for Energy Analysis

The Forum was established to support a public debate which aims to develop low-emission mechanisms for the Polish power sector. The FAE works in the context of decisions reached at the European level about the long term strategy of the power sector to 2030 and beyond. The project aims to develop a comprehensive and cohesive vision for an economically viable transformation of the electricity sector.

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1. EXECUTIVE SUMMARY

- A fast economic growth of Poland is inextricably coupled with the process of building an advanced industry. In the past decade, a process of a quiet albeit very intensive industrialisation took place in Poland. This is a result of the economic transformation, which began already in the 1990s, and of a strong development impulse which the EU accession gave to the country. Despite an increase in the electricity prices in excess of 80% in 2003-2013, the value added of the manufacturing industry went up by 115% and productivity by 97%. Thus, the statement that higher energy prices make the Polish manufacturing less competitive cannot be corroborated by the historical data.
- We may expect that further growth in the volume and complexity of manufactured goods, which is essential to attain the Western European level of development, will have a significant impact on electricity consumption. As a result, the demand for energy from the Polish industry will be growing in the coming decades despite the improved energy efficiency.
- The reason for a limited impact of the electricity cost on competitiveness of the manufacturing at large is the fact that the cost of electricity is of marginal significance in the balance sheets of most of the enterprises. The average share of energy in the expenses structure of the industrial enterprises in Poland is 2.2%. For only 10% of the industrial plants does that share exceed 5%.
- From the viewpoint of many enterprises, quality and stability of electricity supply is essential. That holds true especially for the machinery and metalworking as well as transport equipment, which have been primary growth drivers of the industrial activity in Poland over the past decade.
- For about 10% of the Polish industry, the cost of energy has a great impact on competitiveness. These are mainly large consumers who take advantage of relatively low prices which result from lower transmission costs and a bigger bargaining clout that they wield compared with smaller consumers. In Poland, there has been a significant yet unused room for improvement of their cost competitiveness. Even though the average price of electricity for industrial use is still among the lowest in Europe, the most sensitive high energy-intensive sectors are paying the price of flat tax rates and other levies (excise tax, "coloured" certificates) which are not diversified for various categories of consumers.
- The impact of ETS on the electricity cost is not a significant factor for the competitiveness of most of the industrial sectors. It is, however, quite important for some production processes. These processes have been quite well identified by the European Commission and put on the so-called carbon leakage list. The European law does allow for the protection of electricity-intensive enterprises against increasing electricity prices but such measures require a decision to be taken at the domestic level, i.e. by the Polish government.

2. BACKGROUND OF THE STUDY

The Polish public debate is dominated by the opinion that a low electricity price is the linchpin of the economic growth and the fundamental factor in determining the increase in competitive capabilities of the industry. As the Forum for Energy Analysis, we decided to verify that statement by taking a wider look at the whole issue. We set out to check what factors determine the competitiveness of the Polish industry and which of its sectors are the most prospective from the point of view of the entire Polish economy.

In the context of the decision by the European Council of October 2014 and emission reduction goals of 40% by 2030, a discussion is necessary about which industrial model should be pursued in Poland as the economy takes the low-emission course and how to sensibly share the cost of energy transformation among the market players.

The Great Recession and prolonged economic stagnation in Western Europe have made search for new growth stimulants the focus of the EU political agenda. In the public debates in Brussels, as well as in Warsaw, the role of industry in the economy is very often emphasised.

The advocates of re-industrialisation of the European economy point out that industry is the key to increasing productivity; it creates stable, well-paid jobs, and remains the cornerstone of export capabilities.

The turbulent changes which have occurred on the global raw material markets and in particular the shale gas revolution in the USA, have transformed Europe, which essentially has no significant natural gas and oil resources, into a continent of a relatively expensive primary energy. The US shale revolution has the predominant effect on shale gas as the energy carrier in the US gas-fired power plants and the raw material for the American chemical industry. Industrial companies in the other parts of the globe such as Japan, China, and Europe which do not have a similar cost advantage must now include the relatively higher cost of natural gas in their investment project calculations. Indirectly, that affects the electricity market, too, although to a lesser extent. Thanks to the lower generation costs in the gas-fired power plants, the electricity price on the US market has become significantly different than that in Europe or Asia. An exception are the Nordic countries which have put in place an exceptionally favourable technology mix in their electricity sector which makes the electricity price resistant to the perturbations in the raw materials markets.

Over the past years, the electricity cost in Europe has been going up also owing to the regulations which impose lower emissions on the energy sector and the development of renewable energy sources. Many point out that the EU climate policy goals and its course towards re-industrialisation are incompatible. Simultaneously though, the German example shows that there is no definitive connection between the electricity price and the overall condition of the industry. Despite the expensive policy of support for renewable energy sources and high taxes on electricity, the German industry has managed to remain the driving engine of the European economy also because the cost competitiveness of the largest electricity consumers in Germany has been adequately protected.

This document presents the key conclusions from a study that shows the relationship between electricity and the industrial competitiveness in Poland.

3. SCOPE

The Forum for Energy Analysis has commissioned WISE to conduct a study that encompasses the following research questions:

- What is it that determines the competitiveness of the industry and well-being of the economy?
- What is the relationship between industrialisation and electricity consumption?
- Is the electricity price essential for the industrial competitiveness?
- What determines the electricity prices in Europe? To what extent is ETS relevant to competitiveness?

The study was commissioned in August and conducted in September-October of 2014.

4. METHODOLOGY

This Policy Paper has been drawn up in accordance with the following methodology:

1. WISE has been commissioned to prepare the study, as a think-tank experienced in conducting cross-sectional research into the relationship between the power sector and economic growth at large, both from the short- and long-term perspectives.
2. WISE has conducted the study using a variety of sources which inter alia include reports on industry competitiveness, publicly available statistics of the industry and energy sector, and a detailed database of the industry cost structure.
3. The results of the study were presented and discussed by the Expert Panel in November 2014. More than 25 experts in the field of the energy sector participated in the Panel.

The Expert Panel

A distinctive feature of the papers commissioned by the Forum for Energy Analysis is that before they are published they are confronted with the opinion of experts in the field of energy. That enhances the transparency of analyses and of the recommendations development process. On the Expert Panel sit representatives of the public administration, energy sector enterprises, academia, as well as sectoral and non-governmental organisations.

This Paper includes the opinions of the experts as expressed during the Panel, without any prior authorisation.

4.1. DATA SOURCES

Many diverse data sources were used for the purpose of this study. They included:

1. Open-access databases of statistical offices and other international institutions: GUS, Eurostat, United Nations.
2. The database of the Polish industrial enterprises by GUS as drawn up based on the F-02 report forms. It shows inter alia the expense structure (including energy expenses) broken down by type of industrial activity.
3. The study determining the impact of the EU ETS system on enterprise expenses by sector which has been drawn up for the European Commission in order to identify the sectors which are prone to the risk of carbon leakage (Results of carbon leakage assessments for 2015-19 list (based on NACE Rev.2) as presented to the Climate Change Committee on 5 May 2014).
4. The analysis of energy prices for industrial use commissioned by the European Commission and drawn up by CEPS and presented in the 'Energy prices and costs report' (SWD 2014 20/2).
5. Industry competitiveness rankings (e.g. BCG Global Manufacturing Cost-Competitiveness Index, Deloitte Global Manufacturing Competitiveness Index).
6. Indexes which describe the quality of electricity supply published by CEER.

4.2. ASSUMPTIONS OF ETS IMPACT ON THE ELECTRICITY PRICE

For the purpose of the study, we use the latest ETS cost impact assessment estimates for industrial companies as ordered by the European Commission. These estimates are available in a table which presents the direct and indirect ETS cost as a percentage of value added generated by enterprises from various business activity classes of the entire European Union. The indirect impact index (increase in the electricity price generated in ETS covered power plants) for Poland was calculated based on the differences between the emission performance of electricity generation in Poland and the whole European Union. For Poland, emission performance of electricity generation of 880 kg of CO2/MWh has been assumed pursuant to the Guidelines for certain state aids in the context of ETS after 2012 (C (2012) 3230).

In order to calculate the impact of the increase in electricity prices generated by the ETS on the profitability of the enterprises, in addition to the indirect ETS impact indicator mentioned above, the data were used on the profit-to-value-added ratio for various business activity classes in Poland derived from the Eurostat database.

5. KEY RESULTS

Growth and restructuring of the Polish industry in the 21st century.

Fig. 1 Value added (left panel) and productivity (right panel) in the manufacturing in Poland, Germany, EU, and the new member states (NMS) in 2003-2013

Source: WISE based on Eurostat data

The EU enlargement of 2004 was a breakthrough in terms of industrial output in Poland which has begun to grow after several years of stagnation at the pace of 7% p.a. The same period saw a stagnation in the Western European industry where a deep recession reeled back the growth from the previous period of economic upturn. That period was also a time of restructuring and alignment with the EU market requirements. The greatest boost, both in terms of rate and absolute figures, took place in the machinery industry which saw a yearly average output volume increase of 16% which was driven by the exports to the EU. Owing to the export-oriented industrialisation, the sectors which gained most were the metalworking (yearly average of 13%) and transport equipment (yearly average of 9%) which are basically low-energy sectors. Among the sectors with a high electricity demand, the mineral industry boasted the highest growth rate (10% yearly average). Yet, its contribution to the increase in the industrial output in 2003-2013 was small due to relatively modest contribution to the generation of value added. The outcome of these processes was that even though the electricity-intensive sectors continue to dominate electricity consumption for production purposes, their economic relevance has been declining in favour of those with a low electricity demand. In the mining sector, there has even been a consistent decline in the value added (by approx. 4,5% p.a. in the period in question).

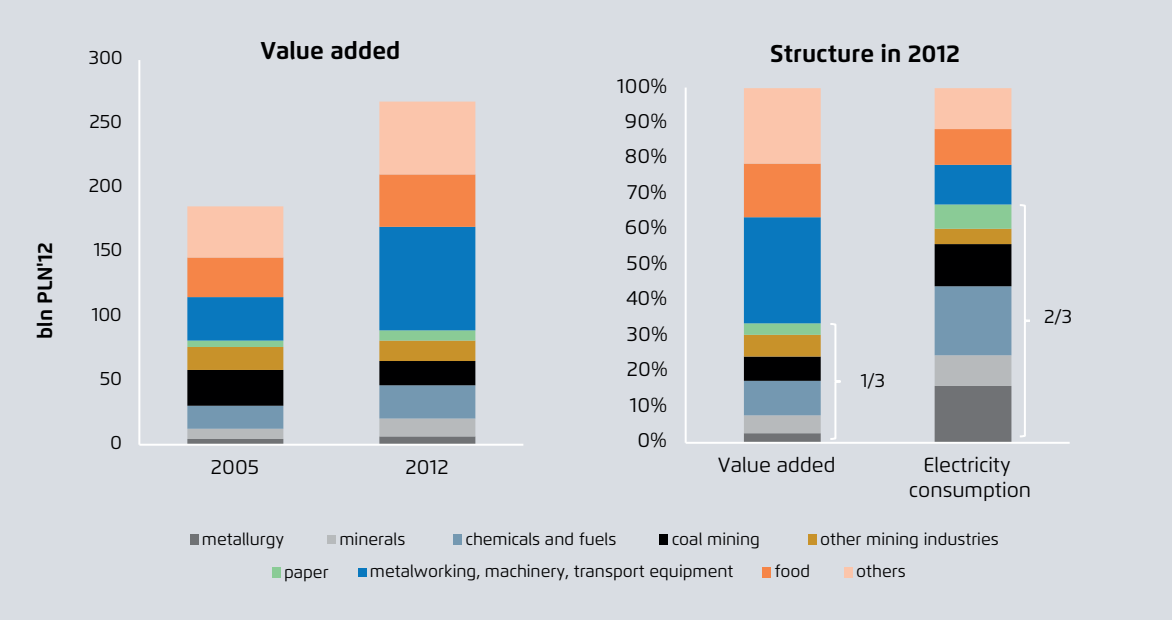
Table 1. Value added growth across the Polish industry, by electricity-intensity

	Change in value added 2005-12
Manufacturing - low electricity-intensity (<0,2 kWh/PLN)	+ 86%
Manufacturing - medium electricity-intensity (0,1-0,5 kWh/PLN)	+ 44%
Manufacturing - high electricity-intensity (>0,5 kWh/PLN)	+ 40%
Mining, others (0,13 kWh/PLN)	-4%
Coal mining (0,35 kWh/PLN)	-35%

Note: electricity-intensity = electricity consumption / value added in 2012

Source: WISE based on GUS data

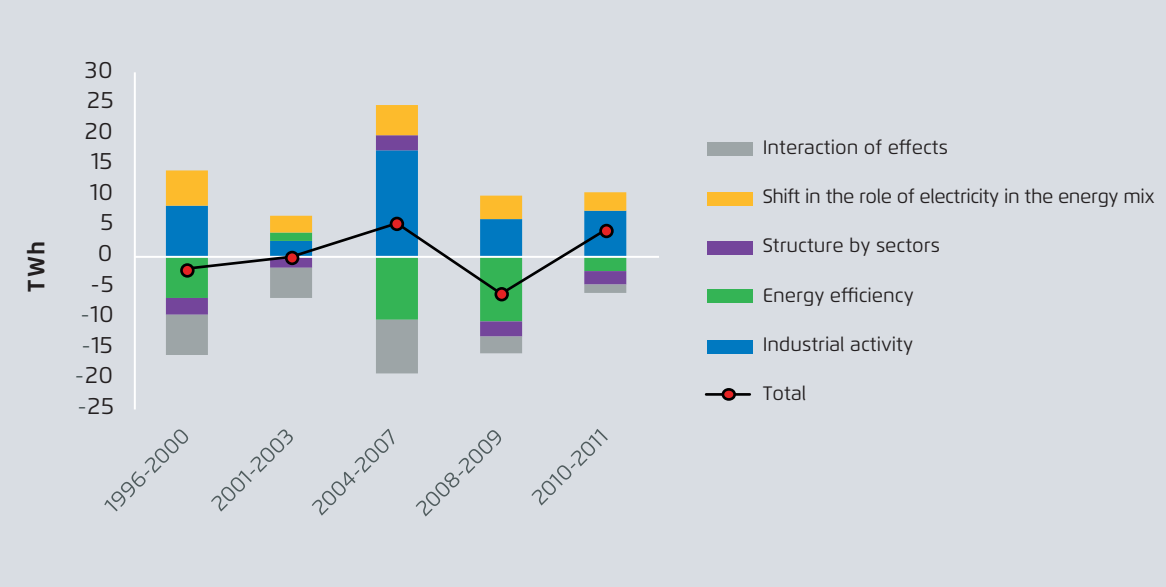
Fig. 2 Value added 2005-2012 (left panel) and electricity consumption use in 2012 (right panel) in the manufacturing and mining in Poland.



Source: WISE based on GUS data

Factors determining changes in the demand for electricity from the Polish industry

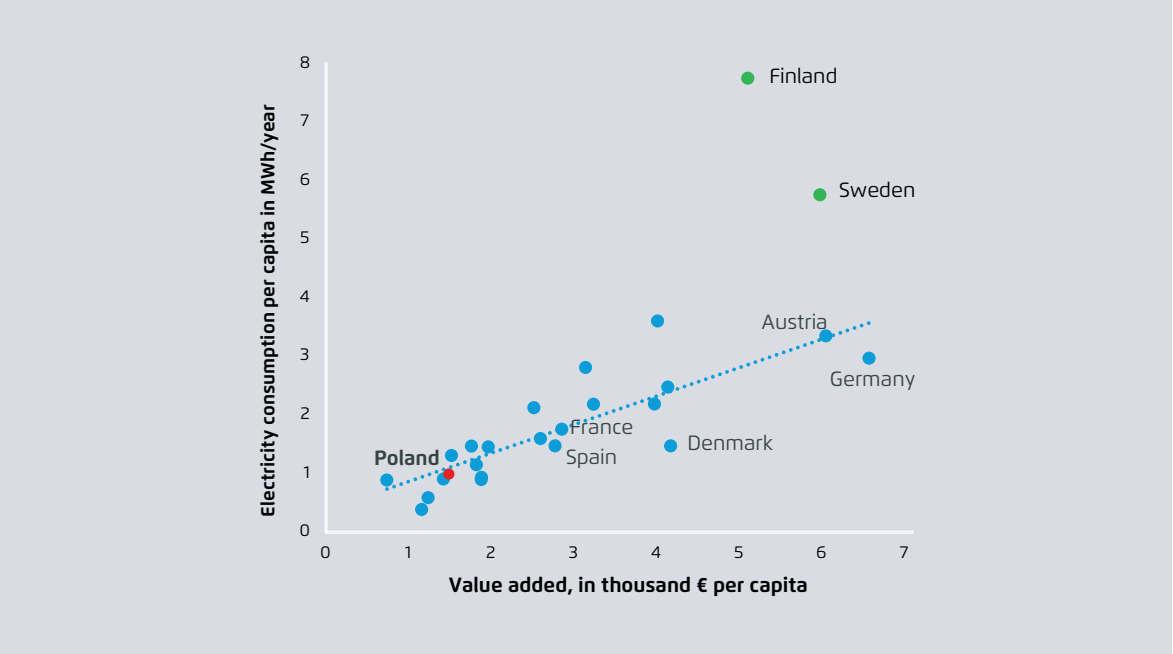
Fig. 3 Breakdown of the electricity consumption growth in the Polish manufacturing



Source: WISE based on Eurostat and GUS data

The restructuring processes in the Polish industry influences indirectly the dynamics of electricity consumption. In particular, the growing economic activity continues to have a positive impact on the electricity demand. The share of electricity in the total amount of the energy consumed went up and decreased the role of fuels and of the derived heat. The main driver behind it is the ongoing electrification of production processes with underlying mechanisation and alterations in the industrial structure which now favours the sectors which predominantly require the use of electric motors and cooling of production halls rather than the use of heat and industrial steam. Conversely, the main inhibitor of the electricity demand is the improvement of energy efficiency that took place across the industry and has led to a decrease in the amount of energy that is needed to produce one unit of value added. That decrease is driven not only by the technological shift (e.g. replacement of the existing motors with more efficient ones) but also by the economic transformation (e.g. increase in the production output value owing to a stronger brand and/or a better alignment with the market needs). The structural shift towards less electricity-intensive types of business activity is another factor decreasing the electricity demand from industry. That factor however is significantly weaker than the effect triggered by the improvement of energy efficiency. The cumulative result of those factors is an overall stabilisation of the electricity demand across all industry sectors.

Fig. 4 Value added vs. electricity consumption in the manufacturing per capita in the EU Member States in 2011.



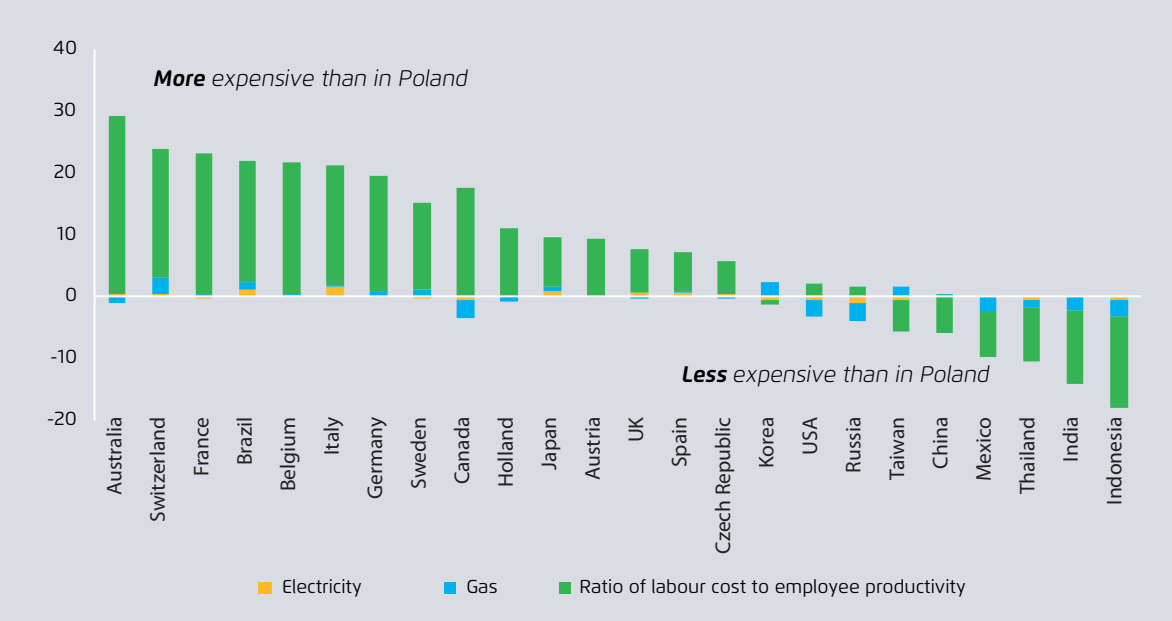
Source: WISE based on Eurostat data

A comparison of Poland with the other EU countries shows that in the future we may expect an increase in the electricity demand from industry. There is a distinct correlation between the level of industrial development of a country and its industrial electricity consumption. Despite the dynamic growth in 2003-2013, however, the Polish industry is still characterised by a relatively small scale of operation and electricity demand continues to be relatively low in Poland. But the more industrialised countries consume significantly more electricity per capita than Poland. For example, Denmark and Spain use 40% more electricity, France 60%, and the most industrialised Germany as much as 160% more than Poland does.

For Poland, catching up with Western Europe will require intensification of the volume and complexity of industrial production. That in turn will lead to increased electricity consumption. The ultimate electricity demand level will be eventually determined by the final structure of industrial sectors and by the quality and energy efficiency of the industrial production.

Significance of electricity prices for industrial competitiveness

Fig. 5 Difference in the manufacturing cost by countries against Poland according to the BCG Global Manufacturing Cost-Competitiveness Index 2014



Note: Cost in Poland = 100

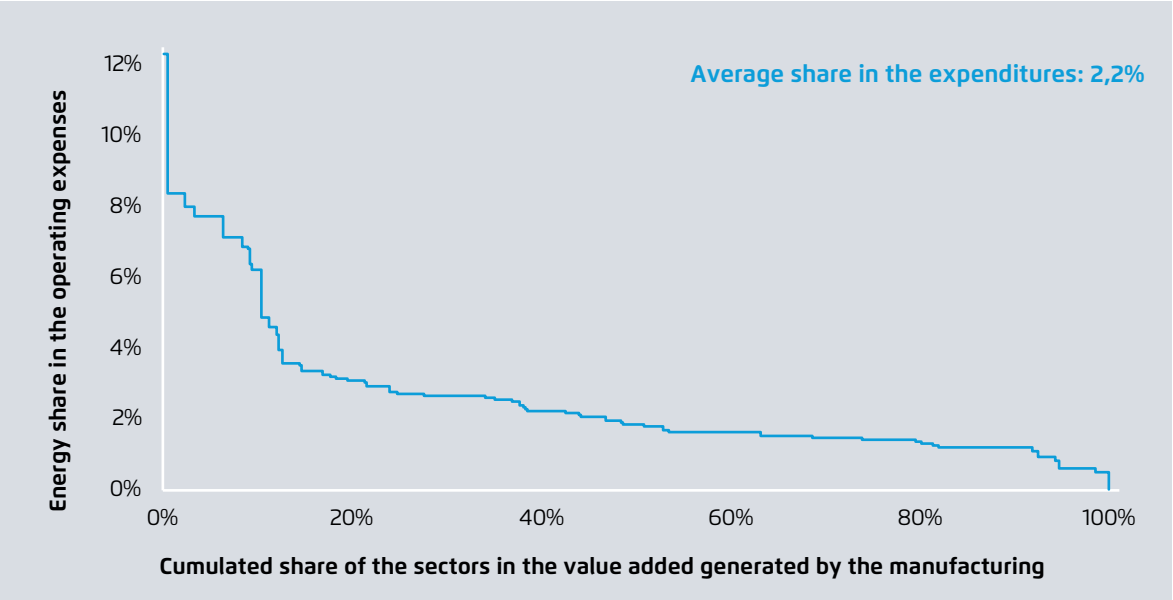
Source: WISE based on BCG data

The so-called global competitiveness indexes, indexes attempt to compare the level of competitiveness of countries. But as opposed to innovativeness, regulations, taxes, and export capabilities, energy is not a relevant component of such indexes. That fact results from a limited share that the electricity cost takes up in the operating expenses of an average industrial operation. The significance of electricity prices for competitiveness of an industry is by an order of magnitude smaller than for example that of the cost of labour. It is worth noting that, for the labour cost, not the level of unit cost (e.g. hourly wage) is significant but how that cost relates to the average productivity of employees. Thus, availability and quality of employees, especially highly skilled ones, plays a much more significant role in the competitiveness indexes than the labour unit cost.

Similarly, in the indexes which include energy, the quality and security of supply are much more important than the price per unit of energy. Those indexes which focus on average competitiveness indicators of the entire industry, however, fail to consider significant differences which exist between sectors. Although, in general, the electricity costs are of marginal importance for the average company, it is quite the opposite in certain production sectors. As the analysis of operating expenses in the Polish manufacturing shows, the share of energy costs in operating expenses amounts on average to 2.2% but for 10% of the production it exceeds 5% of operating expenses. Predominantly, those sectors manufacture bulk ware, such as minerals (ceramics, cement), metallurgy (steel) and chemicals (fertilisers), as well as paper and textiles. What is noteworthy is that the sensitivity of sector to energy price fluctuations depends not so much

on the share of energy in the cost structure but rather on its profitability. The lower the profitability of a sector (e.g. due to a high competition in that sector), the more sensitive to the energy price fluctuations is its profit. The sectors most vulnerable to adverse energy price shifts include energy-intensive ones which are characterised by low operating margins due to a fierce international competition (e.g. steel).

Fig. 6 Different significance of energy costs in the Polish manufacturing



Source: WISE based on Eurostat and GUS data

Tab. 2 Production types with the highest share of energy costs in the operating expenses

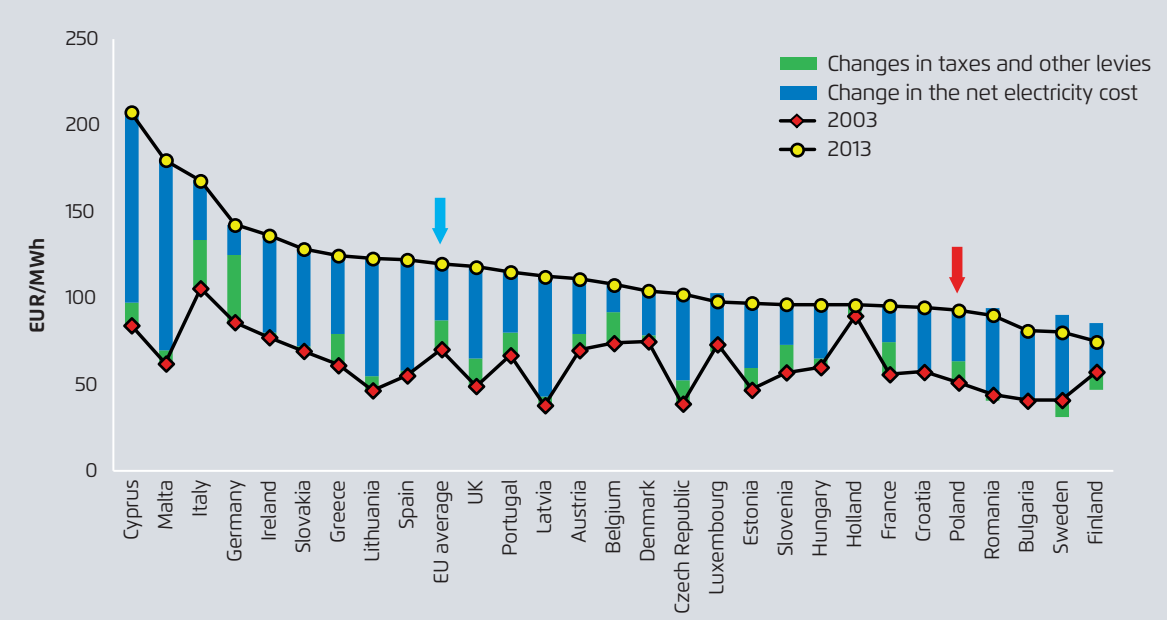
PKD*	Production type	Share of energy in the costs
233	Ceramic construction materials	12,3%
241	Raw steel, iron alloys, cast iron, steel and steel products	8,4%
235	Cement, lime, and gypsum	8,0%
201	Basic chemicals, fertilisers, and nitrogen compounds, plastics, and basic forms of rubber	7,7%
232	Inflammable products	7,7%
234	Other porcelain and ceramic products	7,2%
231	Glass and glass products	7,1%
245	Foundry engineering	6,9%
131	Fibres	6,8%
206	Chemical fibres	6,4%
133	Textile products	6,4%
171	Pulp, paper, and cardboard	6,2%
132	Fabrics	5,3%

**Polish Classification of Activities code (based on NACE)*

Source: WISE based on GUS data

Electricity prices for industrial use in Poland in comparison with the rest of the EU

Fig. 7 Electricity prices for industrial use in the EU, 2003-2013



Source: WISE based on Eurostat data

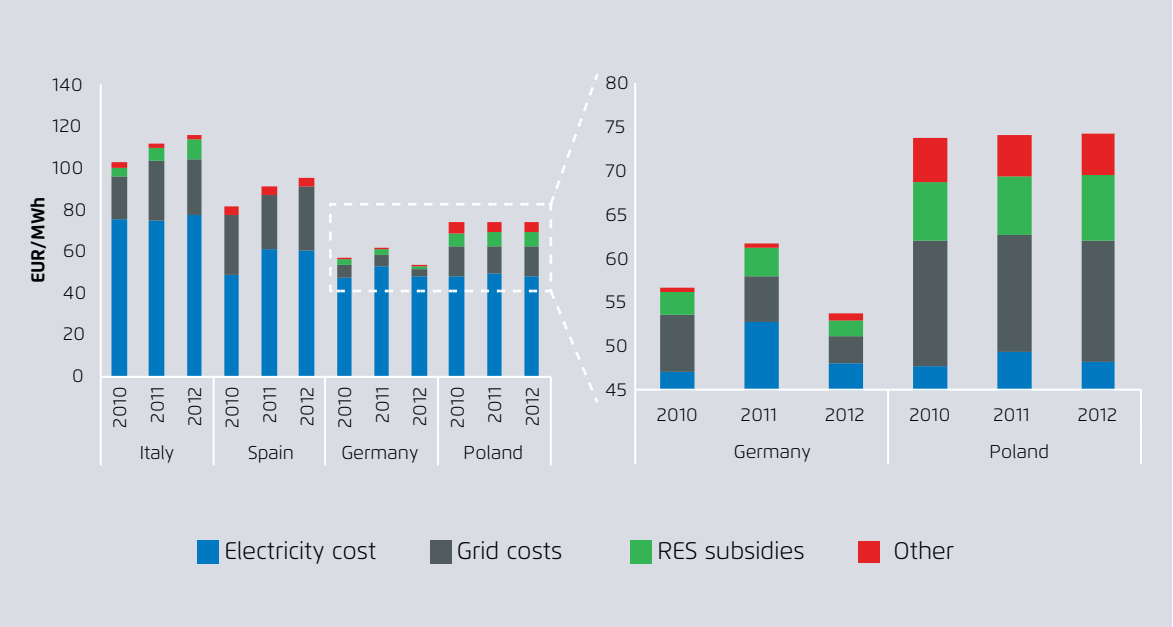
In the past decade, an increase in electricity prices for industrial use in the EU was mainly driven by the growing prices of fuels (natural gas and coal). A surge in taxes and levies which was related to the energy and climate policy took place only in the recent years and its impact on the electricity prices in the most countries has been so far smaller than that of increased fuel prices. An important exception here is Germany where the levies account for 2/3 of the overall increase in the electricity prices over the period 2003-2013[1]. Nonetheless, the change in the net electricity price in Germany has been one of the smallest in Europe owing to a large extent to a decline in the wholesale electricity prices which resulted from a very dynamic growth of the subsidised RES. Also in Poland, despite the significant growth over the past decade, the electricity prices for the industry have remained among the lowest in Europe.

Similarly to what the competitiveness indexes show, a comparison of average electricity prices for industry is only a part of the whole picture because there are differences in electricity prices for different consumer categories. The largest electricity consumers, i.e. huge, energy-intensive industrial plants, can obtain much lower prices than smaller companies owing to much lower costs of grid operation and current transformation and their much bigger bargaining clout. On top of that come in certain countries also differences in the taxation and other levies. Indeed, it is the national regulatory environment rather than the European one which hugely impacts the energy-intensive sectors of industry. For example, despite a higher average electricity price for industrial use, the largest German plants can obtain much more favourable price conditions than

[1] A significant rise in the electricity prices in Germany occurred mainly in the period 2008-2011 due to a dramatic development of solar power generation which was driven by a fast decline in the technology deployment cost and which was not quickly enough offset by a reduction in RES subsidies.

their respective Polish competitors. That is a result of lower grid costs for large consumers in Germany and of an exceptionally low excise tax rate and of fee rebates in that country. By contrast, in Poland the excise tax rate for electricity is uniform and does not account for the differences among the types of industrial consumers who have extremely different levels of sensitivity to electricity prices. By the same token, in the green certificates system, all electricity consumers bear the same RES support costs without accounting for price flexibility of the individual consumer groups.

Fig. 8 Structure of the electricity cost in the EU energy-intensive industrial plants



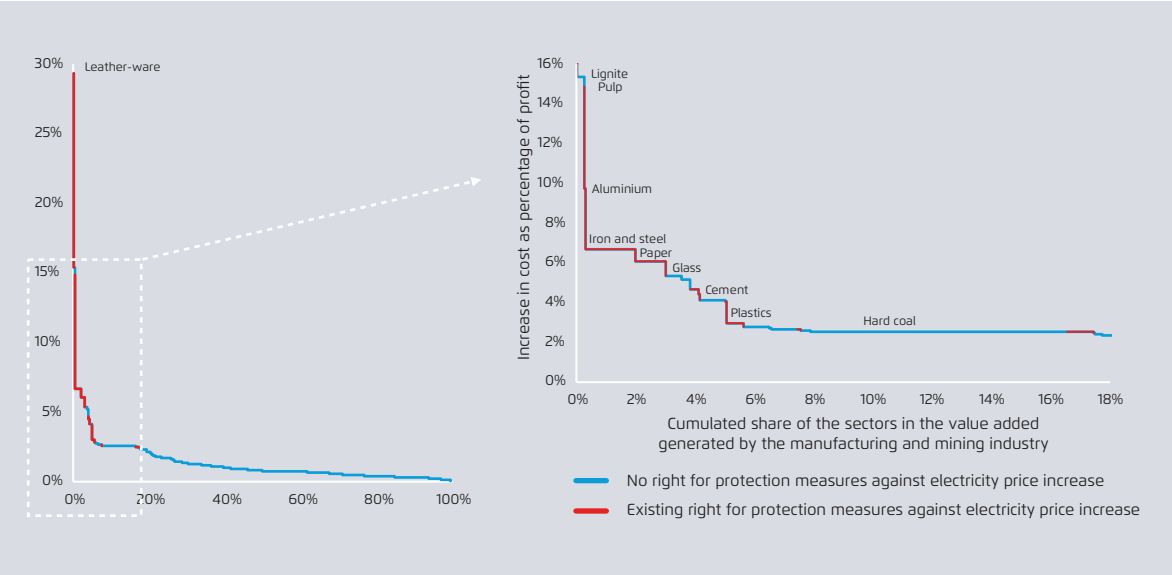
Note: an estimation based on the questionnaire sent to energy-intensive industrial plants

Source: WISE based on CEPS data

Impact of ETS on the electricity prices and industrial competitiveness

Despite a high emission-intensity of the Polish power generation sector, 90% to 95% of the Polish industry has experienced only limited negative effects of the price shifts of emission allowances. The sectors which have been affected most have the right to protective measures against carbon leakage. Having said that, to implement the mechanisms which help to compensate for high electricity prices in the electricity-intensive sectors requires that decisions be taken at the national level. Among the sectors which cannot benefit from the protection against price surges, the coal and lignite mining industries are in a peculiar position. In spite of lignite mining being a very electricity-intensive operation, the specificity of the sector makes it impossible to move the production abroad. As for coal, a relatively high sensitivity of profits to the rises in the ETS prices results from the general low profitability problem of that sector in Poland.

Fig. 9 Increase in electricity costs resulting from the price rise of the ETS allowances by €10 as a percentage of profit, by production type in the Polish manufacturing and mining industry



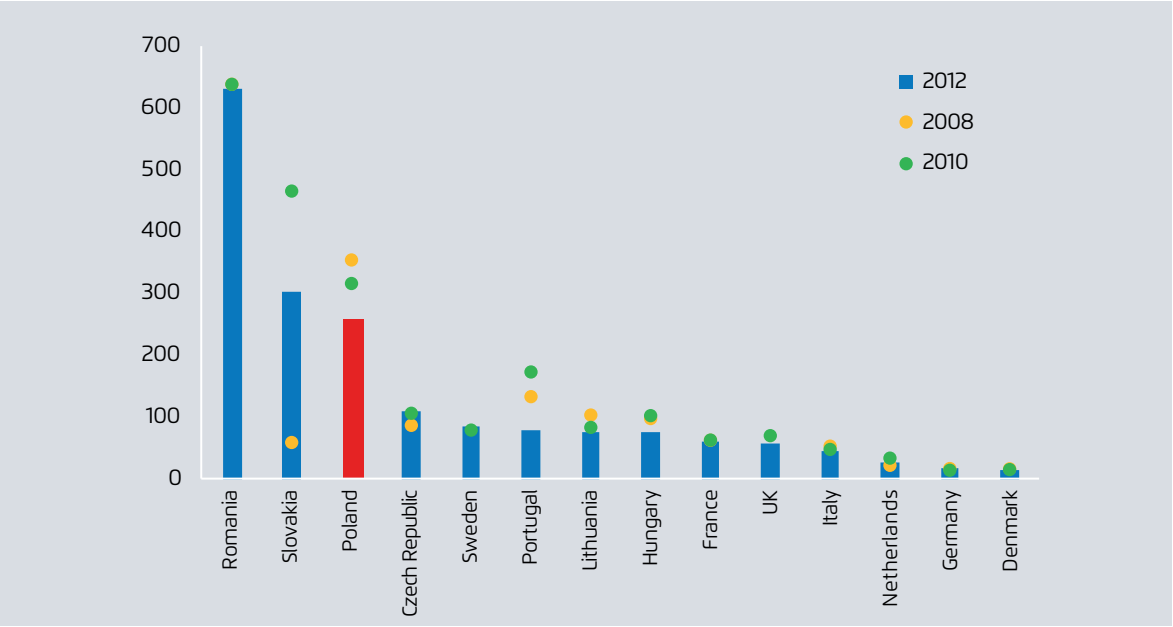
Source: WISE based on Eurostat and EC data

Quality of electricity supply in Poland in comparison with the rest of the EU

Quality of electricity supply is equally or even more important to the industry than its price. That holds true especially for the less electricity-intensive sectors. In as much as they are capable of absorbing higher purchase costs of electricity, unstable supply which disrupts the manufacturing processes may be decisive in abandoning investment projects in a given region.

In Poland, the System Average Interruption Duration Index exceeds the Western European standards several times. The problem still persists despite a significant improvement in relation to previous years. The main reason for the problem is a low grid quality in the eastern part of Poland. A mediocre quality of the electricity infrastructure is one of the stumbling blocks on the path to growth of the local economies which has petrified the division into more and less industrialised regions of Poland. Closing that infrastructure gap will require expensive investments which, in addition to their role in the overall modernisation, will also be conducive to improving cohesion of the Polish economy.

Fig. 10 SAIDI index for unplanned interruptions



***SAIDI – System Average Interruption Duration Index**

Source: WISE based on CEER data

Recommendations

- As a part of the industrial policy, the development of the sectors with relatively lower electricity-intensity and high degree of mechanisation should be supported due to their high growth potential of value added and labour productivity.
- For electricity-intensive industries, policy action should be limited to the protection against unilateral burdens resulting from the climate policy (higher emission fees in the EU than outside it) and with the diversification of taxes and levies for consumers. The latter should be made dependent on the consumers' sensitivity to electricity pricing (lower charges for energy-intensive sectors will allow them to stay competitive against the manufacturers from neighbouring countries).
- The quality of supply and availability of electricity for industrial consumers should be improved through modernisation of the transmission grid, in particular in those regions where biggest infrastructure backlogs are present which hamper the development of the local industrial potential.
- The anticipated increase in the electricity demand from the industry should be satisfied with the corresponding increase in the domestic electricity supply or by electricity imports from abroad at a competitive price.

6. SUMMARY

The process of building a modern industrial base in Poland capable of standing up to the global competition is still far from completion. The reason for it though is not a low share of the industrial output in the GDP but rather a continuously small volume, low technological complexity and relatively high labour intensity (low mechanisation) of the industrial output. The economic growth is possible only under the condition that the volume of the industrial output in Poland and the degree of processing involved are elevated. That in turn is expected to drive up the demand for electricity from the industry. In the attempt to move up the global ladder of quality of life, Poland needs to abandon the competition model that is based on purely resource- and efficiency-related advantage and instead proceed to build a capability for innovativeness and exceptionality in industrial manufacturing.

The role that electricity plays as a production cost factor is expected to gradually decline. Even today, the average share of energy in the expenses structure of the industrial enterprises in Poland is 2.2%. For only 10% of the industrial plants, that share exceeds 5%. In case of a few easily identifiable energy-intensive sectors that picture is different. However, these sectors are dominated by large consumers, who face much lower electricity prices than the industrial average. In this case the key factors affecting electricity costs are - besides the wholesale electricity price - the power grid fees, excise taxation, and other levies on the electricity. Even today, due to an unfavourable structure of those charges, the energy-intensive sectors in Poland have to pay more for electricity than their counterparts in Germany.

7. ABBREVIATIONS AND DEFINITIONS

BCG – Boston Consulting Group.

Carbon leakage - transferring of emission intensive business operation from an area with an existing system of greenhouse gas emission charges to those countries where such charges are lower or where they do not exist. Carbon leakage may include both transferring manufacturing operations abroad by companies and supplanting goods encumbered with emission charges on the global markets. That phenomenon affects both the direct and indirect emission generators, the latter being the facilities which use electricity from emission-generating power plants and thus are exposed to electricity price rises.

CEER – Council of European Energy Regulators.

CEPS – Centre for European Policy Studies.

SAIDI – the average long and very long outage duration index. It is the sum of the products of the outage duration and the number of customers exposed to its effects during the year divided by the number of supplied consumers. It is expressed in minutes per consumer per year.

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