

# THE HIDDEN BILL FOR COAL 2017

SUPPORT FOR MINING AND COAL-BASED  
ENERGY SECTOR IN POLAND – YESTERDAY,  
TODAY AND TOMORROW

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## LIST OF ABBREVIATIONS

Abbreviation	Explanation
<b>EEA</b>	European Environment Agency
<b>EU-ETS</b>	European Union Emission Trading System
<b>SCR</b>	Supplemental Contingency Reserve
<b>KHW</b>	<i>Katowicki Holding Węglowy</i> , Coal Holding of Katowice
<b>PPA</b>	Power Purchase Agreements
<b>KOBiZE</b>	<i>Krajowy Ośrodek Bilansowania i Zarządzania Emisjami</i> , Polish National Centre for Emissions Management
<b>RIA</b>	Regulatory Impact Assessment
<b>RES</b>	Renewable energy sources
<b>OCR</b>	Operational Capacity Reserve
<b>PGG</b>	<i>Polska Grupa Górnicza</i> , Polish Mining Group
<b>SRK</b>	<i>Spółka Restrukturyzacji Kopalń</i> , Polish Mine Restructuring Company SA
<b>TGE</b>	<i>Towarowa Gielda Energii</i> , Polish Power Exchange
<b>UOKiK</b>	<i>Urząd Ochrony Konkurencji i Konsumentów</i> , Polish Office of Competition and Consumer Protection
<b>URE</b>	<i>Urząd Regulacji Energetyki</i> , Polish Energy Regulatory Office
<b>ZUS</b>	<i>Zakład Ubezpieczeń Społecznych</i> , Polish Social Insurance Institution

## EXECUTIVE SUMMARY

- Since 1990, the support for coal mining and coal-based energy sector has reached a total of nearly PLN 230 billion (an average of PLN 8.5 billion per year). In 2016, it amounted to PLN 9.2 billion<sup>1</sup>. However, these numbers do not include the external costs generated by the coal-based power industry (i.e. costs mainly related to citizens' health, which are not compensated by energy industry, but paid by the society), which in 2016 alone reached PLN 31 billion.
- In recent years, the level of support for hard coal mining intensified substantially, due to the crisis suffered by the industry. With low coal extraction output in Poland and the fall of its prices on the global market, restructuring of the Polish mining industry became unavoidable. Currently, the industry is supported not only by the mine-closure subsidies, but also by the state-owned companies, which invest their capital in sustaining the unprofitable mining enterprises.
- The renewable energy sector receives substantially lower support than the coal-based power sector. In recent years, the support for RES infrastructure (except for old hydroelectric power plants and co-firing biomass with coal) constituted less than one third of the subsidies granted to mining and coal-based power industries. Once the external costs of coal-based power generation are taken into account, the support per unit of energy is also higher for coal than for RES.
- Polish energy industry is facing two challenges: 1) the structural underperformance of coal mining and 2) the need to modernize the energy infrastructure. The estimates presented in this study indicate that if the current energy policy is continued, by 2030 the subsidies to coal mining and coal-based power sector will absorb over PLN 150 billion. This way the average annual support for coal (PLN 11 billion) will increase by almost 30%, when compared to the previous quarter of the century. However, the final level of support will depend on the shape of the future public policies. This study has identified actions, which will allow to shift the current path of energy industry development away from the direct and hidden subsidies that benefit coal mining and coal-based energy sectors:
  - Adjusting the scale of coal mining activities to their real economic potential and inclusion of the sector's workers in the common social security scheme.
  - Diverting the funds allocated to the modernization of the domestic energy sector towards the investments that would facilitate diversification of the energy mix, as well as the development of the RES infrastructure.
  - Establishing the national emission standards for investments supported by the capacity market (in case it is to be introduced), and those funded by the European Union Emission Trading System (EU-ETS) funds.

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<sup>1</sup> All values are provided in local currency in constant 2016 prices.

# 1. INTRODUCTION

The ongoing crisis in the hard coal mining industry, as well as the need to modernise the energy infrastructure and the increasing social awareness regarding environmental and health problems related to coal-based power generation, make energy policy one of the main axis of the current public debate.

The overarching objective of this study is to present a comprehensive estimate of the scale of financial support for mining and coal-based energy sectors, as well as for the renewable energy sector in Poland, with a special focus on hidden factors that influence energy prices. This analysis is particularly important in light of the low level of transparency regarding the mechanisms that govern the support for the coal-based power industry, especially when these are being compared to the structure of support for renewable energy. While the development of RES in the past has been mainly incentivised by a system of green certificates and EU subsidies, mining and coal-based energy sectors have been supported directly from the national budget as well as through indirect costs borne by society.

A report published in 2014 entitled “Hidden bill for coal” was the first attempt to structure the discourse and answer the questions about the scale of social costs generated by the Polish energy sector. The report presented an estimate of direct and hidden costs of coal subsidies and renewable energy subsidies between 1990 and 2012. The results suggested that, during this period, the support for coal mining and coal-based power sector amounted to PLN 170 billion (constant prices from 2010), and once all the factors were taken into account – including the external costs associated with the deteriorating health and degradation of the natural environment – this number soared to as much as PLN 1.65 trillion (an average of PLN 1.9 thousand per year *per capita*). In contrast, during the same period, a total amount of subsidies for the development of RES (excluding co-firing biomass with coal and old hydroelectric power plants) amounted to PLN 7 billion.

Currently, as the debate regarding the future of the Polish energy policy up to 2030 is picking up the pace, the update of the analysis from 2014 and assessment of the potential future financial support for coal mining and coal-based power sector is of extreme importance.

At the end of 2016, the European Commission presented the ‘Clean Energy for All Europeans’ package, i.e. the ‘Winter Package’ – a set of regulations mainly aimed at reducing the CO<sub>2</sub> emissions by 40% by 2030, through transformation of the energy sector and promotion of the renewable energy sources. Such changes, combined with the ever stricter emission standards resulting from the increasing importance of the European Union climate policy, emphasise the need to evaluate actions of the government that prioritize coal-based energy industry and at the same time restrict the development of RES.

The analysis of support for coal mining and coal-based power sector presented in this report gives the most recent and comprehensive description of the direction in which Polish energy policy is heading, as well as provides an assessment of potential consequences related to the implementation of the mechanisms that are currently under consideration. This is especially important as the political decisions that are to be made in the following months and years, will not only define the direction of change within domestic energy sector by 2030, but also – due to long investment cycle – will determine to a great extent prospects for the development of the energy sector in the upcoming decades.

## 2. METHODOLOGY

This study updates the analysis published in 2014, which covered the period of 1990-2012. Present work extends the analysed period until 2016, as well as provides an estimate of the amount of the potential future financial support for mining and coal-based power industry until 2030. Discrepancies between the results for the years 1990-2012 presented in previous publication and this report result from the present availability of the more complete and revised statistical data regarding energy consumption for this period.

All monetary values are presented in local currency in constant 2016 prices.

The study encompasses eight areas of support, which were also considered in the analysis done in 2014:

1. Restructuring the hard coal mining industry (subsidies and cancellation of debt owed to the state, including debt related to the payment of social security contributions and environmental levies).
2. Subsidies to pensions and social security benefits for miners.
3. Impact of subsidies for mining industry on the economic efficiency of the coal-based power generation.
4. Free allocation of EU-ETS allowances.
5. Power Purchase Agreements and stranded costs.
6. External costs related to pollutant emissions from electric power generation.
7. Green certificates.
8. EU subsidies.

Additionally, new types of support instruments that emerged in Poland between 2013 and 2016 were taken into account:

1. Recapitalisation of hard coal mines by state-owned enterprises.
2. Capacity remuneration mechanisms: Operational Capacity Reserve (OCR) and Supplemental Contingency Reserve (SCR).
3. Discount system for prosumers.

Estimates for the period of 2013-2016 do not cover the new auction-based support scheme for renewable energy. The RES fee that covers the costs of this mechanism appeared on consumers' electricity bills in mid-2016, and the first auction took place in December of the same year. However, the renewable energy sector began to receive funds only in the following year, once the auctions were finalised in January 2017.

As an addition to the previous report, this study presents an estimate of the potential support that could be provided until 2030 for coal mining industry and coal-based power sector and was calculated based on current trends in Polish energy policy. Same analysis of the subsidies for the renewable energy sources is however impossible, due to the lack of clearly defined governmental plans for the development of RES infrastructure. This also concerns subsidies to co-firing biomass with coal, which constitute an indirect support for the coal-fired power plants. The prognosis also does not cover the estimates of external costs of the coal-based power generation for the period of 2017-2030 – the dynamics of which will depend on the pace of adjustment of each particular power plant to the new emission standards at the beginning of the 2020s.

The next parts of this chapter describe the methodology and the assumptions adopted for the purpose of this study, with a special focus on aspects that were not considered in the 2014 analysis.

## 2.1 RESTRUCTURING THE HARD COAL MINING INDUSTRY

The official data regarding the subsidies for the restructuring of the hard coal mining industry for the years 2013-2015 can be found in the reports of the Polish Office of Competition and Consumer Protection (*Urząd Ochrony Konkurencji i Konsumentów*, UOKiK) on state aid. Information on the amount of support in 2016 comes from the European Commission's decision on state aid to Polish hard coal mining for the period of 2015-2018 (EC 2016).

Restructuring was also financially supported by a new instrument, which was applied for the first time in 2016, i.e. the recapitalisation of mining enterprises by state-owned companies, mainly by those from the energy sector. A detailed analysis of the decision, made in April 2016, to invest in PGG (*Polska Grupa Górnicza*, Polish Mining Group) shows that with no further restructuring actions than these planned by the aforementioned mining enterprise, such investment is not profitable (Bukowski et al., 2016) and in fact constitutes a subsidy to unviable hard coal extraction. Considering the current, insufficient, mining restructuring scheme and taking into account the recent prognosis of hard coal prices, it is possible to forecast that the funds spent in 2016 on recapitalising PGG will not be recovered and that further financial aid will be needed (see chapter 2.11). Therefore, state investments in the PGG was classified as a support for mining restructuring.

### Frame 1. Funds for Remediation and Mining Damages

Exploitation of coal deposits has an impact on the whole socio-economic system within the mining area. Extraction of resources contributes to degradation of road infrastructure, buildings, transmission networks, as well as arable land and natural environment (Bednorz, 2010). According to Polish law, mines are obligated to remediate damages caused by the mining activity. Such actions should allow the area to recover to its previous state, and if it turns out to be impossible, the mine is required to pay compensation. Costs of elimination of the mining damages stand for approx. 2% of total coal extraction costs, and approx. 1/5 of expenditures on damage remediation is used for compensations (Kugiel, 2011).

These activities are financed from the mine-closure fund, to which the mining enterprise should contribute not less than 3% of depreciation on fixed assets in case of underground excavation and not less than 10% in case of coal extraction through the open-cast method. This system does not, however, provide sufficient funds for mine-closure in case it occurs before the deposits are exhausted. This is due to the fact that mining enterprises have a possibility of distributing the contributions to the aforementioned fund throughout the whole period of deposit exploitation (Uberman, 2015). Moreover, the fund's assets will not be sufficient if the mines were operational already before the requirement to establish the fund was introduced (Naworyta, 2010). The assets will be insufficient for more than half of mines (Saługa et al., 2008). Only some enterprises establish additional reserves to address this problem. For instance, a long-term reserve of *Jastrzębska Spółka Węglowa*, dedicated to cover the costs associated with its closure and mining damages, was increased in the period of 2009-2014 by 80% (Sierpińska, 2016). In addition to that, this coal-producing company holds an environmental protection reserve for soil remediation of PLN 33 billion. This study does not take into account the indicated insufficiency of funds. However, it should be emphasised, that it is a key example of how mining regulations are being shaped with disregard for the economic profitability of coal extraction in a mine's life cycle.

## 2.2 SUBSIDIES TO PENSIONS AND SOCIAL SECURITY BENEFITS FOR MINERS

The terms of pension benefits for the mining industry employees are more favourable than under the common scheme for the employees of other sectors of the Polish economy. In addition to this, contributions paid by this sector do not completely cover the generated debts, i.e. the future cost of miners' pensions.

Similarly to the study from 2014, subsidies to pensions and social security benefits for miners are defined as the amount that hard coal and lignite mines would have to contribute to the Polish Social Insurance Institution (ZUS) in order to guarantee pension benefits to their employees under the common scheme equivalent to mining benefits they are entitled to in a given year. Additionally, the amount of this subsidy is directly related to the number of workers employed and their wages.

It is worth noting that the applied methodology allows to estimate the future costs of subsidising pensions of workers currently employed in the mining industry. An alternative approach was applied by the Supreme Audit Office (*Najwyższa Izba Kontroli*, NIK) in the report published in 2017. It was based on the calculations of the difference between the costs of pensions paid to sector's former employees in a given year and the amount of social security contributions received from the sector in the same year. Taking into account the systematic decline in employment in the mining sector, the estimated support for the sector based on this approach is over twice as high as the one presented in this report. This discrepancy is due to the fact that the NIK approach captures the effect of shrinking revenue base for the social security contributions. This effect, however, applies to every sunset industry and does not influence the current profitability of companies that operate within it – unlike the preferential social security schemes for miners, which directly benefit mining enterprises.

### 2.3 IMPACT OF SUBSIDIES FOR MINING INDUSTRY ON THE ECONOMIC EFFICIENCY OF THE COAL BASED POWER GENERATION

The use of subsidised coal indirectly supports energy enterprises. In order to convert the subsidies for the extraction of Polish coal into the subsidies to coal-based electric power generation, the amount of subsidy per energy unit received from coal firing was divided by the conversion efficiency factor in Polish power and combined heat and power plants. Then, the share of imported fuel in domestic energy consumption from coal was subtracted from that number. The calculations were made separately for hard coal and lignite, for each year between 1990 and 2016. The calculations did not consider the support in the form of mine recapitalization by state-owned companies, great part of which are the energy enterprises.

### 2.4 FREE ALLOCATION OF EU-ETS ALLOWANCES

Since 2013, unlike during the period of 2005-2012, auctioning has been the main way of distributing allowances under the EU-ETS emission trading system. This refers in particular to the European power industry. In this study, free allocation of allowances was considered as a subsidy. This is because a power plant, which received free allowances, faces a choice either to keep generating energy and make use of the granted emission allowances, or to stop generating energy and sell these allowances on the market to other emission-generating entities. Therefore the decision to keep producing energy implies renouncing the revenue from selling the emission allowances on the market. The lost revenue forms an alternative cost and should be taken into account by energy enterprises aiming at maximising their profits while setting the power prices, in the same way they would evaluate the cost of purchasing allowances on the market in the absence of free allowance allocation mechanism. Thus, the resulting alternative costs are transferred onto the end-users just like other costs related to the power generation. Granting free allowances to a particular power plant – regardless of the current energy production level – is in fact a free-of-charge transfer of securities, which does not necessarily reduce energy prices for the end-users.



For these reasons, free allocation of allowances in the European energy sector was brought to an end in 2012. One exception is the derogation mechanism for Central and Eastern European countries – Poland included – that enables governments to allocate a certain part of allowances to the energy sector completely free of charge, in exchange for modernisation investments. This mechanism is therefore a type of investment subsidy for the energy sector, rewarding enterprises that own emission-generating power plants, as those units receive free allowances based on historical data. Polish energy sector has been benefiting from the derogation mechanism since 2013. The extent of this type of support has been calculated based on the European Environment Agency (EEA) data on the EU-ETS system performance (especially the number of allowances granted to Polish power plants under the derogation mechanism), as well as market data regarding the emission allowance prices on the market.

## 2.5 POWER PURCHASE AGREEMENTS AND STRANDED COSTS

The introduction of Power Purchase Agreements (PPA) in the 1990s provided a stable source of income to the Polish power sector, which allowed for modernization investments that for example ensured compliance of coal-fired power plants with stricter environmental standards. Such Agreements guaranteed constant, long-term, prices for the electricity purchased from the energy producers by the publicly owned transmission system operator (*Polskie Sieci Elektroenergetyczne*). Over time, PPAs began to play a dominant role in the national electricity market: after a decade, the mechanism covered nearly 2/3 of domestic electricity production. Ensuring guaranteed prices for the energy uptake to most power plants petrified the market structure, which in turn reduced the competitive pressures and thus limited the incentives for cost optimization in the sector. In 2007, PPAs were terminated, as a consequence of the implementation of a broader EU reform that liberalized the electricity market. As a result, it led to the creation of the so called ‘stranded costs’, which could no longer be covered by the PPA’s fixed fees. Instead of Power Purchase Agreements, an additional subsidy mechanism that supported the operation of power plants was introduced – an ‘interim fee’, which was being transposed into the bills of energy end-users.

The data on the PPA termination costs in the years 2013-2016 were taken from the studies done by the Polish Office of Competition and Consumer Protection (*Urząd Ochrony Konkurencji i Konsumentów*, UOKiK) and from the reports published by the Polish Energy Regulatory Office (*Urząd Regulacji Energetyki*, URE).

## 2.6 COSTS OF CAPACITY REMUNERATION MECHANISMS (SCR AND OCR)

During the period of 2014-2016, Polish coal-based energy generation gained two new sources of income, i.e. the capacity remuneration mechanisms: the Operational Capacity Reserve (OCR) and the Supplemental Contingency Reserve (SCR).

The Operational Capacity Reserve was established in 2014 as a mechanism that was supposed to provide stability to the Polish power system. Under the OCR, energy producers have been remunerated by the transmission system operator in exchange for the availability of the power plant to operate during the periods of higher power demand. The level of reserve depends on the maximum power generation capacity in the previous year and constitutes 15% of this value. Once implemented, the OCR mechanism helped to improve the performance of the least profitable coal-fired power plants, however increasing the costs for energy end-users. In previous years, this mechanism failed to successfully solve

the problem of power system stability, among other things, also due to the lack of fines for failure to deliver the contracted capacities (Bayer et al., 2015).

The Supplemental Contingency Reserve (SCR) was launched in 2016. It covers power plants, which closure was initially planned for 2016 due to the failure to comply with the recent EU environmental standards introduced by the Industrial Emissions Directive, however this mechanism enables their operation until 2023. Under SCR, a capacity of 830 MW has been contracted for the period of 2016-2019.

Subsidies allocated to coal-fired power plants under the OCR and SCR mechanisms were estimated based on the data published by the Polish Energy Regulatory Office (*Urząd Regulacji Energetyki, URE*).

## 2.7 EXTERNAL COSTS OF ELECTRIC POWER GENERATION

Similarly to the 2014 report, the external costs of electric power generation were determined using statistical data on actual pollutant emissions levels (sulphur and nitrogen oxides, as well as PM2.5 and PM10 particulate matter) and based on estimates of the external costs of emissions per unit, derived from literature (Kudęłko, 2012; EEA, 2011), from which environmental levies were subtracted. The external cost calculation doesn't take into account the costs of climate change related to greenhouse gas emissions from the power generation sector and only refers to the impact of power plants on citizens' health and local natural environment. The estimates for external costs vary in the available literature, depending on the methodology used to quantify the monetary value of health deterioration and natural environment degradation. For this reason, this report presents both the average external cost calculated based on the different estimation methods, as well as the top and bottom limit values for this indicator.

## 2.8 GREEN CERTIFICATES

The amount of financial support for different RES technologies granted in the framework of green certificates system was calculated based on the data published by the Polish Energy Regulatory Office (*Urząd Regulacji Energetyki, URE*), as well as the Polish Power Exchange (*Towarowa Giełda Energii, TGE*) indices. Support for co-firing biomass with coal was classified as a subsidy to the coal-based power sector, as it didn't incentivise the creation of new RES infrastructure and provided operational support to the existing coal-fired power generation plants, while boosting their profitability. Moreover, financial support for co-firing biomass with coal did not guarantee an increase in renewable energy production: coal-fired power plants added biomass to fuel only as long as the related costs were lower than the benefits provided by green certificates.

The support for the hydroelectric power plants that had already operated before the system was put in place in 2005, was estimated based on the Eurostat data on the installed capacities. Subsequently, it was possible to define a separate category for RES subsidies, which were actually dedicated to supporting investment in new capacities. Calculations in this category for 2016 also take into account the introduction of the so called 'blue certificates', which are an extension of the green certificate system dedicated to the support of electricity generation in agricultural biogas plants.

## 2.9 DISCOUNT SYSTEM FOR PROSUMERS

In mid-2016, a new discount system for prosumers was implemented to support the electricity micro-generation installations that operate on renewable energy sources. The discounts for prosumers who not only produce power for self-consumption but also feed it back into the grid have replaced the previously planned feed-in tariff system. One key difference between the feed-in tariffs and the discount system is that tariffs reward prosumers with a remuneration for any excess power supplied to the grid, whereas the discount system only entitles them to a discounted per-kWh payment in exchange for the power fed into the grid.

This incentivises owners of the renewable energy micro-installations to maximize power production for self-consumption, while reducing the amount of financial support. It is also worth noting that the discounts only cover the variable costs of the power supplied to the prosumer, and do not lead to reduction of the amount of the fixed components of the electricity bills. Under the current solution, in the case of micro-installations with a capacities of up to 10 kW, the energy supplier calculates the costs of the energy supplied and received in the 1:0.8 ratio (i.e. for each energy unit fed into the grid the prosumer can receive 0.8 unit of free-of-charge energy from the grid). In case of micro-systems with capacities greater than 10 kW, this ratio becomes 1:0.7. Such discounts can be received within one year from the moment of feeding power into the grid. Each renewable energy micro-installation can operate under the scheme for 15 years.

The amount of support provided by the discount system was calculated based on the estimates of the capacity of the photovoltaic micro-installations in Poland, published in 2017 by the Institute for Renewable Energy (*Institut Energetyki Odnawialnej*, IEO), as well as on the estimates of the difference between the amount that prosumers are saving from the discount system (reduction of variable costs of energy purchased from the grid) and energy prices on the wholesale market.

## 2.10 EU SUBSIDIES

The update of the 2014 results encompasses a revision of projects financed from the EU subsidies provided between 2013 and 2016, as well as allows for verification of project data from the period of 2004-2012. Subsidies were divided into four categories: 1) subsidies for investments in coal-based power generation infrastructure (including environmental protection systems in coal-fired power plants); 2) support for the development of innovations in the area of mining and coal-based power generation; 3) support for the construction of renewable energy infrastructure; 4) support for development of RES related innovations. Calculations took into account both – the EU funding, as well as financing from Polish public funds.

## 2.11 ESTIMATES OF THE POTENTIAL SUBSIDIES FOR COAL MINING AND COAL-BASED POWER GENERATION BY 2030

Estimates of the potential subsidies for coal mining and coal-based power generation by 2030 include the following categories:

- Costs related to restructuring of the coal mining industry, these related to the further mine-closures and the ones resulting from investments of the state-owned companies needed to sustain the work of currently operating mines.

- Further subsidies to pensions and social security benefits for miners.
- Free emission allowances for coal-fired power plants allocated under the derogation mechanism, in particular between 2021 and 2030.
- Further compensation for the stranded costs that resulted from the PPA termination.
- Further remuneration of the capacity reserves (SCR and OCR).
- Establishment of the capacity market in accordance with the regulations proposed in July 2017.

The information on costs related to the direct support for restructuring until 2018 was taken from the European Commission's decision (EC, 2016) and for the period of 2019-2020 from the draft of the governmental programme for the Polish hard coal mining sector (Polish Ministry of Energy, 2017).

Financial support necessary for the mine recapitalization, provided by the state-owned companies by 2030, was estimated using the methodology and assumptions described in the analysis of the economic impact of the merger of mining and energy sectors (Bukowski et al., 2016). It was assumed that the support will be granted to mines belonging to PGG (including the mines owned by the Coal Holding of Katowice – *Katowicki Holding Węglowy*), which will be in charge of carrying out the central restructuring scenario. The estimates were calculated based on data from the latest World Bank's forecasts regarding the coal prices (2017). Calculations suggest that despite the spike in prices in 2016, a decline in real coal prices is predicted for the years to come, which will have a negative impact on the profitability of mining enterprises.

Subsidies allocated to pensions and social security benefits for miners were estimated based on assumption that the current benefits scheme for the mining sector's employees is maintained. Moreover, the relation between the average wage in mining and in other sectors of economy was assumed to remain constant. Another assumption was that the decline in employment in the sector stays in line with the adopted restructuring scenario for mining enterprises, with the initial number of sector's employees being provided by the Central Statistical Office of Poland (*Główny Urząd Statystyczny*, GUS). According to these data, the number of people employed in the hard coal and lignite mining sector will decrease from nearly 90 thousand in 2017 to approximately 66 thousand in 2030. It should be stressed that this forecast takes into account the systematic actions undertaken to prevent the aforementioned decline in employment in the hard coal mining industry through the recapitalization of unprofitable mines.

The scale of support under the derogation mechanism was estimated based on the information regarding the free allocation of emission allowances for the energy sector between 2021 and 2030 published by KOBiZE (National Centre for Emissions Balancing and Management), as well as based on the authors' forecast of future allowance prices. It was assumed that as a consequence of the EU-ETS system reform, by 2030 these prices will rise to EUR 30 per tonne (see Bukowski et al., 2016b).

The estimates of the amount of support needed to compensate for the stranded costs that resulted from the termination of the Power Purchase Agreement were based on the stipulations of the Bill on the early termination of Power Purchase Agreements. These stipulations defined the maximum amount of total support that power plants are entitled to under this mechanism. The Bill on the early termination of Power Purchase Agreements also provides a forecast of the dynamics related to the stranded costs, which should be compensated with funds retrieved from the interim fee. It was assumed that during the period covered by the forecast, the power sector will gain a total amount that will be equivalent to the difference between the maximum amount of support indicated in the Bill on the early termination of Power Purchase Agreements and a total of subsidies paid in this regard, however the dynamics of future payments will stay in line with the forecast provided in the Bill. This means that – as forecasted in the Bill – the extent of support will start decreasing significantly from 2017 onwards, in comparison with the current scale of support. It should be emphasized that according to the amendments made to

the Bill in 2016, the interim fee covering the costs of this mechanism was raised and set to a fixed level, regardless of the real amount of payments in a given year. This means that already in 2017, the funds retrieved from the interim fee will exceed the costs of compensation related to PPA termination (including the debts of *Zarządca Rozliczeń* – the enterprise that is paying the compensations to power plants – which were accumulated in previous years due to the insufficient funding from the interim fee). In the light of the amended Bill stipulations, the resulting surplus of money could be allocated to certificates of national investment funds, which could then be exchanged for shares in the energy enterprises and transferred to the state. This stipulation means that the funds from the interim fee can be used not only to cover the PPA stranded costs, but also to recapitalise energy enterprises. However, the costs of the increasing state control over the energy sector will be borne by the energy consumers.

For OCR and SCR, it was assumed that the level of support will remain stable until 2019 (inclusive), and it will be withdrawn in 2020 with the launch of the capacity market. In the case of the capacity market, the estimates of the scale of support were based on the values presented in the impact assessment, which was included in the July 2017 Act (for the period of 2027-2030 the values were extrapolated because the impact assessment did not include the values for this period). It's worth noting that it is a conservative estimate, based on net costs, i.e. taking into account the expected fall of energy prices on the wholesale market as a consequence of establishment of the capacity market. The total gross costs of establishment of the capacity market may be higher by 40 to 60% (ClientEarth, 2017).

The estimates of the scale of support by 2030 for all the aforementioned categories are based on the assumption that the national energy policy, which is focused on keeping the dominant position of coal-based energy generation in the national energy mix and the related support instruments are maintained. Therefore, they do not constitute a forecast of the future situation, but rather an assessment of the possible consequences of maintaining the current state and implementing new instruments of support for the mining and coal-based power sectors. Thus, if Polish energy policy changes, the scale of future support, in the indicated areas, might decrease considerably.

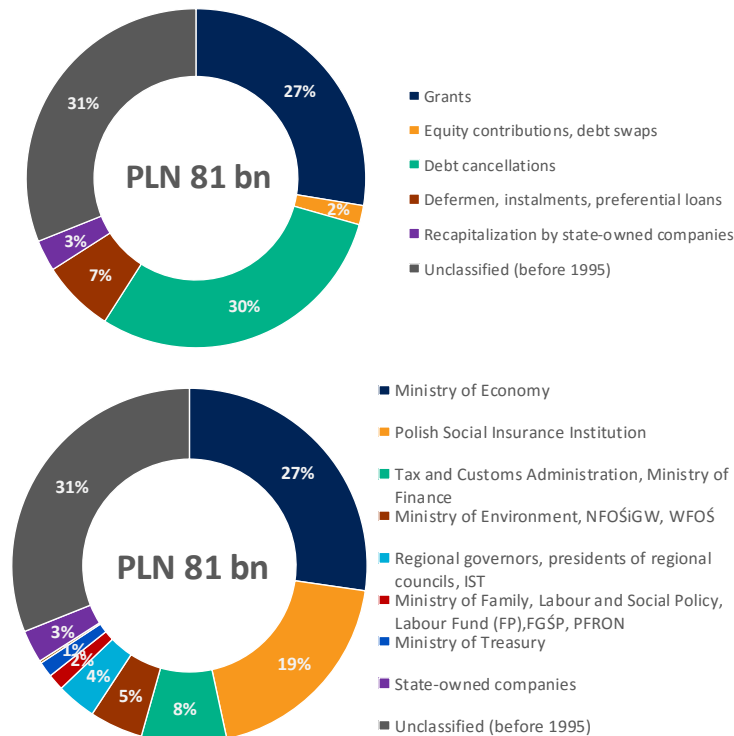
## 3. RESULTS

### 3.1 SUBSIDIES TO HARD COAL AND LIGNITE MINING INDUSTRY

Throughout the last quarter of century Polish public institutions used different ways of direct financial support for mining enterprises. Among them, the most important one has been a direct fund allocation to mines in the form of subsidies for mine operation and their restructuring, as well as deferral or even cancellation of outstanding debts, including the unpaid pension contributions or mining damage compensation.

Direct support for the mining industry in the period of 1990-2016 (except for subsidies to pensions and social security benefits for miners) is estimated at PLN 81 billion. It should be stressed that during the last four years the total value of support has increased by 7% in comparison with the period of 1990-2012. Two most cost-absorbing activities during the analysed period were debt cancellations and subsidies, which amounted to PLN 24 and 22 billion, respectively. Deferments, instalments and other forms of debt bail-in contributed to the recapitalization of the mining industry by nearly PLN 6 billion. In recent years, a key type of support has been a combination of investments in unprofitable mines made by state-owned companies, as well as mine-closure subsidies for mines acquired by the Mines Restructuring Company (*Spółka Restrukturyzacji Kopalń, SRK*).

**Figure 1. Structure of subsidies and grants for the coal mining industry (except for subsidies to pensions and social security benefits for miners) in the period of 1990–2016 by type of support (upper diagram) and by donors support (lower diagram)**



Source: WiseEuropa's own elaboration based on data from UOKiK, Eurostat, OECD, ZUS, NIK

Note: The support for the period of 1990-1994 could not be classified due to lack of detailed data on the structure of subsidies in public documents. The diagrams do not cover the subsidies to pensions and social security benefits for miners, which are financed from the national budget by compensating deficits in the Polish Social Insurance Institution (ZUS). The pensions will be analysed in the next part of the study.

While the largest subsidies were provided at the beginning of the 1990s – during the time of the most intense restructuring of the mining industry, a sudden increase was also recorded right before Poland’s accession to the EU, in 2003, when the financial support amounted to as much as 2% of the GDP. Subsidies and grants in the following years were gradually decreasing, until 2014. This is when the fall in coal prices on the global market exposed unresolved structural problems within the Polish mining industry: low coal extraction efficiency and high labour costs. In 2015-2016, the sector witnessed losses worth billions and the biggest mining enterprises faced the risk of insolvency and bankruptcy. The support which was then set in motion, i.e. subsidising the closure of the least profitable mines combined with recapitalisation of the mining sector by the state-owned companies successfully reversed the downward trend in the support intensity. In the last two years, the direct and indirect support for the sector started increasing, reaching nearly 0,2% of the GDP in 2016.

It is also worth noting that subsidies to pensions and social security benefits for miners, which should also be treated as a form of aid to the mining industry, for more than ten years now have been maintained within the range of PLN 3-4.5 billion per year. According to our estimates, in 2015 they amounted to PLN 3.4 billion and in 2016 – to PLN 3.3 billion<sup>2</sup>. Since 1990, this type of support has absorbed more funds than direct coal subsidies and grants, and it currently remains the main source of funding received by the sector. This is due to the regulations that entitle miners to receive benefits on more favourable terms than employees of other sectors – each zloty paid by a miner to the Polish Social Insurance Institution (ZUS) increases the pension system liability towards him by PLN 1.5 or 1.8, depending on the type of work performed by the miner.

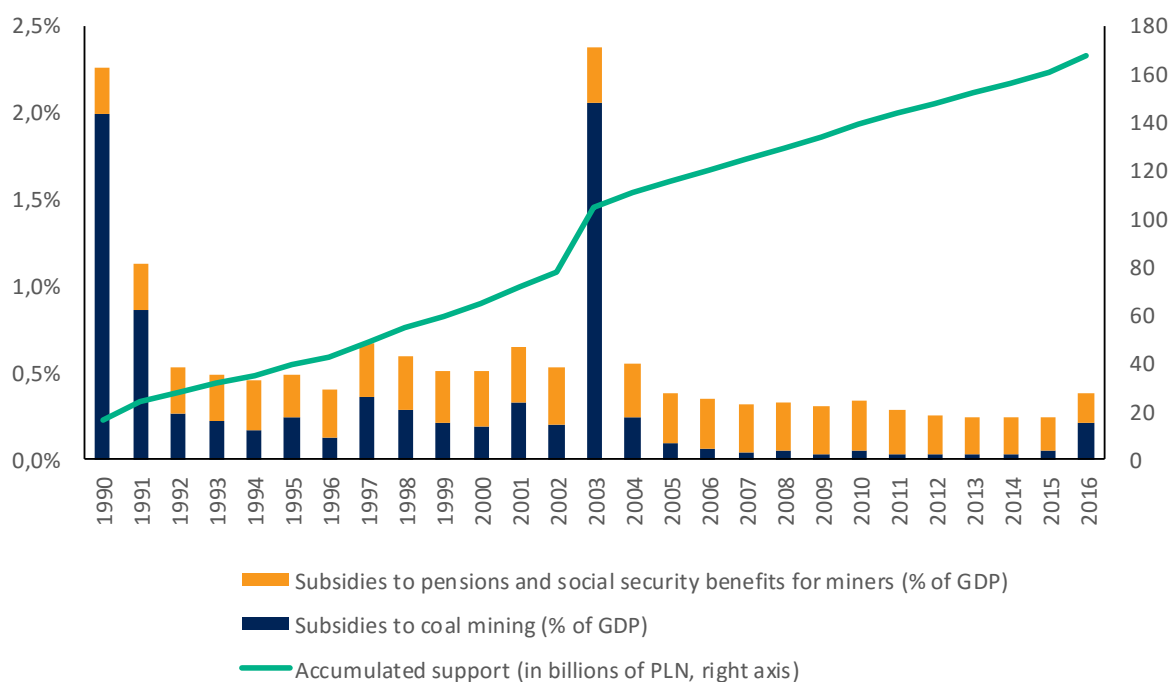
**Table 1. Subsidies and grants for the coal mining industry (both hard coal and lignite) and subsidies to pensions and social security benefits for miners, 1990–2016 [billions of PLN]**

	1990-1994	1995-1999	2000-2004	2005-2009	2010-2012	2013-2016	Total
Subsidies and grants	25.2	11.3	33.8	3.4	1.7	5.7	81.0
Subsidies to pensions and social security benefits for miners	9.7	13.2	17.5	19.5	12.4	14.1	86.5
Total	34.9	24.5	51.4	22.9	14.1	19.7	167.6
Mean value of grants per year	7.0	4.9	10.3	4.6	4.7	4.9	6.2

Source: WiseEuropa’s own estimates based on data from UOKiK, Eurostat, OECD, ZUS, NIK

2 According to the Polish Supreme Audit Office’s (*Najwyższa Izba Kontroli*, NIK) estimates from 2017, which take into account the need to finance from the national budget the current difference between the contributions paid by the sector and the pension benefits paid to its former employees, in 2015 budgetary expenditure in this regard amounted to PLN 7.7 billion.

**Figure 2. Subsidies and grants for the coal mining industry, as well as subsidies to pensions and social security benefits for miners, 1990–2016 [% of GDP] and accumulated support [billions of PLN]**



Source: WiseEuropa's own estimates based on data from UOKiK, Eurostat, OECD, ZUS, NIK

### Frame 2. Environmental and social costs of lignite mining

Unlike hard coal mining, lignite extraction is less challenging and thus less labour-intensive. For this reason, Polish lignite mines do not face the problem of structural economic underperformance of extraction and, in comparison with the hard coal mining sector, receive much less support from the national budget. The main financing instrument used for support of this branch of mining is indirect aid in the form of subsidies to pensions and social security benefits for miners. However, it should be emphasised that the construction and operation of open-cast lignite mines generates significant environmental and social costs. They cannot be as easily monetised, which is why they were not included in the calculations presented in this study.

From the environmental point of view, the impact of open-cast mines on groundwater is especially problematic. The techniques of rock mass dewatering in the area of mine workings, necessary for the proper lignite mine operation, lower the ground-water table, creating a cone of depression with a range exceeding the mine excavation area (Polak, 2005). The lowering of the ground-water table has a negative effect on the general water conditions in the region – one example that clearly shows the extent of negative externalities caused by lignite mining is a mine located in Konin, which is responsible for nearly 20% of lignite extraction in Poland. It is estimated that the activity of this particular mine contributed to the loss of approximately 4 billion m<sup>3</sup> of water (Stachowski, 2007).

Such changes contribute, among other things, to losses in agriculture and forest soil desiccation. The scale of costs that the agricultural sector will have to incur as a consequence of the open-cast mining activity is reflected in the economic impact assessment done by Pepliński (2016). The study shows that the losses in agricultural production due to the activity of the Konin's open-cast mine amount to PLN 62 million per year in the areas that are localised within the extent of depressions and to nearly PLN 400 million per year if the whole area affected by the mine is considered. These losses refer both to lower yields of arable crops and decreased livestock production caused by a restricted availability of forage. In both cases, unstable water conditions in the proximity of the open-cast mine are the reason for the incurred losses.

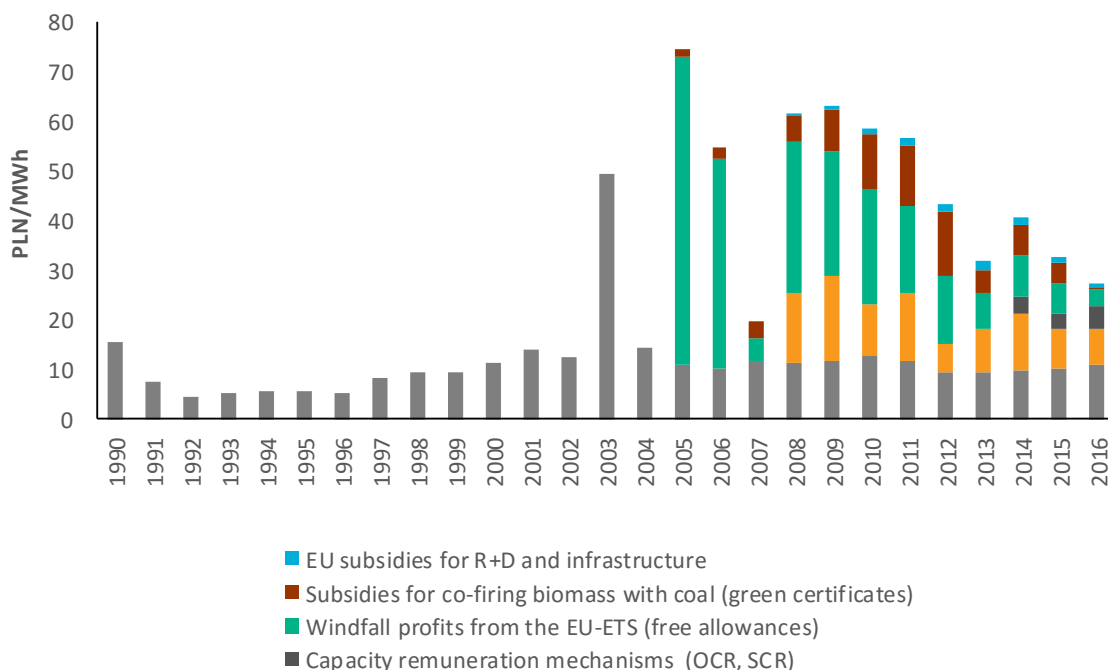
From the social point of view, a key problem related to lignite mining is the expropriation and displacement of the population living in the area of open-cast mine construction. Under Polish law, lignite exploration, documentation, storage and extraction are considered to be public investments. Such stipulation allows for restriction of ownership rights by expropriation in case the property owner refuses to sell it. This regulation was introduced as a response to excessively high prices of land acquisition for mining enterprises (Uberman, 2010), which were a result of incorporation of the value of coal deposits into the value of the whole property. The Polish law also grants mining enterprises the right to compulsory land acquisition in areas where fossil fuel extraction licenses were issued.



## 3.2 SUBSIDIES TO COAL-BASED POWER SECTOR

In the period of 1990-2016, the average financial support for the coal-based power generation amounted to PLN 27/MWh, whereas during the last decade it amounted to as much as PLN 45/MWh, which corresponds to approximately 1/4 of the electricity wholesale market price. In other words, in the mentioned period each PLN 4 gained by the electricity generation sector from selling power corresponded to PLN 1 of direct or indirect subsidies. Since the beginning of this decade, the intensity of support for the coal-based power generation industry has been decreasing: in 2016 it reached PLN 27/MWh. As indicated in the next chapters, in the future this trend might reverse. Importantly, in the last few years not only the amount of support, but also its structure have been changing substantially.

**Figure 3. Support to coal-based power production per MWh [PLN]**



*Source: WiseEuropa's own elaboration based on data from Eurostat, European Commission, URE*

The use of subsidised domestic coal constitutes a type of support that has been continuous since the beginning of the analysed period. Currently, the Polish power industry is based, in approximately 80%, on the domestic hard coal and lignite, therefore it indirectly benefits from the support granted to the national coal-based mining sector. Over the years, the amount of subsidies related to the consumption of Polish coal varied between PLN 4 and nearly PLN 50 per 1 MWh of energy produced by the coal-based power plants. The higher level of support was seen in 2003, due to the particularly high level of cancellations of tax and social security debts in mining. After 2003, this support per 1 MWh of energy produced in coal-based power plants did not exceed PLN 15.

The accession of Poland to the EU has brought not only the electricity market liberalisation and new requirements for the power sector in terms of environmental protection, but also the emergence of new types of support for the coal-fired power plants. The biggest subsidies were granted to power plants as a result of Poland joining the EU Emission Trading System (EU-ETS). In 2005, CO<sub>2</sub> emission

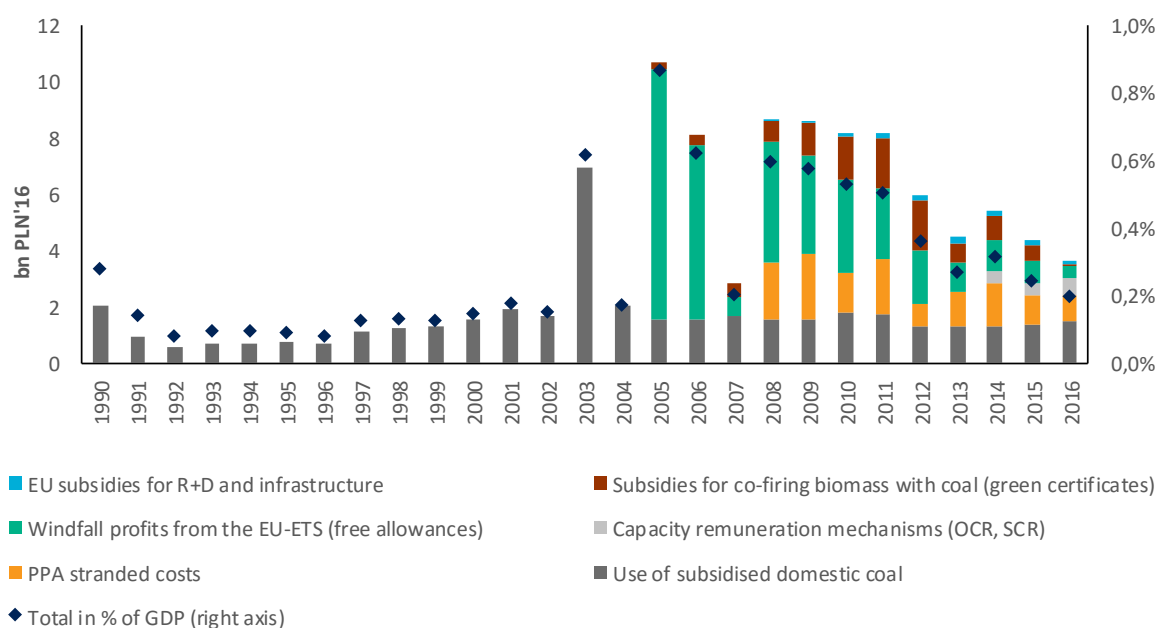
allowances that were allocated free of charge to the power sector under the EU-ETS translated into subsidies exceeding PLN 60/MWh. These were only as high in the first years of the system operation, when allowance prices were relatively high (approx. EUR 20 per tonne of CO<sub>2</sub> in the period of 2005-2006 and in 2008, however in 2009-2011 they were EUR 10-15 per tonne of CO<sub>2</sub>) and granting free allowances was the main mechanism of their allocation. In the subsequent years, as a result of surplus of allowances on the market, their prices have decreased. Moreover, since 2013, during the third stage of the EU-ETS operation, the free allocation of allowances to the Polish energy sector under the derogation mechanism was consistently reduced (this is due to the derogation mechanism being an interim and gradually diminishing form of support towards the sector). The combination of these two factors substantially reduced the benefits for the coal-based power generation sector related to free emission allowance allocation.

A similar dynamics governed the support for power plants that co-fired coal with biomass under the system of green certificates. In the initial years of the system implementation, the shortage of certificates on the market resulted in their high prices (an average of nearly PLN 250/MWh in the period of 2005-2012). This incentivised power plants to quickly increase the share of co-firing biomass with coal. Such actions allowed for a rapid increase in the power plants income. However, because it happened during the period in which obligation to purchase the certificates was imposed slowly and the wind power sector was in the stage of dynamic development, the oversupply of these certificates on the market and a significant decrease in their value has been observed. An average price of these certificates in 2016 was approx. only PLN 74/MWh. This in turn lowered the profitability of co-firing biomass with coal, thus it reduced the incentives to use this solution in coal-fired power plants. The fall in prices and volume of the energy produced from coal and biomass in co-firing plants in the period of 2013-2016 currently results in almost complete disappearance of this peculiar fund flow directed to coal-based power generation industry.

The decrease in financial support for coal-based power generation in the form of free allowance allocation and subsidies for co-firing biomass with coal was compensated by the introduction of a new type of support: the capacity remuneration mechanisms (OCR and SCR). However, because such grants had a smaller impact (they covered only a part of coal-fired power plants), they were characterized by a limited support intensity (approx. PLN 4/MWh in the period of 2014-2016). In contrast, the PPA stranded costs were twice as high in the same period (approx. PLN 9/MWh).

In total, subsidies for coal-based power generation in the years 1990-2016 amounted to over PLN 100 billion, nearly 80% of which were granted in the period of 2005-2016. This corresponds to a mean value of 0.3% of the GDP in the whole analysed period and 0.4% of the GDP since 2005. In 2016, the total support for hard coal and lignite-based electricity generation in Poland was PLN 4 billion (0.2% of the GDP).

**Figure 4. Total subsidies to the hard coal and lignite-based power generation sector [billions of PLN] (left axis) and [% of GDP] (right axis)**



Source: WiseEuropa's own elaboration based on data from Eurostat, European Commission, URE

The diagram presented above includes the mechanisms that allow for direct and indirect financial support to coal-based power generation sector. While evaluating the hidden financial costs of power generation (those not reflected on consumers' electricity bills), external costs of coal combustion in power plants should also be taken into account. These costs are mainly related to deteriorating health due to pollutant emissions and are not compensated by the energy industry. The lack of accountability for the damages to the environment constitutes the least visible and at the same time the most important type of support for the coal-based power generation industry: it exceeds the value of other subsidies by as much as an order of magnitude.

**Table 2. Mean annual values of external costs of the coal-based power generation, 1990–2016 [billions of PLN]**

	1990-1994	1995-1999	2000-2004	2005-2009	2010-2012	2013-2016	1990-2016
Lower value	47	42	32	27	21	17	<b>32</b>
Upper value	142	128	96	81	61	51	<b>97</b>
Mean value	94	85	64	54	41	34	<b>65</b>

Source: WiseEuropa's own elaboration based on EEA (2011) and Kudelko (2012)

Note: Considering the uncertainty of estimates regarding the scale of external costs, they are usually presented as a range of values. In this table, the lower values were estimated based on parameters presented in the study of Professor Kudelko (2012), whereas the upper values – based on more pessimistic parameters published in EEA reports (2011).

Despite the long-lasting downward trend in pollutant emissions from domestic power generation industry, in the past few years the pace of reduction of sulphur and nitrogen oxides, as well as particulate matter emissions, was lower than in the period of 1990-2012, which is when the national power industry relatively quickly adjusted domestic emission levels to the European standards. In the next four years,

pollutant emission reduction is expected to speed-up again, due to the implementation of the stricter EU environmental regulations.

**Table 3. Total external costs of the coal-based power generation, 1990–2016 [billions of PLN]**

	1990-1994	1995-1999	2000-2004	2005-2009	2010-2012	2013-2016	1990-2016
<b>Lower value</b>	235	212	159	135	62	68	<b>871</b>
<b>Upper Value</b>	708	639	480	404	184	204	<b>2618</b>
<b>Mean value</b>	472	425	319	269	123	136	<b>1744</b>

*Source: WiseEuropa's own elaboration based on EEA (2011) and Kudelko (2012)*

It should be noted that despite a tripling of the reduction efforts per unit of external costs by the Polish energy sector since the beginning of the 1990s, according to average estimates, these costs still amount to approx. PLN 250/MWh, a value that is one-and-a-half times higher than the price at which electricity is sold. Further and continued implementation of ever more ambitious environmental standards, which aim at reducing particulate matter, sulphur and nitrogen oxide atmospheric emissions is therefore particularly important. Despite the substantial costs of power plant modernization, the benefits that allow to avoid health costs, make environmental standards an exceptionally profitable investment from the social-welfare perspective.

**Table 4. External costs of the coal-based power generation per produced energy unit, 1990-2016 [PLN/MWh]**

	1990-1994	1995-1999	2000-2004	2005-2009	2010-2012	2013-2016	1990-2016
<b>Hard coal (lower value)</b>	249	254	198	160	128	111	<b>190</b>
<b>Hard coal (upper value)</b>	745	761	593	476	377	330	<b>568</b>
<b>Hard coal (mean value)</b>	497	508	395	318	253	220	<b>379</b>
<b>Lignite (lower value)</b>	524	407	284	240	187	156	<b>313</b>
<b>Lignite (upper value)</b>	1583	1230	863	727	562	472	<b>948</b>
<b>Lignite (mean value)</b>	1054	819	573	484	375	314	<b>631</b>
<b>Total coal (lower value)</b>	367	317	232	190	150	129	<b>240</b>
<b>Total coal (upper value)</b>	1103	954	701	569	447	387	<b>723</b>
<b>Total coal (mean value)</b>	735	635	466	379	298	258	<b>482</b>

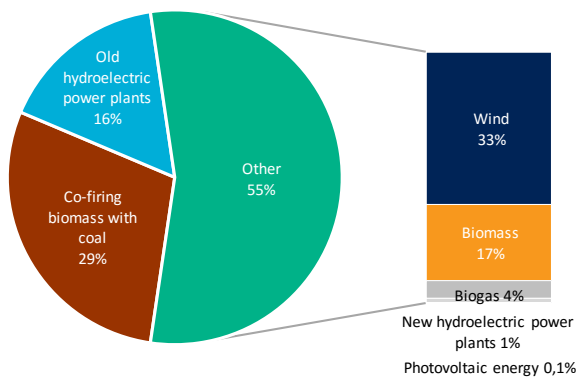
*Source: WiseEuropa's own elaboration based on EEA (2011) and Kudelko (2012)*

### 3.3 SUBSIDIES TO RENEWABLE ENERGY SECTOR

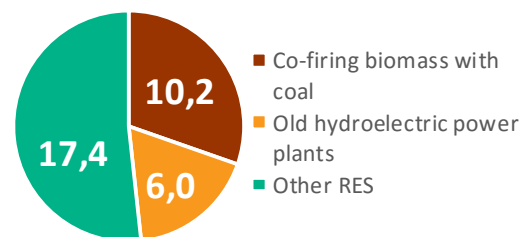
In comparison with the support dedicated to the mining and coal-based power generation industry, the mechanisms incentivising the energy production based on renewable resources in Poland are characterised by bigger simplicity and transparency.

The fundamental form of support for the development of RES in the analysed period were the green certificates. Importantly, the terms of support during the period of 2013-2016 were more favourable for the development of new RES infrastructure than during the period of 2005-2012, which is when co-firing biomass with coal and old hydroelectric power plants received most of the systemic support (approximately 40% and 25%, respectively). Such dynamics was mainly due to a short-term investment boom in the wind power generation sector: as in the case of co-firing biomass with coal, the high price of green certificates at the beginning of the current decade incentivised investors to develop this type of RES. However, the oversupply of green certificates, which caused a sharp fall in their prices and the actual collapse of this financing mechanism, as well as unfavourable regulatory changes restricting the development of wind power energy sector, do not offer any prospects in terms of creation of similarly favourable conditions for the renewable energy generation sector in the coming years. Moreover, RES infrastructure finds itself in a much more difficult situation than coal-fired power plants, which a few years ago gained profits from co-firing biomass with coal. Energy enterprises holding coal assets could quickly withdraw from co-firing biomass with coal, when green certificate prices began to fall down. An analogue reaction is not possible in case of entities which invested in new RES infrastructure. For them, low prices of green certificates may imply significant losses or even the risk of bankruptcy.

**Figure 5. Power generated under the system of green certificates, 2005–2016**



**Figure 6. Support for co-firing biomass with coal versus other RES, 2005–2016 [billions of PLN]**



Source: WiseEuropa's own elaboration based on data from URE, Eurostat

The period of 2013-2016 was also characterised by lower intensity of the EU subsidy absorption, which was related to running out of project fund allocations for 2007-2013, as well as a delay in funds distribution for the 2014-2020 financial perspective. On the other hand, the new mechanism directed to prosumers, i.e. discounts system, has currently a marginal impact on the energy market. This is mainly due to the low capacity of the infrastructure covered by new regulations. In the absence of systemic support, (e.g. in the form of feed-in tariffs), until now there has been no significant development of the prosumer-oriented energy market. At the same time, the discount system for prosumers does not offer any prospects of change in this situation in the coming years, due to relatively unfavourable terms

of energy uptake offered to prosumers. Supplying energy to the grid generates savings of approx. PLN 0.37-0.42/kWh, which considering the current costs of photovoltaic energy generation, may only be attractive to investors who can assume long-term return on investment and own infrastructure bigger than a singular micro-source (then the cost of photovoltaic power generation can be estimated at approx. PLN 0.35-0.42/kWh). This incentive, however, won't be sufficient for households which consider investing in a micro renewable installation, as in such case the costs of investment per energy unit are higher and the time of the return on investment is too long.

In the face of the aforementioned changes in the RES support system, the only support instrument available at the moment that could speed-up the development or renewable energy production again is the auctioning system. The renewable energy sector began to receive funds from auctions only in 2017, beyond the period analysed in the present study. However, it needs to be noted that according to the estimates made in September 2017, RES infrastructure will gain from the finalised auctions nearly PLN 150 million in 2017 and PLN 6.8 billion in the period of 2017-2030 – by an order of magnitude less than the support forecasted for the coal-based power generation industry in the same period (see chapter 3.4).

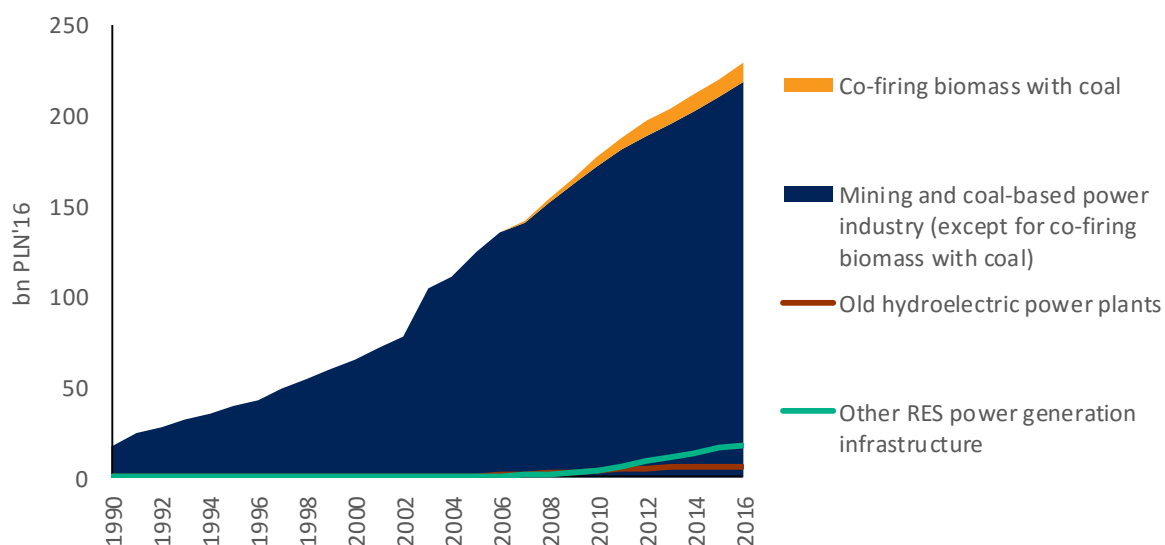
The table presenting the breakdown of financial support for RES, as well as the mining and coal-based power generation sectors, shows that the energy production based on renewable sources still receives less subsidies than the one based on coal. In the previous years, both branches of the energy sector witnessed a decrease in intensity of support (mainly due to the fall in prices of emission allowances and green certificates), however the extent of financial support still remains higher than in the case of the coal-based electricity generation. The total financial aid to mining and coal-based power generation sectors since 1990 up till now has reached the amount of nearly PLN 230 billion. The support for RES (except for co-firing biomass with coal and old hydroelectric power plants) during the same period was by an order of magnitude lower (PLN 17 billion), and in the years 2013-2016 – almost three times as low (PLN 9 billion).

**Table 5. Support for renewable energy sources, 2005-2016 [billions of PLN]**

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Total
Total green certificates, including:	1.0	1.1	1.5	1.8	2.3	3.2	3.8	4.2	2.9	3.7	2.8	1.5	<b>30.0</b>
Co-firing biomass with coal	0.2	0.4	0.5	0.8	1.2	1.5	1.8	1.8	0.7	0.8	0.5	0.0	<b>10.2</b>
Old hydroelectric power plants	0.6	0.5	0.6	0.6	0.6	0.8	0.6	0.5	0.4	0.4	0.2	0.2	<b>6.0</b>
New RES infrastructure	0.2	0.3	0.4	0.5	0.6	0.9	1.4	1.9	1.9	2.5	2.0	1.3	<b>13.8</b>
Innovation grants	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	<b>1.0</b>
Grants for the construction of infrastructure	0.0	0.0	0.0	0.1	0.2	0.5	0.5	0.5	0.3	0.3	0.2	0.1	<b>2.6</b>
Discount system for prosumers	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	<b>0.0</b>
<b>Total support for RES</b>	<b>1.0</b>	<b>1.1</b>	<b>1.5</b>	<b>1.9</b>	<b>2.7</b>	<b>3.8</b>	<b>4.4</b>	<b>4.8</b>	<b>3.4</b>	<b>4.1</b>	<b>3.0</b>	<b>1.7</b>	<b>33.6</b>
Total except for co-firing biomass with coal	0.8	0.8	1.0	1.2	1.5	2.3	2.7	3.0	2.8	3.3	2.5	1.6	<b>23.4</b>
Total except for co-firing biomass with coal and old hydroelectric power plants	0.2	0.3	0.4	0.6	0.9	1.5	2.0	2.5	2.3	2.9	2.3	1.4	<b>17.4</b>

*Source: WiseEuropa's own elaboration based on data from URE, Eurostat*

**Figure 7. Accumulated support for coal mining, as well as coal-based and RES-based electricity generation, 1990-2016 [billions of PLN]**



Source: WiseEuropa's own elaboration

The comparison between the scale of support and the volume of energy produced from each source indicates that without taking into account the external costs, the level of support for the energy production from renewable energy sources per MWh remains much higher than for power generation based on coal. However, once damages to health and local natural environment, which are not compensated by the coal-based energy industry, are considered, these estimates get reversed: during most of the analysed period, from the social point of view, RES infrastructure was less subsidised than the coal-based power generation sector. In the coming years, both the RES subsidies and the external costs of coal-based power generation will be decreasing due to further reduction of costs associated with RES infrastructure installation and operation (until they reach the expected cost competitiveness in 2020s) and the implementation of new stricter environmental standards.

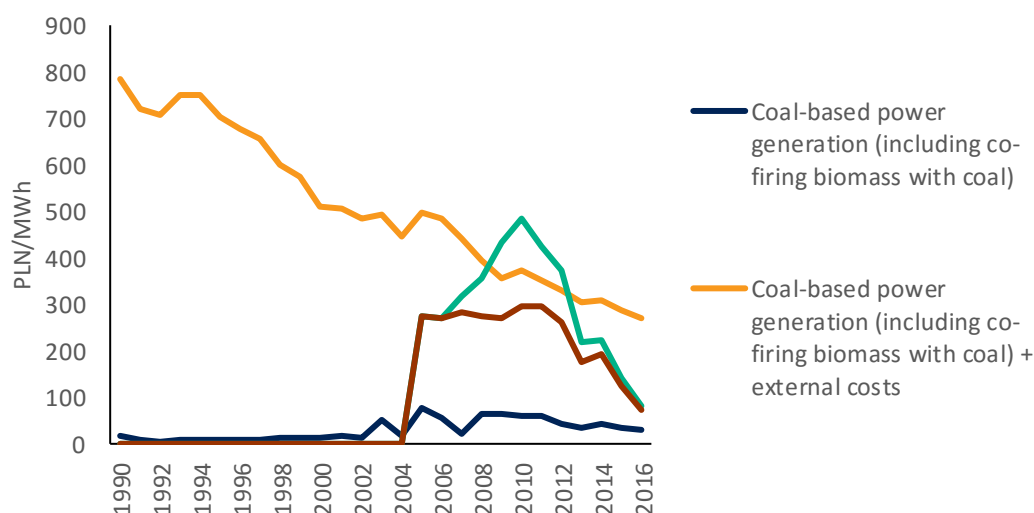
**Table 6. Support for the coal mining sector, as well as the coal-based and RES-based electricity generation, 1990–2016 [billions of PLN]**

	1990-1994	1995-1999	2000-2004	2005-2009	2010-2012	2013-2016	1990-2016
Coal mining	35	25	51	23	14	20	<b>168</b>
Coal-based power industry (except for co-firing biomass with coal)	5	5	14	36	18	16	<b>94</b>
Coal-based power industry (including co-firing biomass with coal)	5	5	14	39	23	18	<b>104</b>
Total mining and coal-based power industry*	35	25	51	54	32	32	<b>229</b>
Total RES	0	0	0	8	13	12	<b>34</b>
Co-firing biomass with coal	0	0	0	3	5	2	<b>10</b>
Old hydroelectric power plants	0	0	0	3	2	1	<b>6</b>
New RES infrastructure	0	0	0	2	6	9	<b>17</b>
Total RES power generation (except for co-firing with coal)	0	0	0	5	8	10	<b>23</b>

\*While calculating the total support for mining and coal-based power industry, the double-counting of the support for coal used to produce electricity was taken into account, therefore this value is lower than the total of all its components.

Source: WiseEuropa's own elaboration

**Figure 8. Support for electricity generation including external costs, 1990-2016 [PLN/MWh of energy coming from each source]**



Source: WiseEuropa's own elaboration

### 3.4 POTENTIAL SUPPORT FOR COAL MINING AND COAL-BASED POWER GENERATION BY 2030

Polish energy policy is currently facing two serious challenges, which might substantially increase the amount of subsidies granted to mining and coal-based power generation industry in the future. One of them is low efficiency of the national coal mining industry, which translates into poor competitiveness and inability to maintain the current levels of extraction and employment without external support, both direct (recapitalization by state-owned companies) and indirect one (preferential terms of social security benefits for the sector's employees). It is forecasted that maintaining the current support model within the mining sector will generate total costs exceeding PLN 80 billion in the period of 2017-2030, with mine-closure subsidies approved by the European Commission standing for as little as 12% of this number.

**Table 7. Total potential costs of support for coal mining and coal-based power generation by 2030 [billions of PLN]**

	Total for 2017-2030
<b>Subsidies to pensions and social security benefits for miners</b>	41.9
<b>Capacity market</b>	38.2
<b>Recapitalization of mines</b>	31.6
<b>Free emission allowances</b>	30.4
<b>Costs of mining restructuring</b>	10.1
<b>Capacity remuneration mechanisms (SCR and OCR)</b>	2.1
<b>PPA stranded costs</b>	0.5
<b>TOTAL</b>	<b>154.8</b>

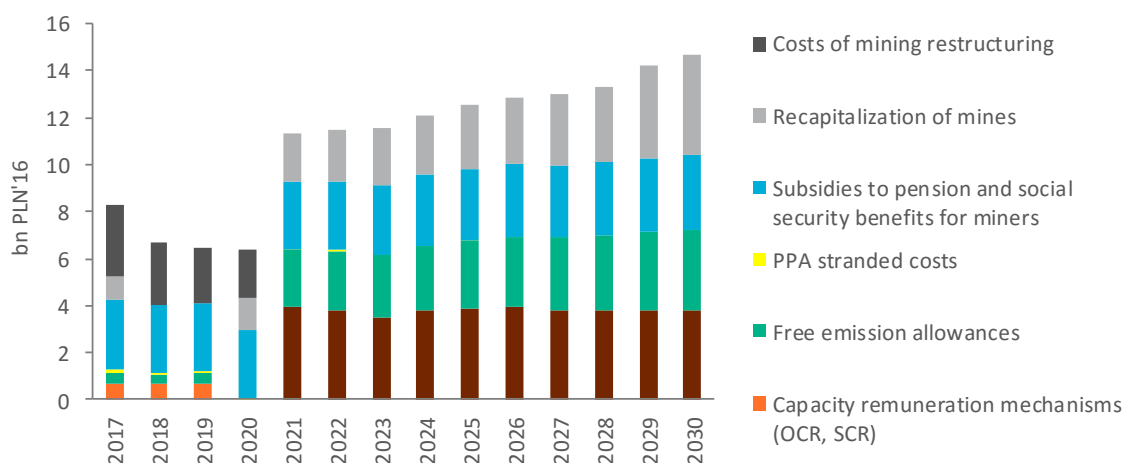
Source: WiseEuropa's own elaboration



The second challenge concerns the need to modernise the power sector's infrastructure within the national energy system, which is a result of depreciation of a significant part of coal-fired power plants. The current Polish energy policy in this aspect focuses on modernisation of the existing and building new generation capacities based on coal. In this regard, two key support instruments are currently under consideration: the capacity market – a mechanism which rewards facilities that operate within the energy system for the capacity made available for system's operation (regardless of actual electricity production levels) – and derogation mechanism that operates under the EU-ETS scheme (free allowance allocation in exchange for modernization investments), and their total amount may reach approximately PLN 70 billion by 2030. It is however important to emphasise that these mechanisms do not necessarily have to be used for investments in the coal-based power generation sector. Nevertheless, it would require changes in current plans regarding the distribution of the funds to support unprofitable investments in conventional coal-based power plants. If emission limit values for technologies participating in the capacity market are established and investments are made to expand the RES infrastructure, this mechanism could be used to finance above all power plants that serve as back-up to the energy system to those units that operate on low-emission renewable sources. Allowing for the participation, in the capacity market, of the end-users who are able to limit their energy demand at the request of the system operator, as well as cross-border exchange and power storages, will additionally reduce the need for investments in conventional power units. Another possibility is to shift away from the establishment of the capacity market and focus on reforming the existing energy-only market instead, so that it can more effectively provide incentives for investments that ensure stable operation of the energy system.

The total predicted support for mining and coal-based power generation may reach nearly PLN 155 billion by 2030 and will be characterised by an upward trend in the next decade. This is mainly due to the elevation of costs of the operation of the capacity market and escalation of state-owned companies' debts associated with continuous support to unprofitable hard coal extraction. While the EU-ETS allowance prices will rise, the scale of support under the derogation mechanism will increase. The expected cessation of the capacity remuneration mechanisms at the end of the current decade will not reduce the support for coal-based power industry, as they get replaced by the much more extensive capacity market. Likewise, the finalisation of the planned restructuring activities within the mining sector, financed from the national budget (mainly closure of the least profitable mines), at the end of this decade will not lead to the reduction of the subsidies for coal extraction in the 2020s. Sustaining the operation of other mines will require ever growing support from the state-owned companies, which at the end of the analysed period will amount to over PLN 4 billion per year.

**Figure 9. Forecasted costs of support for mining and coal-based power generation, 2017-2030 [billions of PLN]**



Source: WiseEuropa's own elaboration

The compensation for the stranded costs that resulted from the PPA termination is an unusual mechanism of hidden support for the coal-based power sector. Direct costs of this mechanism – included in the presented calculations – are relatively low, as the legally established limit of support for power plants from this instrument has been almost entirely exhausted. However, the amendments to the Bill on early termination of Power Purchase Agreements introduced in 2016, introduced the possibility of recapitalization of energy enterprises using funds retrieved from the interim fee, which had been initially established only for the purpose of compensation for the costs related to the early termination of Power Purchase Agreements (see chapters 2.5 and 2.11). The Bill suggests that the minister of energy can shorten the period of charging the interim fee, in case the power plants have received full compensation and the compensating company has paid off the related debt. However, the stipulations of the Bill do not guarantee that withdrawing from interim fees will actually occur when they are no longer necessary to compensate for the costs related to the early termination of PPAs – the decision in this regard is to be taken by the minister. There are thus two possible scenarios: either a quick withdrawal of such charges and ending the continued use of funds received from them for recapitalization of energy enterprises or maintenance of the legally stipulated amount of the interim fee for the maximum permitted period of time (until 2029). According to authors' estimates, if the second scenario is adopted, until the end of the next decade the government will gain a total of PLN 26 billion for recapitalization of energy enterprises. Due to high uncertainty as to what will be decided in this regard, this amount was not included in the summary compilations (see Table 6). However, the authors would like to stress that the risk of introducing this new mechanism of hidden support for the energy industry at the cost of the end-users in the coming years is significant.

It should be emphasised that if Polish energy policy is to be reoriented towards diversification of the energy sector and reduction of pollutant emissions, the future amount of support for coal extraction and its combustion in power plants could get reduced. The most important decisions will be the ones defining which electricity generation capacities will be subsidised, as well as the way of restructuring the hard coal mining sector: will the current approach, focused on investing in coal-based capacities and sustaining the unprofitable coal extraction by direct and hidden subsidies be maintained or will the funds for the development of the energy sector be diverted towards its diversification and capturing the national potential of renewable energy resources? It is also worth noting that the possibility of financing the investments in coal-based power generation through the capacity market and the funds

from EU-ETS is highly doubtful. In the coming years, Polish support for coal will get restricted by EU regulations, which will determine the rules governing state aid. Current proposals of the European Commission are heading towards the elimination of support for coal-fired power plants in the next decade, both by the capacity market and the derogation mechanism under the EU emission trading system.

## 4. SUMMARY AND RECOMMENDATIONS

The analysis of support for the coal mining sector and the power industry clearly shows that in Poland subsidies to coal extraction and coal-based power generation in absolute terms still prevail over the subsidies dedicated to renewable energy sources. Considering health and environmental costs related to pollutant emissions generated by the coal-based power industry and incurred by the society, the ‘hidden bill’ for coal is higher than for RES, also when transposed to per-energy-unit values. It is also worth noting that the total support dedicated to renewable energy sources – unlike the subsidies to mining and coal-based power generation – are of transparent nature.

**Table 8. Annual costs of support for mining and coal-based power generation per capita and per household [PLN, based on constant 2016 prices]**

	Annual costs:			
	per capita		per household	
	2016	Mean value 1990-2016	2016	Mean value 1990-2016
<b>Incurring by tax-payers</b>				
Subsidies to pension and social security benefits for miners	86	84	234	240
Costs of mining restructuring	99	78	270	230
EU subsidies	1	2	4	6
<b>Included in the electricity bill</b>				
PPA stranded costs	24	13	66	35
Capacity remuneration mechanisms (SCR, OCR)	17	1	45	4
Free emission allowances	11	34	30	95
Green certificates – co-firing biomass with coal	1	10	3	28
<b>Harm to health and environment degradation</b>				
External costs (mean value)	806	1689	2191	4936
<b>TOTAL</b>	<b>1045</b>	<b>1910</b>	<b>2843</b>	<b>5572</b>

Source: WiseEuropa's own elaboration

**Table 9. Annual costs of support for the renewable energy sector per capita and per household [PLN, based on constant 2016 prices]**

	Annual costs:			
	per capita		per household	
	2016	Mean value 1990-2016	2016	Mean value 1990-2016
<b>Incurring by tax-payers</b>				
EU subsidies	3	3	8	10
<b>Included in the electricity bill</b>				
Green certificates – old hydroelectric power plants	4	6	12	16
Green certificates – new RES infrastructure	35	13	94	37
Discount system for prosumers	0	0	1	0
<b>TOTAL</b>	<b>42</b>	<b>23</b>	<b>115</b>	<b>63</b>

Source: WiseEuropa's own elaboration

In 2016, the cost of support for the mining and coal-based power generation sectors *per capita* amounted to PLN 239 (PLN 1045 once external costs were included) and was similar to the average annual value from the past quarter of century. Out of this amount, PLN 187 is provided by public funds and PLN 53 – is included in the electricity bills. In case of RES, this amount was slightly over PLN 40 and was almost entirely financed by energy end-users (via electricity bills). By way of comparison, in 2012, the support for the coal mining and coal-based power generation sectors *per capita* amounted to PLN 233 (PLN 1233 taking external costs into account), and RES subsidies – PLN 79.

The period of 2013-2016 brought a series of changes, which influenced the amount and structure of subsidies in the mining and power industries. Firstly, the fall in hard coal prices on the global market, as well as low productivity of Polish mining, translated into a deep crisis suffered by the sector. This led to a new increase in the subsidies: the last couple of years during which the lower financial support was granted, turned out to be rather an exception resulting from a boom on the global coal market during the period of 2004-2011. However, most importantly, a new type of aid was applied for the first time in 2016, i.e. the recapitalization of unprofitable mining enterprises by state-owned companies. It is a particularly risky type of support, as – contrary to direct aid programmes approved by the European Commission and dedicated to alleviate the effects of unprofitable mine-closure – no clear perspective was outlined on how the state would withdraw from the mechanism.

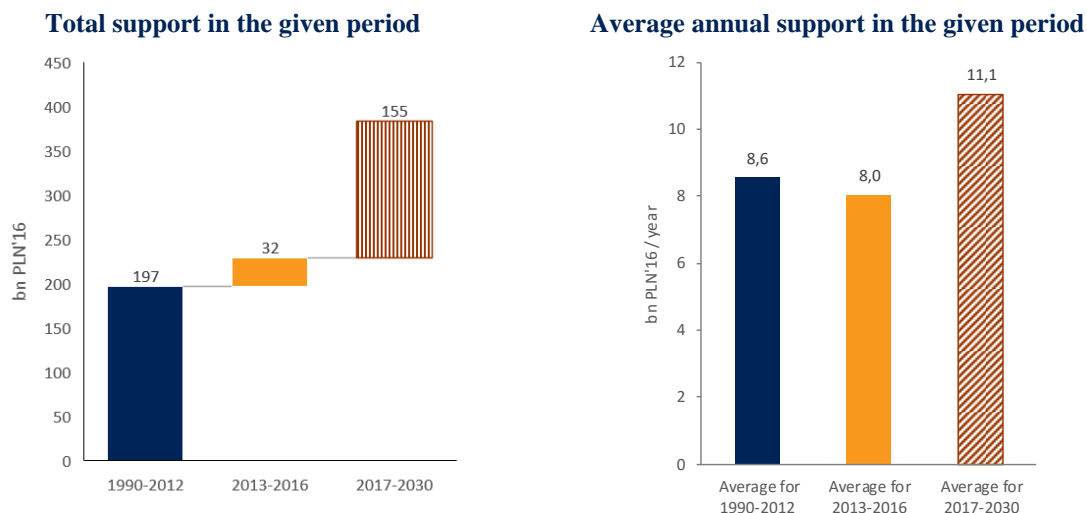
Secondly, the system of green certificates suffered a collapse. The oversupply of certificates on the market associated with both supply (inclusion of co-firing biomass with coal in the system, dynamic development of wind power sector) and demand factors (the obligation to acquire green certificates increasing not quickly enough) resulted in an over threefold fall of their prices and the subsequent decrease in the intensity of support for the renewable energy sector. On the other hand, the scale of support under the newly established auctioning system is much smaller, which practically makes it impossible for Poland to reach the RES goal for 2020 (Ecofys, 2017). The auctioning mechanism itself has a positive impact on the cost-efficiency of the renewable energy infrastructure development, however, it is not well suited to support distributed power generation. The discount system for prosumers – introduced in 2016 in place of the previously planned feed-in tariffs – until now has remained a niche solution, which considering the current costs of RES micro-installations doesn't offer an incentive sufficient enough to significantly boost the investments in this segment of the market.

Thirdly, as a result of a decrease in prices of emission allowances under the EU-ETS and implementation of stricter regulations for the electricity generation sector, since 2013 the amount of support in the form of free allowance allocation for coal-based power generation has been reduced. This trend will, however, be only temporary. Taking into account the current negotiations of the EU-ETS system reform, which will probably lead to a rise in allowance prices, as well as the possibility of extending the derogation mechanism until 2030, which Poland successfully negotiated, free allowance allocation will constitute one of the key support instruments for the Polish energy sector in the next decade. The only question that remains unanswered is what kind of investments will be supported under this mechanism.

Fourthly, due to the progressive depreciation of infrastructure, importance was given to investments in modernization and boosting generation capacities, which provide stability to the energy system. In the previous years, solutions of interim nature, i.e. the capacity remuneration mechanisms (OCR and SCR) were introduced, however according to the current plans, the final solution will establish the capacity market in Poland. In its proposed shape, this mechanism creates the risk of maintaining the *status quo* in the Polish energy sector, especially in terms of financing the construction of new coal-fired power plants, which would then constitute a basic component of the national energy system. It can

however be modified to support diversification within the sector. Establishment of emission limit values that would exclude conventional coal-based power plants from the capacity market will allow for diverting the funds towards flexible capacities that can cooperate with the wind energy sector and the photovoltaic systems, as well as help end-users to open up to innovation and give way to cross-border exchange. A reform of the energy-only market, while ensuring stable energy system operation with a simultaneous dynamic development of the renewable energy infrastructure without establishing a separate capacity market, can also be envisaged.

**Figure 10. Support for coal mining and coal-based power generation (except for external costs) during the period of 1990-2016 and forecasted support for 2017-2030 [billions of PLN, based on constant 2016 prices]**



Source: WiseEuropa's own elaboration

The crisis in the hard coal mining sector coupled with the urgent need to modernise the energy industry create risk of a major increase in support for the coal-based power generation sector. The estimates presented in this study suggest that maintaining the current shape of Polish energy policy may lead to financial support reaching PLN 150 billion to the mining and coal-based power sector by 2030. This stands for an average annual support of over PLN 11 billion, which would be 30% higher than in the past quarter of century.

An increased support for coal extraction and coal-based power generation is not yet certain and depends on the approach that the national decision-makers will adopt in the coming years. Public policy should shift away from the current path of energy industry development, that is mainly based on the direct and hidden subsidies, and ignores the impact of coal-based power industry on the environment. In particular, the following measures are recommended:

- Refraining from further investments in unprofitable mines and adjusting the scale of hard coal mining activities to their real economic potential.
- Shifting the support towards restructuring of local economies currently dependant on the deteriorating mining industry and relocating employees from mining enterprises to other sectors.
- Inclusion of mining sector's new employees in the common social security scheme.
- Revision of the PPA Bill in order to ensure that the interim fee does not exceed the real costs of compensation paid to power plants for early termination of Power Purchase Agreements.

- Diverting the funds allocated to the modernization of the national energy sector towards the investments that would facilitate diversification of the energy mix, as well as development of the RES infrastructure. A possible establishment of the capacity market should support flexible units, which are supposed to play an auxiliary role in the system, as well as demand-side management. This will ensure safe system operation, while increasing the share of renewable energy technologies, which will offer increasingly competitive prices, in particular wind power installations and photovoltaic systems.
- Establishing – without awaiting resolutions at the EU level – national emission standards for investments supported by the capacity market (in case it is to be introduced), and those funded by the European Union Emission Trading System (EU-ETS) funds, especially under the derogation mechanism.

## REFERENCES

- World Bank (2017), *World Bank Commodities Price Forecast – April 2017*, Washington.
- Bayer E., Rączka J., Baker P. (2015), *Elementy nowej organizacji rynku energii w Polsce*, FAE, Warsaw.
- Bukowski M., Śniegocki A. (2014), *Ukryty rachunek za węgiel. Analiza wsparcia gospodarczego dla elektroenergetyki węglowej oraz górnictwa w Polsce*, WISE, Warsaw.
- Bukowski M., Siedlecka U., Śniegocki A. (2016a), *Coalapase. Will fusion with the energy sector save Polish mining?*, WiseEuropa, Warsaw.
- Bukowski M., Siedlecka U., Śniegocki A. (2016b), *Revenues from ETS auctioning as source of financing for low-emission modernization in Poland*, FAE, Warsaw.
- Client Earth (2017), *Rządowy projekt ustawy o rynku mocy. Wątpliwości prawne, środowiskowe i ekonomiczne*, Warsaw.
- Ecofys (2017), *Prognoza realizacji celu OZE 2020 dla Polski*.
- EEA (2011), *Revealing the costs of air pollution from industrial facilities in Europe*, EEA Technical Report, European Environment Agency, Copenhagen.
- IEO (2017), *Rynek fotowoltaiki w Polsce 2017*, Instytut Energetyki Odnawialnej, Warsaw.
- EC (2016), *State aid to Polish coal mining in the period 2015-2018*, C(2016) 7510 final, European Commission, Brussels.
- Kudęłko M. (2012), *Koszty zewnętrzne produkcji energii elektrycznej z projektowanych elektrowni dla kompleksów złożowych węgla brunatnego Legnica i Gubin oraz sektora energetycznego w Polsce*, Cracow.
- Kugiel M. (2010), *Działania Kompanii Węglowej SA w zakresie ochrony środowiska, ze szczególnym uwzględnieniem gospodarczego wykorzystania metanu*. *Górnictwo i Geologia*, 5(1), 73-87.
- ME (2017), *Program dla sektora górnictwa węgla kamiennego w Polsce*, wersja z 9.08.2017, Ministerstwo Energii, Warsaw.
- Naworyta W. (2010), *Wybrane problemy szacowania kosztów likwidacji kopalń odkrywkowych na podstawie własnych doświadczeń*. *Górnictwo i Geoinżynieria*, 34(3), 131-140.
- NIK (2017), *Funkcjonowanie górnictwa węgla kamiennego w latach 2007-2015 na tle założeń programu rządowego*, Najwyższa Izba Kontroli, Delegatura w Katowicach.
- Pepliński B. (2016), *Skutki ekonomiczne dalszej eksploatacji w czynnych odkrywkach węgla brunatnego w zagłębiu konińskim – analiza kosztów dla rolnictwa i przetwórstwa rolno-spożywczego*, Poznań.
- Polak K. (2005), *Kształtowanie środowiska wodnego w antropogenicznie przekształconym górotworze na wybranych przykładach kopalń węgla brunatnego w Polsce*. Wydział Górnictwa i Geoinżynierii AGH, Cracow.
- Saługa P., Jarosz J., Sobczyk E., Kicki J. (2008), *Fundusz likwidacji kopalń – czy wszystkim wystarczy*. *Gospodarka Surowcami Mineralnymi*, 24(2/4).
- Sierpińska M. (2016). *Rezerwy jako źródło finansowania aktywów spółek górniczych*. *Studia Ekonomiczne*, 307, 103-114.
- Stachowski P. (2007), *Ocena odbudowy zwierciadła wody na terenach przekształconych działalnością górnictwa węgla brunatnego*. *Rocznik Ochrona Środowiska*, 9, 225-238.



Uberman R. (2015), *Podatki, opłaty i zabezpieczenia finansowe w polskim górnictwie, w tym w górnictwie surowców energetycznych*. *Polityka Energetyczna*, 18.

UOKiK, *Raporty o pomocy publicznej w Polsce udzielonej przedsiębiorcom za lata 2013-2016*, Urząd Ochrony Konkurencji i Konsumentów, Warsaw.

**Useful websites:**

Eurostat – <http://epp.eurostat.ec.europa.eu/>

Map of EU subsidies for Poland – <http://www.mapadotacji.gov.pl/>

Polish Power Exchange (*Towarowa Gielda Energii*, TGE) – <https://www.tge.pl/>

Polish Energy Regulatory Office (*Urząd Regulacji Energetyki*, URE) – <http://www.ure.gov.pl/>