GOSPODARKA SUROWCAMI MINERALNYMI

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Can ecological charges be a solution for the environmental liabilities?

Key words

Mining industry, environmental protection, waste management, operating costs

Abstract

In 2002 MMSD Report it was stated that "in a well-functioning market economy, the price paid for a mineral commodity — as for any other good or service — should reflect the full marginal costs of both production and use". It could have lost some of actuality now, when most of raw mineral commodities prices is rising, but it can be still true for European producers, especially when new ecological charges are anticipated.

Mining is one of most environmentally destructive activities, often producing high output of waste. The idea that mining companies have the responsibility to manage and pay for the rehabilitation of mine sites during and after production is now widely accepted. Usually a mine, together with the processing plant and the tailings and waste-rock facilities, will only be in operation for a few decades, but mine voids, tailings and waste-rock may remain long after termination of the mining activity. Therefore special attention needs to be given to the proper closure, rehabilitation and after-care of these facilities. Moreover, all operators from the extractive industry should secure sufficient financial means to ensure the eventual full reinstatement of the waste management facilities for which they are responsible.

EU Environmental Policy promotes the green market economy, which include internalisation of environmental and social costs as well as subsidies reform to achieve environmental efficiency. The introduction of environmental charges cause an increase of the production cost and influence the company competitiveness. Therefore the level of any charges for any pollutant should be uniform within the EU.

In this paper operating activity of mining companies is analysed, in the aspect of EU enlargement, valid and prepared legislation, environmental initiatives, but most of all — with the consideration of common market conditions determining production costs. The main emphasis is put on costs of waste management, especially for tailings, as for obligatory funds, taxes, fees and charges related to environmental protection (monitoring and post-closure, waste disposal, etc.). Comparisons of different economic instruments for environmental protection in chosen countries and total operating costs for waste management is also presented.

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Introduction

In 2002 MMSD Report it was stated that "in a well-functioning market economy, the price paid for a mineral commodity — as for any other good or service — should reflect the full marginal costs of both production and use". It could have lost some of actuality now, when most of raw mineral commodities prices are rising, but it can be still true for European producers, especially when new ecological charges are anticipated.

Mining is one of most environmentally destructive activities, often producing high output of waste. The idea that mining companies have the responsibility to manage and pay for the rehabilitation of mine sites during and after production is now widely accepted. Usually a mine, together with the processing plant and the tailings and waste-rock facilities, will only be in operation for a few decades, but mine voids, tailings and waste-rock may remain long after termination of the mining activity. Therefore special attention needs to be given to the proper closure, rehabilitation and after-care of these facilities. Moreover, all operators from the extractive industry should secure sufficient financial means to ensure the eventual full reinstatement of the waste management facilities for which they are responsible.

Moreover, according to the EU Environmental Policy, the green market economy is promoted, including internalisation of environmental and social costs and subsidies reform to achieve environmental efficiency. The introduction of environmental charges caused an increase in the cost of production and influenced the competitiveness of production. Therefore the level of any charges for any pollutant should be uniform within the EU.

1. EU legislation and regulatory aspects

Some solutions for creating financial guarantee for closure and after-care phase and for cost internalisation for extractive industries are confirmed in following EU documents:

— EU Directive 2006/21/EC on the Management of the Waste from Extractive Industries, officially published on June 2, 2003, and published in Official Journal on March 15, 2006. The Directive merely creates "a level playing field" in the areas of extractive waste, by specifying requirements on the design, operation, closure and most importantly — post closure inspection of waste management facilities. This will be achieved, by specifying and requiring improvements on all aspects of these facilities.

— EU communication published in October 2003 (COM (2003) 572) entitled "Towards a Thematic Strategy on the Sustainable Use of Natural Resources". This is the first step in the development of a European Resource Strategy, for which the main objective is to achieve a decoupling of any resource-related environmental impact from economic growth over the longer term (25 years). The Strategy will complement existing environmental policies that address the status of environmental media, but will begin a proposal for environmental cost internalisation in mining sector as well as

using life-cycle assessment (LCA) for environmental assessment of mineral resources, i.e. taking into account the entire life-cycle of a product as well of its substitutes.

2. Proposal of cost internalising calculation

Cost internalisation means that economic measures, such as taxes and fees, should be applied to internalise the full cost of production. The introduction of environmental charges, caused an increase in the cost of production and influenced the competitiveness of production. Therefore, the level of any charges for any pollutant should be uniform within the EU. In theory, to express the pollutant harmfulness in monetary terms, many approaches can be used (contingent valuation or hedonic prices and travel cost) but two main forms of monetary valuation can be distinguished:

— Based on the effects-oriented policy: the damage is expressed in monetary terms,
— Related to the source-oriented policy: the cost required to prevent the effect are expressed in monetary terms.

To implement these methods some solutions were proposed. In the US there were a number of attempts to convert emission data for lead into monetary figures. Other metals are then compared to lead, in terms of toxicological data and calculated exposures, based on USES model. Damages due to airborne lead emissions, via all exposure routes, range from 400 USD/kg to 44 000 USD/kg. A different approach, developed in the USA, was to equate damage cost to the marginal costs of emissions control at the lead smelter.

Poland is one of the unique countries where environmental charges for cost internalisation were introduced in the 1980, and with the implementation of a new ecological policy in 1991, thry increased significantly. The aim was to deal with the remnants of the previous regime, therefore every users of the environment should pay for it. In Poland, there are charges for gases, dust, wastewater as well for solid waste (according to EU code), e.g. cost of placing 1 ton of non-ferrous metal tailings is equal to PLN/Mg (~2 EUR).

Environmental charges have been collected by special funds, i.e. the National Fund of Environmental Protection and Water Management, as well as by local community funds. The implementation of environmental charges boosted interest in environmental protection, which took the form of increased environmental investments — a significant part of which was financed from own sources, credits and loans, as well as subsidised by the environmental funds (Fig. 1). The highest share of environmental investments in GNP was noticed in 1996—1997 (2%, towards 1,2% in 1995), but quickly reduced to ~1% in 2000—2002.

During the past a lot of Polish companies have been developing environmentally friendly solutions through reduction of material and energy intensity (as price of water, energy and other primary natural resources increased significantly to eliminate the unsuitable under--pricing policy), enhancing the possibility of material recycling, maximisation of sustainable use of renewable resources, waste reduction etc. The improved environmental efficiency was

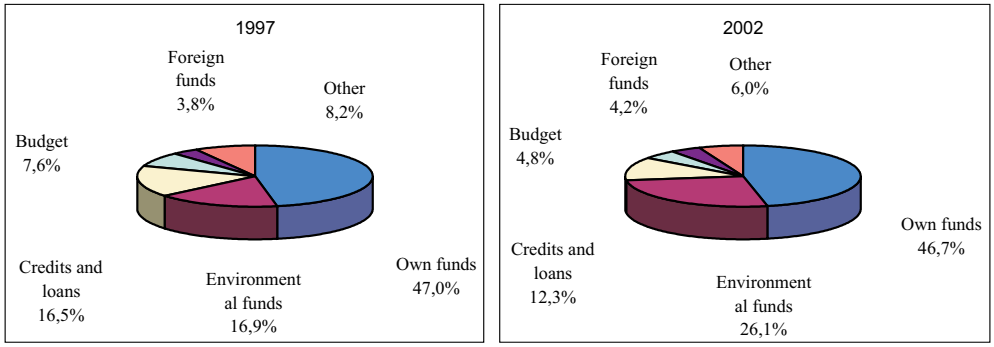

Fig. 1. Financing sources of environmental investment in Poland (source: Polish Official Statistics)

Rys. 1. Źródła finansowania inwestycji środowiskowych w Polsce (źródło: GUS)

achieved because of the introduction of the environmental charges, but also due to better understanding of the damage done to the environment and/or increased availability of tools that allow care for the environment, e.g. pollution generation by Gross Domestic (or National) Product (Table 1). At the same time the mentality of people (also as corporate members') is changing — they can see that being green pays off, and that is currently the driving force for the economy.

TABLE 1

Pollution generation by Gross Domestic Product (calculation based on Polish Official Statistics)

TABELA 1

Zanieczyszczenie środowiska a Produkt Krajowy Brutto (obliczenia w oparciu o dane GUS)

Pollution	Unit	1995	1996	1997	1998	1999	2000	2001	2002
Dusts	kg/'000 PLN of GDP	4.25	3.22	2.39	1.57	1.32	0.56	0.65	n/a
	%	100	76	56	37	31	13	15	-
SO_2	kg/'000 PLN of GDP	7.71	6.11	4.62	3.43	2.79	2.12	2.08	n/a
	%	100	79	60	44	36	27	27	-
NO_2	kg/'000 PLN of GDP	3.64	2.98	2.36	1.79	1.55	1.17	1.07	n/a
	%	100	82	65	49	43	32	29	-
Industrial waste produced per year	kg/'000 PLN of GDP	398	321	264	240	205	176	165	153
	%	100	81	66	60	52	44	41	38

Environmental charges for waste storage have to be paid even if company storage tailings on its own damps. This is particularly meaningful for mining, as the mining waste (tailings)

represents 25% of total industrial waste produced in Poland yearly. As a factor increasing total cost of production, they influence on competitiveness of Polish mining procures. Therefore for most mining projects there is a growing need to identify environmentally compatible and economically feasible solutions, which minimise waste and pollution, but also maximise resource productivity.

Generally, basing on Polish experience, introduction of the appropriate level of charges can promote environmental and economic efficiency, but it is an extremely complex and difficult task. There are many different ecological taxes and charges within the EU (Table 2). The aim is general the same — to promote rational use of water, energy, raw materials and proper waste management, but the level and type of charges are different what influenced on cost of production and on competitiveness of different producers. To internalise environmental costs for mining industry the technique concerning the life cycle perspective can be applied. It means that should be taken into account all environmental and social costs incurred at all stages of the mineral life cycle, including environmental damage and social disruption in mining as well as pollution from processing and waste use. Such techniques can be LCA and LCC, which aim is to quantify all environmental costs, i.e. both internal and external, incurred at all stages of the product life cycle.

The LCC analysis can be used for development of the cost-effective model solution in respect to the predicted environmental impact of the particular mine, for those currently in operation and in liquidation, or designated for closure. Any comparison study of the influence of the environmental costs on mining projects should be based on long-term cost-benefit analysis of environmental investment. Depending on the accuracy of the model, the LCC calculation can consist of the sum of costs for functional units or a sum of costs for every process. Using LCC, it is possible to calculate the maximum budget available for any investments that will reduce the amount of waste. For such a calculation it is proposed to use the Life Cycle Net Present Value (LCNPV) that helps to evaluate and select the best solution for new investment plans in existing mining projects, or to assess the economic and ecological feasibility of new projects.

3. The role of taxation in mine rehabilitation

Environmentally related taxes can be defined as any compulsory, unrequited payment to general government levied on tax-bases deemed to be of particular environmental relevance. Taxes are unrequited in the sense that benefits provided by government to taxpayers are not normally in proportion to their payments. The term levy can be used to cover both “taxes” and “fees and charges”.

Two main mechanisms exist for preparing for the rehabilitation of currently operating mines. The more widespread one is an arrangement for the amount to either be physically set-aside or for bonds (e.g. Canada and South Africa) or guarantees (e.g. Australia) to be used. The second one is practised in the USA and provides for funds purely in accounting

TABLE 2

Review of economic instruments for waste management in chosen countries

TABELA 2

Przegląd instrumentów ekonomicznych dotyczących zarządzania odpadami w wybranych krajach

	Taxes	Fees/charges	Deposit-refund systems	Environmentally motivated subsidies	Voluntary approaches
Austria	Waste deposit levy	batteries; municipal waste collection/treatment; packaging	electric bulbs; plastic bottles	For abating air pollution, hazardous waste, and noise (except traffic)	
Belgium (*Flanders)	Écotaxes	waste dumping and burning*		Prevention stimulation for industry*	Covenant on: batteries and storage batteries*; discarded electric and electronic apparatus*; paper waste; wrecked cars and old tyres
Denmark	Duties on: paper bags, plastics, etc.; certain retail containers; disposable tableware; electric bulbs and electric fuses; sealed Ni-Cd batteries; tyres; waste	batteries; hazardous waste; municipal waste collection / treatment	beverage and PET bottles; lead & accumulators; Ni-Cd batteries	For: integrated product policy (general)	Agreements on: collection and recycling of old car tires; collection and removal of lead accumulators; disposal of CFC-containing refrigerators; recycling of packing and containers used for transport; selective demolition
Finland	Oil damage levy; oil waste levy; Tax on waste	hazardous waste; municipal waste collection / treatment; nuclear waste; tyres	car hulks; soft drinks, beer, wine, spirit containers	for environmentally sound technology and products; soft loans for industry and municipalities for pollution control	
France	General tax for pollutants	municipal waste collection / treatment; waste disposal			
Germany		dangerous waste			Agreement on environmentally sound management of end-of-life vehicles
Greece	Charge on: municipal waste collection / treatment; waste disposal				
Italy	Consumption tax on lubricant oil; Tax on: waste disposal; plastic bags	batteries; lubricant oil; municipal waste collection / treatment; packaging			Memorandum of Understanding; Programmatic / Voluntary Agreements signed between State Authorities and Local Institutions / Industry / Environmental NGOs
Netherlands	Minerals accounting system; Waste tax	Municipal Waste Charge	bottles	Grants for: clean products; International co-operation; Support to environment and technology research	Covenant for the basic metals sector
Sweden	Charge on nuclear waste; Tax on waste	municipal waste collection/ treatment; scrapped cars; batteries	glass and PET bottles, aluminium cans; motor vehicles	Grants for handling ship oil wastes.	
UK	Landfill tax				Packaging Waste Recovery Note and Packaging Waste Export Recovery Note system

terms — notional reserve is created by accruing costs during production. Although such mechanisms provide incentives for companies to prepare for the cost of rehabilitation, it does not guarantee that the funds will be available when required. Whichever of these mechanisms is applied, the government has a responsibility to draft carefully-considered and thorough regulations concerning the tax treatment of rehabilitation costs.

It is necessary to define in detail what items of rehabilitation cost are tax deductible. Regulations in Australia exclude the planning for site rehabilitation, any rehabilitation during mine operations and any restoration activities off the mine site itself. In Namibia deductions are provided in respect of contributions to funds established to remedy "any damage caused by such mining operations to the surface of, and the environment on, the land in question", but these deductions may be clawed back by the government if they are not used for such remedial action.

More complex is determination of time when tax relief may be claimed. Because many companies operate on the basis of discounted cash flow, earlier tax relief is more attractive. Unfavourable scheme exists in Australia — if a trust fund is set up, no deductions can be claimed until the rehabilitation costs are actually incurred, with no provision for loss carry back or tax credit. In South Africa the contributions to the fund are tax deductible at the time of payment, though it is necessary to define how the acceptable level of contribution is calculated in order to prevent abuse. Loss carry back is available in the USA and the UK. Alternatively a unit-of-production method may be used to allocate rehabilitation costs, as in the petroleum sector of the Netherlands.

Another aspect is to define beneficiary of accrued interest as well as objects of tax deductions and tax exemptions. In South Africa the interest earnings of the trust fund accrue to the mining company and are tax exempt, whereas in Canada such income is taxable as are any drawings from the fund. The government also needs to consider whether or not the service fees and interest costs attached to the various forms of financial arrangements should be tax deductible. Estimating the actual future cost of rehabilitation is extremely difficult for many reasons: mines may have a life in excess of 50 years; the ultimate size and life of the mine is essentially almost unknown at the start of operations; the technology available for both mining and rehabilitation is certain to change during the life of the mine; and the standards of rehabilitation acceptable to society are likely to rise. One way to address this dilemma is to set a ceiling for the fund for each mine. If the costs of rehabilitation exceed the value of the fund, the government pays the excess. If the costs are less than the value of the fund, the government keeps the difference.

All rehabilitation funds run the risk that the actual cost of rehabilitation differs significantly from the amount held in the fund. Clear guidelines are required concerning the fate of any excess. If the surplus passes to the government, then companies are likely to underestimate the costs of future rehabilitation in order to reduce the risk of such revenue loss. If the surplus reverts to the company, the tax treatment of this flow of funds must be clarified in advance. Whichever methods are chosen, the government has the responsibility to put in place a regime for environmental protection and mine rehabilitation which not only

protects the national interest but which also imposes on the mining companies financial obligations and incentives which are detailed, transparent and equitable. Those states which fail to do so will lose in the long-term, either through the degradation of their environment or by their failure to attract investors.

4. Operating costs and costs of waste managment in mining industry

Extractive industries produce their own specific wastes. In case of mining waste these include materials that must be removed to gain access to the mineral resource, such as topsoil, overburden and waste rock. The costs of managing all mining waste vary considerably from mineral to mineral, and for a single mineral — they vary significantly from mine to mine. The cost for waste-rock management are presented in Table 3.

TABLE 3

Cost for waste-rock management (EUR/Mg of waste)

TABELA 3

Koszt zarządzania odpadami (EUR/Mg odpadów)

Sub-operation	Units	Cost interval
Hoisting to surface	EUR/Mg	0.5—1.0
Surface transport to dump	EUR/Mg x km	0.2—0.5
Dump construction	EUR/Mg	0.1—0.5

The more complicated considerations concern costs for tailings management. While costs for each producer can be easily quantified, the methods of the calculation containing so many variables make them different. For example, for zinc and copper mines, waste management typically accounts for about 1.5—2.0% of total cash costs, but it concerns only 60-70% of companies. This may include an allowance for capital expenditure (on items such as raising the height of tailings dams) as well as current costs (Table 4).

The differences between cost level achieved in every single mine or company comes from several reasons. First of all — calculations are based on different methodological approach — as it can be seen analysing items presented in the table. Then comes a wide range of unique technical and technological aspects (type of mineral, quality and size of deposit, age / period of exploitation, methods of extraction / processing / disposal, machinery, and many more). Another subject is a regulatory valid in a specific country. Regardless these limitations, as determinants most influencing cost level tailings dewatering and pumping, dam raising, transport, and ecological fees (mainly Poland) can be indicated. Although, as presented in Tables 3—5 single items as well as total operating costs for a given company or mine can vary significantly.

Comparison and calculation of the costs of mining waste management in Europe globally, requires clear accountability and an accepted measurement methodology. While costs for

TABLE 4

Cost for tailings management in (EUR/Mg of waste — tailings)

TABELA 4

Koszt zarządzania odpadami poflotacyjnymi (EUR/Mg odpadów poflotacyjnych)

General review		KGHM		Zinkgruvan		Rio Narcea	
Sub-operation	cost	Sub-operation	cost	Sub-operation	cost	Sub-operation	cost
Pumping to pond	0.1	Pumping to pond	0.530	Tailings pumping	0.11		
Dam raises	0.4	Dam construction	0.060	Piers	0.07	Dam raises	0.5
Tailings distribution	0.05—0.3	Pumping water back to the processing plant	0.333	Pumping water back to processing plant	0.04		
Tailings pumping and maintenance	0.1	Pumping excess water to the river	0.046	Pipe wear	0.16		
Tailings dewatering	1.0—4.0	Ecological fee for tailings disposal	0.470				
		Ecological fees for discharged water	0.097				
Dust suppression	>0.1	Dust spraying with asphalt emulsion	0.031				
Water treatment with lime	0.1	Purification of discharged water	0.031				
Monitoring	0.1	Hydrotechnical monitoring	0.002	Dam safety monitoring	0.05		
		Safety supervision and control procedures (geotechnical monitoring)	0.014				
		Air, water, soil and seismic monitoring	0.020			CN destruction	1.0
Truck transport to mine/dump	0.5—1.0	Emergency alarm system	0.0004	Others	0.38	Others (energy, pipes, maint.)	0.5
Total operating cost	2.4-6.6		1.6		0.8		2.0

each mining producer are easily quantified, the methods of the calculation of waste management costs — with so many variables — for every mine in every country can vary significantly. Even though accounting standards for most European (EU and candidate countries) mining companies are in compliance with International Accounting Standards, there may be differences in the way costs are presented and calculated. This is especially evident in waste management costs. To identify all costs and to develop a transparent methodology for waste management, the cost calculation needs to take full account of Life Cycle Assessment analysis for an individual company.

TABLE 5

Total Operating Cost of tailings management in chosen companies / mines (EUR/Mg)

TABELA 5

Całkowite koszty operacyjne zarządzania odpadami poflotacyjnymi w wybranych firmach /kopalniach (EUR/Mg)

Company / mine	Total Operating Cost (EUR/Mg)
General review	2.45—6.60
Boliden	0.80
Zinkgruvan	0.80
Rio Narcea	2.00
Kemi	0.60
Orivesi	0.40
Pyhasalmi	0.48
Hitura	0.30
Garpenberg	0.40
KGHM (Legnica-Glogow copper basin)	1.63
Average Total Operating Cost (excluding general review)	0.93

As presented, total operating costs are the highest in companies considered in *General review,* probably because of the wider base for calculation. Then comes Polish companies, where additional costs comes from environmental fees (about 30% of total operating cost of waste management). Finally, there is a group of companies achieving cost level for these operations slightly below 1 €/Mg or even in the range of 0.3—0.4 €/Mg. In this last case there is a suspicion that a lot of cost items related to waste / tailings management were not included.

Conclusions

With the introduction of the new EU legislation for extractive industries, all mining companies across the whole of the "new EU" will have to develop or revise their strategies

according to the proposed Directives of waste management. The additional requirements for dealing with waste products from mining operations will increase minesite costs across the EU. These additional costs are not required from their global competitors and will place even more pressure on European producers. In the case of mines, in the new member states additional capital investments may have to be made to bring existing facilities into line with best practice, placing additional financial stress on these operations.

Moreover, if cost internalisation — mentioned in EU communication "Towards a Thematic Strategy on the Sustainable Use of Natural Resources" — will be applied, effects also influence on mining producers falling under regulations. European mining companies can try to applied newest environmental friendly solutions, but it always cost more, like e,g. backfilling — tailings from non-ferrous ore processing can be used as mine back-fill, in combination with added cement. However, the reduction in density that occurs when solid rock is milled means that it would never be possible to backfill all mine waste. The remaining tailings is generally pumped to tailings ponds, in which the solids settle out of suspension, allowing water to be extracted for re-use within the mine. Depositing the tailings below the surface of the water eliminates all contact with air, and is generally considered to represent better practice where sulphidic ore tailings are concerned than depositing them onto the 'beach' of the pond and covering them with water later. However, this better practice also costs more than the alternatives. Mines which do not backfill at all send substantially more material to their tailings ponds. Although the unit cost (per tonne of tailing) is higher for backfilling than for placing within a tailings pond, the practice of back-filling is becoming more widespread.

European mining producers can maintain the high standard of waste management through existing system of permissions (IPPC), including BAT, but it can be achieved without imposing additional duties, as it was done in Poland. Although introduced system of fees and charges in waste management is successful for many items (e.g., municipal waste, emissions of hazardous pollutant to air and water) its implementation into mining activity will not bring advisable results, but surely decrease competitiveness of EU producers. Apart form reasons mentioned in the article, minerals are worldwide tradable (own regulations, international prices, mostly listed on stock exchange) and cannot be treated the same way.

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KAROL KONECZNY, JOANNA KULCZYCKA, MAŁGORZATA GÓRALCZYK

CZY OPŁATY ZA GOSPODARCZE KORZYSTANIE ZE ŚRODOWISKA MOGĄ BYĆ ROZWIĄZANIEM DLA ZOBOWIĄZAŃ ŚRODOWISKOWYCH?

Słowa kluczowe

Przemysł górniczy, ochrona środowiska, zarządzanie odpadami, koszty operacyjne

Streszczenie

W raporcie MMSD z roku 2002 stwierdzono, że „w dobrze funkcjonującej gospodarce rynkowej, cena płacona za surowce mineralne — podobnie jak za każde inne dobra i usługi — powinna odzwierciedlać pełny koszt produkcji i konsumpcji". Stwierdzenie to nabrało nowego znaczenia w sytuacji, gdy ceny większości surowców rosną, ale nadal może nie być prawdziwe dla europejskich producentów, zwłaszcza w odniesieniu do kosztów środowiskowych.

Górnictwo jest jednym z najbardziej obciążających środowisko przemysłów, zwłaszcza w odniesieniu do ilości produkowanych odpadów. Obecnie szeroko akceptowany jest pogląd, że firmy górnicze powinny być odpowiedzialne za zarządzanie i rekultywację terenów górniczych. Ze względu na ogromny wpływ na środowisko terenów górniczych konieczne są właściwe procedury zamykania, rekultywacji i monitoringu tych terenów, a także właściwe zabezpieczenie środków finansowych na te działania.

Polityka środowiskowa Unii Europejskiej promuje ekonomię rynkową przyjazną dla środowiska, która obejmuje internalizację kosztów zewnętrznych i społecznych. Wprowadzenie opłat za korzystanie ze środowiska może zwiększyć koszty produkcji i wpłynąć na konkurencyjność firm, dlatego poziom opłat powinien być jednolity w ramach UE.

W niniejszym artykule przeanalizowano działalność operacyjną firm górniczych w kontekście poszerzenia UE, uwarunkowań prawnych, inicjatyw środowiskowych, lecz przede wszystkim ze względu na wspólne warunki rynkowe określające koszty produkcji. Główny nacisk położono na: koszty zarządzania odpadami, tworzone fundusze celowe, podatki i opłaty związane z ochroną środowiska. Zaprezentowano ponadto porównanie różnych instrumentów ekonomicznych związanych z ochroną środowiska w wybranych krajach oraz analizę całkowitych kosztów zarządzania odpadami.