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# Pricing formula for hard coal sold to power plants and CHP plants in Poland

Key words

Hard steam coal, pricing (sale) formula

Abstract

Presently applied coal price formula was introduced in 1990 and — after some corrections in 1994 — is still used in majority of coal purchasing/selling contracts. This formula was prepared for the conditions of early 1990s. The changes, which occurred in Poland since that time, caused that the price structure of the formula became outdated, so modification of this price structure proved to be necessary. The paper presents a new idea of steam coal price formula. It has been assumed that coal prices change proportionally to calorific value of coal. The ballast elements (sulphur and ash content) decrease the coal price by the value of ecological costs incurred during coal combustion. The structure of coal price is discussed and the method of calculation of factors correcting the coal price is presented in the paper.

## Introduction

In a market economy the accountings for sold/purchased coal are done, as a rule, on the basis of the demand and supply rule. Saying it in a simple way it means that in case of greater demand for coal than temporary (during the time period under analysis) possibilities of its supply the prices will rise. The justification of this trend rests with the idea that in order to

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obtain additional coal (balancing the demand) one must incur determined costs enabling to create supply conditions of the lacking volume of coal on the market. In practice, anyhow, that fact is being taken advantage of that a coal customer is often ready to pay more for coal and not to be endangered by losses that could result from stoppage or reduction of determined products generation in the plants utilising coal. On the other hand when there is surplus of coal on the market (meaning the supply is greater than demand) the customers will try to obtain coal at lowest possible prices selecting respective suppliers. The producers may (or must) reduce the price to find selling potential for their coal products since in the other case they would be endangered by stopping of coal winning. Coal prices in fact should reflect the usage value that coal presents for the user. For this purpose the formulas are constructed, called sale formulas, which usually consist of two basic elements: the price level and the price structure.

The market element of price systems is the level of prices. This level is the element of negotiations between the coal producer (seller) and a customer (buyer). The producers should guarantee for themselves that coal prices cover the cost of coal winning plus a certain rate of profit. The customers should guarantee for themselves that the coal price is at the level enabling them to sell their final products (heat, electric energy, etc.). The interests of the two parties are certainly different, and the negotiations should guarantee advantages for both the parties.

The second element of price system is the price structure. It determines to what extent to reduce or raise the price with the change of particular quality parameters determined in the contract and acknowledged as price formation parameters. The price structure may be agreed upon between the two negotiating parties. As a rule it should reflect the usage value of coal. The usage value of coal in practice is proportional to calorific value (chemical energy) of coal. Other quality parameters as for instance: ash content, sulphur content, moisture content (i.e. parameters of ballast elements) are treated as burdensome factors of coal utilisation. Their influence on coal prices should be determined in such a way as to express this burdensome aspect in money. The investigations run by many years now indicated that only environment effects are possible to be determined (in an objective manner). These effects are being calculated from the values of respective fees imposed for utilisation of natural environment.

The above mentioned circumstances became the basis for elaboration of the price system for steam coal. The aim of the below presented proposal, according to the authors, is to improve (agree upon), the principles of coal sales for power generators and to more clear the accountings between the producers and the customers.

## 1. Assumptions of proposed price system for steam coal

The quantity of chemical energy of the fuel necessary for production of a pre-determined electric energy (or heat) is a simple function of calorific value and the quantity of coal. The

higher is the calorific value the less coal must be combusted to achieve the required effect. The price of such coal, connected with the costs of its transportations to the site of a particular user, will be determining its competitiveness as against other coals.

Determining a certain base price of coal (be it by negotiations or in an arbitrary manner), one at the same time determines the value of chemical energy unit in this coal, since it has a specific base quality, described most often by three ($Q$, $A$, $S$) or four ($Q$, $A$, $S$, $W$) quality parameters.

In elaboration (Lorenz, Blaschke, Grudziński 2002) attention is paid that it is not all the same with regard to what standard the base price will be determined. The lower the calorific value is of the base coal the higher is the value of the quotient $Q_{real}/Q_{base}$.

In the formula applied in Poland up-to-date the coal of following parameters (as received): $Q_i^r = 25,1208$ MJ/kg, $A^r = 12\%$, $S_t^r = 1\%$ has been used as base coal — it is called "reference coal" and its quality responds rather to steam coal parameters being in turnover on international markets. However, coals sold to domestic power generators are of the quality close to the parameters (at as received basis): $Q_i^r = 21$ MJ/kg, $A^r = 22\%$, $S_t^r = 0.9\%$. This coal is called "standard coal" and it is used as a base in accountings between the coal producers and power generators in Poland. Therefore, it seems logic that changes in steam coal prices on home market should, in fact, regard to the standard coal.

While constructing the new sale formula the authors took into account the principle that price should be proportional to the calorific value. They also suggested referring the changes to the standard coal. This assumption is connected with taking into account the consequence of parameters changes in the equation: from the up-to-date used parameters of the so-called reference coal, into the parameter of standard coal.

It is suggested that the parameters of the standard coal ($Q$, $A$, $S$) and the parameters of real coal will be presented on dry basis with quoting the total moisture content. Then the parameters of standard coal will have (after rounding) the values as follows:

$$Q^d = 24\text{MJ/kg}, A^d = 24\%, S_t^d = 10\%, W_t^r = 10\%$$

In the new proposal of the sale formula it has been assumed that the level of base coal will be influencing the price of real coal by the above-mentioned proportionality to changes of the calorific value of tradable coal. It has also been assumed that ash and sulphur content will influence the price of coal by adjustment of the prices in the value resulting from the ecological effects (costs of sulphur dioxide and dusts emission and cost of wastes deposition). This concept will be discussed below in detail.

Summing up the aforementioned, it was assumed that the new coal sale formula will be based on the following assumptions:

— the level (agreed upon) of standard coal base price,
— proportionality of price to calorific value,
— reduction of price by determination ecological costs of utilised coal,
— base coal in the formula is the coal of parameters of standard coal.

## 2. General form of suggested sale formula

Accepting the assumption discussed in the previous section the new proposal can be takes the form of the following general equation:

$$C_{we} = C_{base} \cdot x - y - z \tag{1}$$

where:

$C_{we}$ — calculated price of steam coal, [PLN/Mg],
$C_{base}$ — determined (accepted) base price of standard coal, [PLN/Mg],
$x$, $y$, $z$— elements of the structure of prices.

The first element of the equation:

$$x = \frac{Q_i^d}{Q_{base}^d} \cdot \left(1 - \frac{W_t^r - 10}{100}\right) \tag{2}$$

where:

$Q_i^d$ — calorific value of real coal on dry basis [MJ/kg],
$Q_{base}^d$ — 24 MJ/kg,
$W_t^r$ — total moisture content [%],

causes that the price of coal being determined is proportional to its calorific value.

Because quality parameters in the equation are given on the dry basis it is then also necessary to take into account the total moisture content. From the written form of the formula it can be understand that the change in moisture content by 1% results in one percent change of coal price. However, the idea of the formula is that the moisture content below 10% does not influence the price (i.e. this adjustment acts only toward reduction of coal price and does not increase the price of coal if the total moisture content less than 10%).

The second element of the equation:

$$y = w_S \cdot (S_t^d - 1) \tag{3}$$

where:

$S_t^d$ — total sulphur content in real coal on dry basis [%],
$w_S$ — coefficient valuating the price with regard to sulphur content [PLN/Mg],

It adjusts the price because of sulphur content and expresses the value of this adjustment in PLN/t.

$SO_2$ emission cost — resulting from the fees for emission, was evaluated on the basis of rates from 2002. In this assessment no eventual penalties for emission over the limit are taken

into account since — in accordance with regulations in force in Poland — such situation may occur in Polish power plants only incidentally, otherwise the so called "decision on admissible emission" could have been withdrawn and as the result of that the generation unit would have to stop production.

The third element of the equation:

$$z = w_A \cdot (A^d - 24) \tag{4}$$

where:

$A^d$ — ash content in real coal on dry basis [%],

$w_A$ — coefficient valuating the prices because of ash content [PLN/Mg].

It adjusts the price because of ash content and expresses the value of this adjustment in PLN/t.

Cost of dusts emission and storage of the solid wastes generated (captured fly ashes and sludge) was assessed on the basis of value of fees for dusts emission and storage of solid wastes at power plants (rates of fees as in 2002).

Coefficients valuating in the sulphur element ($w_S$) and the ash one ($w_A$) are determined , as already discussed, on the basis of ecological effects caused by emission of sulphur dioxide and dusts as well as storage of solid wastes generated during combustion of coal of specified sulphur and ash content.

Calculation the value of the coefficients was done for average conditions of combustion in pulverized-fuel boiler with the assumptions that sulphur from coal is transformed in 96% into $SO_2$ and fly ashes (dusts) are captured with the efficiency of 98,5%. It has also been assumed that the volume of solid wastes is the balance volume as against to ash content in coal (minus dusts emission), and the storage costs of wastes that were adopted were in the value twice as high as the fees for storage (procedure applied in Poland) (Lorenz 1999; Lorenz, Blaschke, Grudziński 2002).

## 4. New sale formula of steam coal

Taking into account the aforementioned deliberations the new sale formula can be presented in the form of the following equation (5):

$$C_{we} = C_{base} \cdot \frac{Q_i^d}{Q_{base}^d} \cdot \left(1 - \frac{W_t^r - 10}{100}\right) - w_S \cdot (S_t^d - 1) - w_A \cdot (A^d - 24) \tag{5}$$

where denotations are as in equations 1—4.

The formula is prepared for the base coal with parameters of standard coal.

While recalculating the parameters of standard coal on as received basis (coal of the class: 21/22/9) into the parameters on dry basis the moisture content was assumed equal to 10% and the calculated parameters were rounded to integer in conformity with the principles of mathematics. Thus the base parameters in the equations are as follows:

— $Q^d_{base}$ = 24 MJ/kg

— $A^d_{base}$ = 24%

— $S^d_{t\,base}$ = 1%

— $W^t_{t\,base}$ = 10%

## 5. Determination of coefficients adjusting the coal price

In the suggested sale formula the so-called ecological principle was introduced for determination the influence of sulphur and ash content on the price of coal.

TABLE 1

Rates of fees for emission of sulphur dioxide and dust as well as for depositing of wastes from hard coal combustion, in force in Poland during1990—2002

TABELA 1

Stawki opłat za emisje dwutlenku siarki i pyłu oraz za składowanie odpadów stałych ze spalania węgla w Polsce w latach 1990—2002

| Year | $SO_2$ [PLN/kg] | Dust [PLN/kg] | Wastes [PLN/kg] | Source of regulations |
|---|---|---|---|---|
| 1990 | 0.027 | 0.007 | 0.36 | O.J Nr 42 item. 245 of 30.VI.1990 |
| 1991 | 0.068 | 0.018 | 1.00 | O.J. Nr 88 item.511 of 21.XII.1990 |
| 1992 | 0.077 | 0.042 | 2.00 | O.J Nr 79 item 400 of 27.X.1992 |
| 1993 | 0.12 | 0.06 | 4.00 | O.J. Nr 9 item.44 of 8.II.1993 |
| 1994 | 0.15 | 0.08 | 5.00 | O.J. Nr 133 item.638 of 30.XII.1993 |
| 1995 | 0.19 | 0.10 | 6.18 | O.J. Nr 140 item.772 of 31.XII.1994 |
| 1996 | 0.24 | 0.13 | 7.90 | O.J. Nr 153 item.775 of 29.XII.1995 |
| 1997 | 0.28 | 0.15 | 9.21 | O.J Nr 154 item.747 of 27.XII.1996 |
| 1998 | 0.30 | 0.20 | 10.00 | O.J Nr 162 item.1116 and 1117 of 31.XII.1997 |
| 1999 | 0.33 | 0.22 | 11.00 | O.J. Nr 162 item 1128 and 1129 of 30.XII.1998 |
| 2000 | 0.34 | 0.23 | 11.40 | O.J. Nr 110 item 1261 and1263 of 30.XII.1999 |
| 2001 | 0.36 | 0.24 | 12.10 | O.J. Nr 120 item 1284 and 1288 of 28.XII.2000 |
| **2002** | **0.38** | **0.25** | **13.80** | **O.J. Nr 130 item.1453 of 9.X.2001** |

Source: own elaboration on the basis of Official Journals of the Republic of Poland

The initial point for the assessment of this influence consisted in the assessment the cost — for the user — that is connected with change in sulphur and ash content in coal. Costs of sulphur dioxide and dusts emission were taken as the measure of that cost as well as the cost of storage of solid wastes from coal combustion.

To asses the value the rates of fees in force in Poland were taken, as of 2002. These values are presented in table 1.

The regulations introducing obligatory fees for emission of polluting substances into the air are in force in Poland since the 1 July 1990. Changes in fees rates during recent years are small and are adjusted by the value of planned inflation for the sequent year.

On the basis of fees rates for 2002 the cost of $SO_2$ and dusts emission was calculated as well as the cost of storage of solid wastes generated during combustion of one ton of coal of different sulphur and ash content. Mass emission (with regard to a determined quantity of coal being combusted) depends only on sulphur and ash content and does not depend on the calorific value of coal.

The results of calculations are presented in tables 2 and 3. The calculations do not take into account the penalties for exceed the limit of emission.

On the basis of calculations presented in tables 2 and 3 the assessment was performed of the value of coefficients valuating the changes of coal prices with regard to the sulphur content ($w_S$) and the ash content ($w_A$). The values presented in the last column of each table provide the information by what value (in zlotys per ton of combusted coal) the cost of ecological fees changes resulting from coal combustion of a given content of sulphur and ash. The values say that in case of sulphur content change by 0.1% the of cost of $SO_2$ emission changes by 0.73 PLN, whereas in case of ash content change by 1% — results in change of a cumulative cost of dust emission and storage of wastes coming from coal combustion by 0.30 PLN.

Since calculated costs of $SO_2$ and dusts emission as well as storage of solid wastes resulting from coal combustion take very low values — the authors suggested their rounding up and acceptance of the following values:

— $w_S = 10$ (which means that coal prices changes by 1 PLN with sulphur content change by 0.1%),

— $w_A = 0.5$ (which means that coal price changes by 0.50 PLN with ash content change by 1%).

Those values of the coefficients were adopted in the proposed sale formula.

As the values in table 1 indicate, the rates of fees (for emission and storage of solid wastes coming from coal combustion in power generation industry) are small, and their changes in time reflect only the inflation. The adopted coefficients adjusting the price with regard to sulphur and ash content in the above presented values $w_S = 10$ i $w_A = 0{,}5$ could be left without changes by the time when the rates of fees for $SO_2$ are lower than 0.52 zł per kg of $SO_2$, and by the time when the respective fees rates for dusts emission and storage of solid wastes from combustion raise even by 60% as against the present values, thus not necessitating the changes of coefficient $w_A$.

TABLE 2

Unit costs of $SO_2$ emission in PLN per ton of combusted coal

TABELA 2

Jednostkowe koszty emisji $SO_2$ w złotych na tonę spalonego węgla

| $S_t^r$ [%] | Range of calorific value $Q_i^r$ [MJ/kg] | | | | | | | | | | | | | Increase in PLN per 0.1% of $S_t^r$ content |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | |
| 0.4 | 2.92 | 2.92 | 2.92 | 2.92 | 2.92 | 2.92 | 2.92 | 2.92 | 2.92 | 2.92 | 2.92 | 2.92 | 2.92 | |
| 0.5 | 3.65 | 3.65 | 3.65 | 3.65 | 3.65 | 3.65 | 3.65 | 3.65 | 3.65 | 3.65 | 3.65 | 3.65 | 3.65 | 0.73 |
| 0.6 | 4.38 | 4.38 | 4.38 | 4.38 | 4.38 | 4.38 | 4.38 | 4.38 | 4.38 | 4.38 | 4.38 | 4.38 | 4.38 | 0.73 |
| 0.7 | 5.11 | 5.11 | 5.11 | 5.11 | 5.11 | 5.11 | 5.11 | 5.11 | 5.11 | 5.11 | 5.11 | 5.11 | 5.11 | 0.73 |
| 0.8 | 5.84 | 5.84 | 5.84 | 5.84 | 5.84 | 5.84 | 5.84 | 5.84 | 5.84 | 5.84 | 5.84 | **5.84** | **5.84** | 0.73 |
| 0.9 | 6.57 | 6.57 | 6.57 | 6.57 | 6.57 | 6.57 | 6.57 | 6.57 | 6.57 | **6.57** | **6.57** | **6.57** | **6.57** | 0.73 |
| 1.0 | 7.30 | 7.30 | 7.30 | 7.30 | 7.30 | 7.30 | **7.30** | **7.30** | **7.30** | **7.30** | **7.30** | **7.30** | **7.30** | 0.73 |
| 1.1 | 8.03 | 8.03 | 8.03 | 8.03 | **8.03** | **8.03** | **8.03** | **8.03** | **8.03** | **8.03** | **8.03** | **8.03** | **8.03** | 0.73 |
| 1.2 | 8.76 | 8.76 | **8.76** | **8.76** | **8.76** | **8.76** | **8.76** | **8.76** | **8.76** | **8.76** | **8.76** | **8.76** | **8.76** | 0.73 |
| 1.3 | **9.48** | **9.48** | **9.48** | **9.48** | **9.48** | **9.48** | **9.48** | **9.48** | **9.48** | **9.48** | **9.48** | **9.48** | **9.48** | 0.73 |
| 1.4 | **10.21** | **10.21** | **10.21** | **10.21** | **10.21** | **10.21** | **10.21** | **10.21** | **10.21** | **10.21** | **10.21** | **10.21** | **10.21** | 0.73 |
| 1.5 | **10.94** | **10.94** | **10.94** | **10.94** | **10.94** | **10.94** | **10.94** | **10.94** | **10.94** | **10.94** | **10.94** | **10.94** | **10.94** | 0.73 |
| 1.6 | **11.67** | **11.67** | **11.67** | **11.67** | **11.67** | **11.67** | **11.67** | **11.67** | **11.67** | **11.67** | **11.67** | **11.67** | **11.67** | 0.73 |
| 1.7 | **12.40** | **12.40** | **12.40** | **12.40** | **12.40** | **12.40** | **12.40** | **12.40** | **12.40** | **12.40** | **12.40** | **12.40** | **12.40** | 0.73 |
| 1.8 | **13.13** | **13.13** | **13.13** | **13.13** | **13.13** | **13.13** | **13.13** | **13.13** | **13.13** | **13.13** | **13.13** | **13.13** | **13.13** | 0.73 |
| 1.9 | **13.86** | **13.86** | **13.86** | **13.86** | **13.86** | **13.86** | **13.86** | **13.86** | **13.86** | **13.86** | **13.86** | **13.86** | **13.86** | 0.73 |
| 2.0 | **14.59** | **14.59** | **14.59** | **14.59** | **14.59** | **14.59** | **14.59** | **14.59** | **14.59** | **14.59** | **14.59** | **14.59** | **14.59** | 0.73 |

TABLE 3

Unit cost of dust emission and storage of solid wastes in PLN per ton of combusted coal

TABELA 3

Jednostkowe koszty emisji pyłu oraz składowania odpadów stałych w złotych na tonę spalonego węgla

| $A_t^r$ [%] | Range of calorific value $Q_i^r$ [MJ/kg] | | | | | | | | | | | | | Increase in zł per 1% $A_t^r$ content |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | |
| 9.0 | 2.74 | 2.74 | 2.74 | 2.74 | 2.74 | 2.74 | 2.74 | 2.74 | 2.74 | 2.74 | 2.74 | 2.74 | 2.74 | |
| 10.0 | 3.04 | 3.04 | 3.04 | 3.04 | 3.04 | 3.04 | 3.04 | 3.04 | 3.04 | 3.04 | 3.04 | 3.04 | 3.04 | 0.30 |
| 11.0 | 3.35 | 3.35 | 3.35 | 3.35 | 3.35 | 3.35 | 3.35 | 3.35 | 3.35 | 3.35 | 3.35 | 3.35 | 3.35 | 0.30 |
| 12.0 | 3.65 | 3.65 | 3.65 | 3.65 | 3.65 | 3.65 | 3.65 | 3.65 | 3.65 | 3.65 | 3.65 | 3.65 | 3.65 | 0.30 |
| 13.0 | 3.96 | 3.96 | 3.96 | 3.96 | 3.96 | 3.96 | 3.96 | 3.96 | 3.96 | 3.96 | 3.96 | 3.96 | 3.96 | 0.30 |
| 14.0 | 4.26 | 4.26 | 4.26 | 4.26 | 4.26 | 4.26 | 4.26 | 4.26 | 4.26 | 4.26 | 4.26 | 4.26 | 4.26 | 0.30 |
| 15.0 | 4.57 | 4.57 | 4.57 | 4.57 | 4.57 | 4.57 | 4.57 | 4.57 | 4.57 | 4.57 | 4.57 | 4.57 | 4.57 | 0.30 |
| 16.0 | 4.87 | 4.87 | 4.87 | 4.87 | 4.87 | 4.87 | 4.87 | 4.87 | 4.87 | 4.87 | 4.87 | 4.87 | 4.87 | 0.30 |
| 17.0 | 5.17 | 5.17 | 5.17 | 5.17 | 5.17 | 5.17 | 5.17 | 5.17 | 5.17 | 5.17 | 5.17 | 5.17 | **5.17** | 0.30 |
| 18.0 | 5.48 | 5.48 | 5.48 | 5.48 | 5.48 | 5.48 | 5.48 | 5.48 | 5.48 | 5.48 | 5.48 | **5.48** | **5.48** | 0.30 |
| 19.0 | 5.78 | 5.78 | 5.78 | 5.78 | 5.78 | 5.78 | 5.78 | 5.78 | 5.78 | 5.78 | **5.78** | **5.78** | **5.78** | 0.30 |
| 20.0 | 6.09 | 6.09 | 6.09 | 6.09 | 6.09 | 6.09 | 6.09 | 6.09 | 6.09 | **6.09** | **6.09** | **6.09** | **6.09** | 0.30 |
| 21.0 | 6.39 | 6.39 | 6.39 | 6.39 | 6.39 | 6.39 | 6.39 | 6.39 | **6.39** | **6.39** | **6.39** | **6.39** | **6.39** | 0.30 |
| 22.0 | 6.70 | 6.70 | 6.70 | 6.70 | 6.70 | 6.70 | 6.70 | **6.70** | **6.70** | **6.70** | **6.70** | **6.70** | **6.70** | 0.30 |
| 23.0 | 7.00 | 7.00 | 7.00 | 7.00 | 7.00 | 7.00 | **7.00** | **7.00** | **7.00** | **7.00** | **7.00** | **7.00** | **7.00** | 0.30 |
| 24.0 | 7.30 | 7.30 | 7.30 | 7.30 | 7.30 | **7.30** | **7.30** | **7.30** | **7.30** | **7.30** | **7.30** | **7.30** | **7.30** | 0.30 |
| 25.0 | 7.61 | 7.61 | 7.61 | 7.61 | **7.61** | **7.61** | **7.61** | **7.61** | **7.61** | **7.61** | **7.61** | **7.61** | **7.61** | 0.30 |
| 26.0 | 7.91 | 7.91 | 7.91 | **7.91** | **7.91** | **7.91** | **7.91** | **7.91** | **7.91** | **7.91** | **7.91** | **7.91** | **7.91** | 0.30 |

## Summary

The paper presents a new sale formula for hard steam coal. It has been elaborated for steam fine coal. It may be applied for other tradable grain sizes under condition of introduction of the coefficients adjusting the price to those different grain sizes.

The sale formula maintains the proportionality of coal prices with regard to changes of calorific value. Also the principle was introduced that ballast elements (sulphur and ash content) change the coal price by the value of $SO_2$ and dusts emission costs and the costs of wastes storage, that were generated during coal combustion.

The authors believe that the sale formula accepted for professional power generators may also be the base for accounting of steam coal fines supplied to other customers.


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**FORMUŁY CENOWE WĘGLA KAMIENNEGO SPRZEDAWANEGO DO POLSKICH ELEKTROWNI I ELEKTROCIEPŁOWNI**

Słowa kluczowe

Węgiel kamienny energetyczny, formuła cenowa (sprzedażna)

Streszczenie

Obecnie stosowana formuła cenowa dla węgla energetycznego została wprowadzona w 1990 r. i — po pewnych zmianach w 1994 r. — jest wciąż używana w większości kontraktów kupna/sprzedaży węgla. Formuła ta stworzona została dla warunków rynkowych początku lat dziewięćdziesiątych (XX w.). Zmiany jakie nastąpiły w Polsce od tamtego czasu spowodowały, że struktura cen opisana formułą jest już nieaktualna i jej zmiana wydaje się konieczna. Artykuł przedstawia nową propozycję formuły cenowej węgla energetycznego. W propozycji tej przyjmuje się, że cena węgla zmienia się proporcjonalnie do zmian jego wartości opałowej. Elementy balastowe (zawartość siarki i popiołu) obniżają cenę węgla w sposób wynikający z kosztów „ekologicznych", powodowanych spalaniem węgla. Omówiono nową strukturę cen oraz metodę wyznaczania współczynników korygujących cenę (ze względu na zawartość siarki i popiołu).