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A New Criterion for the ESG Model

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Abstract: This article presents the results of the study, the purpose of which was to develop a new criterion for the Environment, Social, Governance (ESG) model and recommendations for its use in the ESG in determining the socioeconomic benefits of wind and solar energy instead of the most toxic generation—coal. The criterion proposed by the author for the ESG model has not been previously considered in the scientific literature. Based on the theoretical assumptions, the author's methodology for determining the achieved savings is presented in the example of a number of large energy companies RWE, Enel, and Sunseap in Singapore. This article presents the model developed by the author and the calculations themselves and comments related to the proposed model. This article presents the author's developed model and the calculations and comments themselves. The calculations carried out are based on the actual amount of carbon dioxide emissions charges, taking into account the damage caused, the number of people saved from premature death due to harmful CO_2 emissions into the atmosphere, the value of statistical life determined by the World Bank for Germany, Singapore, and Italy, the costs of treating concomitant diseases, and the social discount rate. This makes it possible to determine the real socioeconomic effect of replacing fossil energy sources with cleaner energy carriers that are not carbon-containing. An argument is presented that refutes the argument about the occurrence of a significant increase in costs in the economy that may arise due to the introduction of a fixed fee for harmful emissions. This allows you to set more accurate benchmarks and indicators in the ESG system and use them in attracting investors, forming ratings, and training specialists. The results of the research presented in this article may be useful for analysts who are engaged in the development and use of ratings for the ESG model, primarily for section E but also for section S. This article highlights the possibilities of accelerating investment in solar and wind energy in the context of the current energy crisis.

Keywords: ESG, wind and solar energy, social cost of carbon, the value of statistical life, social discount rate

1. Introduction

The development of the electric power industry is mainly determined by two interrelated and interdependent factors: decarbonization and reduction of the cost of renewable energy. Over the decade (2011–2021), the share of toxic coal, oil, and gas generation in the world decreased from 68% to 61%. At the same time, the share of carbon-free renewable energy, including hydropower, increased from 16% to 19%.[1]

Pricing changes depending on the reduction in the cost of electricity generated by renewable sources; economies of scale, including the introduction of more powerful equipment; and reduction in the cost of production of solar panels and wind generators. In the conditions of the energy crisis, wholesale prices for renewable energy, despite some growth due to the rise in the cost of equipment, are significantly less than in gas and coal generation as shown in Table 1.

However, it should be borne in mind that energy storage is needed to maintain electricity in the network. Taking into account the existing and commissioning of new storage devices, the present cost of electricity (levelized cost of energy) of wind and solar energy may increase by about one and a half times.

Table 1
Levelized cost of energy comparison in the world ($/MWh) a (Lazard, 2021)

Generation	2011	2021
Solar PV	169	38
Wind	71	38
Gas (combined cycle)	83	60
Coal	104	108

As a result of the ongoing structural changes and the reduction of carbon emissions, the number of people saved from premature death and health and environmental costs that would have to be paid with previous CO_2 emissions is increasing.

The development of structural changes in the energy sector predetermined the need to reflect in the Environment, Social, Governance (ESG) model a new criterion that would reflect the socioeconomic benefits of using wind and solar energy instead of the coal. The author's considerations expressed in this article are fundamentally new. The approach used in this article is not

[1]bp (2022) Statistical Review of World Energy 2022. Available at: http://www.bp.com/statisticalreview (Accessed: 24.10.2022)

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currently reflected in publications and is not contained in the criteria for the ESG model.

It is believed that the "S," or social component of ESG, remains underdeveloped, partly because it is difficult to measure. The proposed calculation model allows us to overcome this gap. This innovation is fundamental. Probably, it does not matter in principle that we still take this component into account in the "E" section. The main thing is that it cannot be lost, and where to use it, in the "E" section or in the "S" section, is a secondary question, since in any case it will be reflected in the aggregated ESG indicator.

2. Energy Crisis and ESG

Manufacturing companies, including energy companies, use ESG information to attract investors, in particular information related to new projects for the development, construction, conversion, and refinancing of generating stations from renewable sources, as well as projects for the transportation of electricity and networks.

The currently high wholesale and retail electricity prices in Europe mean that the payback period for solar and wind energy projects can be significantly reduced. Even taking into account the additional costs of electricity storage, the payback period of investment projects may be reduced to 2–3 years. This is an extremely important circumstance for the motivation of investors. In this regard, the relevance of the most complete and objective information on the environmental section of ESG is increasing for potential investors, for compiling appropriate ratings of companies, and for training specialists.

The evaluation of enterprises in the ESG system is carried out in many directions. The information collected by analytical agencies is transformed into various ratings. In the framework of this article, we focus on energy enterprises, moreover highlighting the effectiveness achieved by them in the environmental section of the ESG.

Most often, analytical agencies evaluate enterprises, taking into account to the greatest extent the indicators of their plans and strategies for achieving a certain level of CO_2 emissions reduction over the medium and long term for 20 to 30 years, for example, reflecting them in the Refinitiv ESG Rating. This approach is largely due to the fact that the possibilities for retrospective analysis are still extremely limited due to the short period of implementation of the green transition and, accordingly, the statistical base has not yet been fully formed.

However, assessments of the prospects for the development of enterprises, according to the strategies they have developed, make it possible to improve the prediction of the decarbonization process and related investment plans in new energy technologies, in particular in solar and wind energy. At the same time, the promising indicators contained in the programs and strategies for the development of companies are not always sufficiently justified and actually fulfilled. There are precedents when, in the course of ongoing proceedings on claims of environmental organizations, by a court decision, energy companies are obliged to review the deadlines for achieving indicators for reducing CO_2 emissions, that is, the court issues a ruling and an order that the indicator characterizing decarbonization should be achieved by the company much earlier than the deadline set in the enterprise program. For example, such a situation developed in 2021 regarding the activities of the Royal Dutch Shell energy corporation in the Netherlands.

The author believes that a more balanced and objective approach seems to be the approach in accordance with which the assessments of enterprises are carried out, first of all, based on the results of the work they have already carried out. This means that one should be guided not so much by intentions as by actual results, taking into account the socioeconomic efficiency of renewable energy.

At the same time, ESG strategies and ESG ratings are currently formed without taking into account the quantitative assessment of saved lives, healthcare costs, and other costs associated with harmful emissions. It is no coincidence that some publications question the claims about the positive impact of ESG ratings on the indicators of sustainable development of companies (Clementino & Perkins, 2021).

The estimates we propose are possible and necessary in the process of electricity production by calculating the replacement of fossil sources with renewable energy sources. To this end, when determining the values of the resulting indicators characterizing the environmental section of the ESG, it is necessary to consider a number of theoretical issues that will ensure the possibility of making the most objective and reasonable estimates. We are talking about the social cost of carbon, that is, the public payment for emissions and the establishment of a discount rate corresponding to them; about the quantification of deaths, that is, the prevention of premature mortality due to CO_2 emissions and the associated economic cost of living in various regions of the world; and about healthcare costs in the form of adverse side effects, caused by harmful carbon emissions into the atmosphere.

3. Carbon Emission Charges

We begin the construction of our proposed model with the "social cost of carbon" or "social cost of carbon emissions." This is a tax that takes into account the damage caused by the emission of 1 ton of CO_2. Next, we will take a detailed look at this category of carbon charges, since we attach primary importance to it in the system of indicators characterizing the environmental section of the ESG.

Among the definitions that are close in meaning, the concept of "Carbon Tax" is often used. This tax is levied on enterprises and organizations for their harmful emissions into the atmosphere. In different countries, this indicator is treated ambiguously, which is reflected in the applicable standards and compliance with the relevant doctrines. The established taxes have a high level of variability and differences in the components forming them.

As of April 1, 2021, the value of the Carbon Tax was $137 in Sweden and $101 in Switzerland, and at the same time, in Chile—$5, Singapore—$4, and Japan—$3 (World Bank. 2021; State and Trends of Carbon Pricing 2021). Moreover, these indicators do not always take into account CO_2 emissions into the atmosphere by motor transport. Judging by the intentions of a number of countries, tax rates will increase by the end of the decade, for example, in Norway and Denmark up to $230, in Canada up to $170, in the Netherlands up to $167.

Another important analytical indicator is the quotes on the stock exchanges of quotas for emissions trading (emissions trading system (ETS)). The world's largest greenhouse gas emissions trading market is located in Europe. Quotas are first allocated taking into account the EU directives on the maximum amount of greenhouse gases that can be emitted. Carbon emission quotas are then auctioned and traded. According to the World Bank, the ETS values were on April 1, 2021: in the EU—$50 (average), in Germany—$29, in Korea—$16, and in China—$7.9. Carbon emissions trading has become widespread. Moreover, during 2021, as the energy crisis worsened, quota prices doubled, and in early February 2022, their record value was recorded—98.49 euros ($110) (Chestney, Abnett, Twidale, 2022).

In a number of publications, reasonable considerations have been expressed that in order to level the damage caused to the environment, it is advisable that the quotas provided in States for the implementation of emissions of pollutants into the atmosphere increase. Stanford

University researchers have determined that the real social cost of carbon pollution should be $220 per ton (Dattaro, 2015).

Professor Simon Dietz and Professor Nicholas Stern (London School of Economics) calculated that the cost of each ton of carbon emissions should reach $260 by 2030 (Dietz & Stern, 2015).

According to the German Federal Environmental Agency (Umweltbundesamt), in 2018 the social cost of carbon was 180 euros. Comparing the social cost of carbon in Germany with the rate of the actual tax paid on emissions of 1 ton of CO_2, it can be stated that the first indicator, taking into account discounting, exceeded the second by almost eight times (High costs when environmental protection is neglected, 2018).

Experts from the School of Global Policy and Strategy at the University of San Diego, California, the European Institute of Economics and Environmental Protection (Milan), and the Carnegie Research Institute at Stanford University calculated that the average value of the social cost of carbon pollution is $417 per ton of CO_2 emissions (Ricke et al., 2018). Academic estimates of the costs associated with the capture, transportation, and storage of CO_2, as well as the regeneration of chemicals, far exceed $400 per ton of CO_2. Moreover, in some studies, in particular, the American Physical Society and the Massachusetts Institute of Technology (MIT), it is assumed that, taking into account all costs, the level of the social tax rate for industrially developed enterprises can vary from $600 to $1000 per ton of CO_2 (Evans, 2017).

4. Social Discount Rate

Looking at the materials of the reports of energy companies on ESG, we found that the discount rate in determining the social cost of carbon has remained unchanged for several years, while the annual inflation rate in the countries where these companies conduct business is 3–5%. Obviously, the constant rate applied in practice cannot be considered correct. Therefore, it is advisable to make appropriate adjustments based on the theoretical research being conducted.

We turned to the publications of leading experts who established the relationship between socioeconomic indicators and CO_2 emissions to find out their approaches to discount rates.

So, N. Stern suggested using a rate of 1.4%. He tied the value of this discount to the average growth rate of consumption per capita over a 200-year horizon and to the rate of risk-free assets (Stern, 2008).

Nobel Prize winner in Economics, Professor at Yale University, W. Nordhaus believed that the indicator proposed by N. Stern is underestimated (Ackerman, 2007). Based on the market conditions for the formation of the return on capital, Nordhaus proposed to increase the rate in terms of the elasticity parameter of marginal utility to 3% (Nordhaus, 2017).

W. Nordhaus also insists on a moderate cost of carbon – $31.2 per ton of CO_2, linking this with an unacceptable increase in costs in the economy, in his opinion. This thesis has been actively used in the works of other economists. So, a Professor at the University of New York G. Wagner said: "there are results of new analyses in which carbon prices range from $200 to $400 or more per ton. Meanwhile, even if you set a carbon price of $100 per ton, this will lead to an increase in the price of gasoline by about $0.90 per gallon (3.8 liters). Such an increase in the price at the gas station will be perceived more as a revolution" (Wagner, 2020).

If we use the W. Nordhaus rate in calculations, then the real social cost of carbon should rise to the level of $287.5 by 2030. This value corresponds to many published results and more accurately reflects the market realities of investments in fixed assets.

5. The Value of Statistical Life and the Effect of Solar and Wind Generation

The basis for determining the socioeconomic benefits that are achieved by using wind and solar in the electric power industry is the economic cost of people's lives. Together with the social cost of carbon, they are directly interrelated with the process of reducing harmful CO_2 emissions. This is a fundamentally important circumstance for the implementation of an effective state policy in the electric power industry, in healthcare, in ecology, and in many spheres of life.

Professor Valerie J. Karplus, presenting a study carried out by scientists at the MIT, noted that during the scientific work, three scenarios for reducing CO_2 emissions were modeled. The article published on the results of the study provides data according to which, if China had implemented a climate policy to reduce CO_2 emissions by 3%, 4%, and 5% per year, it would have avoided 36,000, 94,000, and 160,000 premature deaths (Li et al., 2018).

An article by Daniel Bressler, a researcher at Columbia University, notes that for every 4434 tons of CO_2 emissions, 1 person in the world dies (Bressler, 2021).

We use the least optimistic MIT scenario, since it is more in line with the current realities of reducing carbon dioxide emissions—7615 thousand tons of CO_2 emissions account for one premature death. Based on this standard, it is possible to proceed to the economic assessment of all saved lives that have avoided premature death due to emissions.

The next factor determining the socioeconomic benefits of using the sun and wind is the cost of health care in terms of concomitant diseases. They are associated with harmful emissions of pollution from carbon dioxide into the atmosphere and provide a reduction in cancer, heart and respiratory diseases, dementia, diabetes, depression and other diseases, research and development in the field of medicine, chemistry, biology, and ecology.

It should be noted that the report of the World Health Organization "The economic costs of the impact of air pollution on human health in Europe" stated that healthcare costs associated with concomitant diseases account for 10% of the damage caused as a result of premature death of people due to emissions of harmful substances (Air Pollution Costs Europeans 1.6 Trillion Annually, 2015). In the calculations, we used this proportion to determine the total amount of savings.

6. Methodology of Calculations Based on the Example of an Energy Company

A random sampling method was employed for the study. The sample for the study consisted of 22 first-year in-service postgraduate science teachers from one.

Carrying out calculations to determine the potential cost savings in the electric power industry for use in the environmental section of ESG, which may arise during the replacement of coal with wind and solar energy, involves a number of interrelated stages. To determine the potential savings, we calculate the total costs associated with the occurrence of negative consequences from the release of CO_2 into the atmosphere.

The total amount of potential savings in millions of dollars due to the use of wind and solar energy (L_{SWC}) instead of using coal for electricity generation is determined by the following formula (1):

$$L_{SWC} = LD_{SWC} + LH + L_E \tag{1}$$

where LD_{SWC} is the economic cost of the lives of people saved from premature death due to harmful CO_2 emissions into the atmosphere during the year; - unaccounted for current annual expenses for health purposes, the need for which arises due to CO_2 emissions into the atmosphere; the cost of prevented environmental damage that could be caused to the environment as a result of CO_2 emissions.

The determination of the cost of prevented environmental damage, which includes economic losses associated with crop loss, damage to buildings and infrastructure, and damage to human health (except for treatment costs), is calculated as:

$$L_E = CO2_{SWC} \times ST \tag{2}$$

$$ST = \theta \times \eta \times \kappa \tag{3}$$

where $CO2_{SWC}$ is the amount of carbon dioxide emissions into the atmosphere that could be replaced by solar and wind generation instead of using coal for electricity production, million tons; θ is the base rate of payment for damage from emissions of each ton of CO_2; η is the annual rate of discounting the cost of emissions, that is, the correction factor by year; κ is the coefficient characterizing the ratio of currencies (euro/USD) this year; $\theta \times \eta \times \kappa$ is the amount of dollars paid for 1 ton in the current year, taking into account discounting; and d is the discount rate.

Fossil energy sources, P_F, used in the production of electricity, due to which CO_2 emissions (GWh) occurred. Electricity production from coal is, GWh, P_C. Then, CO_2 emissions from coal in the production of electricity in thousand tons, $CO2_{Cm}$, will be equal to $CO2_{Cm} = P_C \times \varepsilon$.

The specific weight of CO_2 emissions (%) due to coal in fossil energy sources in the production of electricity is determined by (4):

$$CO2_C = P_C : P_F \tag{4}$$

Electricity generated due to wind and solar energy is, GWh, SW. Then, the replacement of coal with wind and solar energy is SWC. In turn, CO_2 emissions prevented by replacing coal with wind and solar energy (thousand tons) are determined by the following formula (5):

$$CO2_{SWC} = SWC \times \varepsilon \tag{5}$$

The definition of savings achieved by saving people's lives from deaths due to harmful CO_2 emissions into the atmosphere is carried out according to the formula as follows:

$$LD_{SWC} = D_E \times D \tag{6}$$

where D_E is the value of statistical one life, taking into account the discount; D is the number of lives saved.

$$D_E = \varphi \times d \tag{7}$$

where φ is the basic value of statistical one life for RWE, equal to \$7904 million - data for Germany presented in the article (Viscusi & Masterman, 2017), monograph (Gazman, 2022), d- the social discount rate of Nordhaus.

To calculate the value, we use the following formula:

$$D = \frac{CO2_{SWC}}{\tau} \tag{8}$$

where τ is the amount of CO_2 emissions into the atmosphere, allowing to save one life from premature death (7.615 thousand tons).

The costs for the implementation of health measures necessary to maintain human health due to the occurrence of harmful CO2 emissions into the atmosphere in billions of dollars are determined (9):

$$LH = LD_{SWC} \times \delta \tag{9}$$

where is the coefficient, meaning the ratio of healthcare costs relative to the economic cost of living. It is equal to 0.1.

The tax paid for emissions from the use of coal at a power plant in millions of dollars is calculated using the following formula:

$$T = T_N \times CO2_{Cm} \tag{10}$$

where T_N is the CO_2 tax rate.

Additional environmental costs, without the tax paid by the enterprise, are calculated according to the following formula (11)

$$L_E = CO2_{SWC} \times ST - T \tag{11}$$

where ST is the social carbon tax, and T is the tax paid for emissions from the use of coal at a power plant.

7. Instrument Calculation of Savings from the Use of Solar and Wind Generation

To calculate the savings, we use the system of indicators discussed above, which is now reflected in Table 2.

The calculation of savings according to the proposed methodology showed that by reducing carbon dioxide emissions into the atmosphere due to the use of wind and solar energy instead of coal in RWE, it was possible to save the lives of 3538 people from premature death within 3 years. The economic benefits received from resource conservation from reducing CO_2 emissions into the atmosphere by replacing coal with wind and solar energy amounted to \$40 billion, including \$16.6 billion in 2021. If we compare this indicator with the German budget, it turns out that the effect created in RWE is equal to 2.8% of the annual budget of Germany.

Another calculation was made according to the data of the energy company Enel. The calculation showed that, according to the methodology developed by us, in 3 years, when replacing wind and solar coal generation in the production of electricity, it was possible to save the lives of 2769 people from premature death. The economic cost of living of employees of Enel enterprises located in 21 countries was determined by us as a weighted average indicator for operating production facilities. As a result of the reduction of CO_2 emissions, the cumulative socioeconomic effect for this period amounted to \$16 bn for Enel.

One of the leading energy companies in Singapore is Sunseap. According to the data presented on the website of this company, the annual report (Sunseap, 2020), and our estimates, it was possible to determine that due to the active use of solar energy in 2019–2021, the company reduced emissions into the atmosphere by almost 180 thousand tons of greenhouse gases. Unlike calculations for RWE and Enel, calculations were carried out here not on the entire volume of solar electricity generated, which replaced one energy resource with another, but on the annual reduction of CO_2 emissions, that is, each year to the previous one. The obtained result indicates that by reducing emissions, the premature death of 26 people was prevented. Taking into account the discounted values of the economic cost of living, healthcare costs, and

Table 2
Calculation of savings from replacing wind and solar coal generation in RWE in 2019–2021

Indicator	Symbol and calculation formula	Line	2019	2020	2021
Fossil energy sources used in the production of electricity, due to which CO_2 emissions occurred, GWh	P_F	1	112,237	90,402	105,460
Electricity production from coal, GWh	P_C	2	62,449	42,782	53,056
CO_2 emissions from coal in the production of electricity, thousand tons	$CO2_{Cm} = P_C \times \varepsilon$	3 = 2 × 0.8936	55,804	38,230	47,411
The share of CO_2 emissions from coal in fossil sources in the production of electricity	$CO2_C = P_C : P_F$	4 = 2: 1	0,5564	0,4732	0,5031
Electricity generation due to solar and wind energy, GWh	SW	5	12,125	23,708	24,228
Replacement of coal with wind and solar energy, GWh	SWC	6 = 5 × 4	6746	11,219	12,189
CO_2 emissions prevented by replacing coal with solar and wind energy, thousand tons	$CO2_{SWC} = SWC \times \varepsilon$	7 = 6 × 0.8936	6028	10,025	10,892
Saved lives, people	D	8 = 7 : 7615	792	1316	1430
Discount rate by 2016	d	9	1,0927	1,1255	1,1593
The value of statistical one life, taking into account the discount rate, thousand dollars	$D_E = \varphi \times d$	11 = 9 × 10	8637	8896	9163
The cost of saved lives, millions of dollars	$LD_{SWC} = D_E \times D$	12 = 11 × 8	6841	11,707	13,103
The cost of maintaining health, millions of dollars	$LH = LD_{SWC} \times \delta$	13 = 12 × 0,1	684	1171	1310
Social tax on carbon emissions, USD	ST	14	207,67	218,17	232,86
Additional environmental costs, millions of dollars	$L_E = CO2_{SWC} \times ST$	15 = 14 × 7	1252	2187	2536
The tax paid by the enterprise for emissions from the use of coal, millions of dollars	T	16	167	283	318
Additional environmental costs, without tax paid by the enterprise, millions of dollars	$L_E = CO2_{SWC} \times ST - T$	17 = 15 – 16	1085	1904	2218
Total resources saved by replacing coal with solar and wind energy, millions of dollars	$L_{SWC} = LD_{SWC} + LH + L_E$	18 = 12 + 13 + 17	8610	14,782	16,631

additional environmental costs, the socioeconomic effect for Sunseap amounted to $326 million for Singapore over 3 years of observations.

Calculation of the RWE savings associated with the reduction of CO_2 emissions (Table 2) also showed that the share of CO_2 emissions from coal in this company in 2019–2021 ranged from 47.6% to 55.6%. At the same time, in Germany as a whole, this figure was significantly higher—from 69.2% to 75%. Therefore, it is no coincidence that the replacement of coal with wind and solar energy turned out to be below the national average in RWE. Accordingly, the proportion of lives saved in RWE was only 8% of the figure for Germany.

8. Conclusion

The discrepancy in the estimates intended for ESG between energy corporations and their rating positions may differ significantly. Rating agencies in such situations do not always focus on the current state of affairs but on the company's plans for decarbonization.

Taking into account the formation of ESG ratings when using the scenario of maximum substitution of solar and wind energy for coal, the proposed approach seems to be the most preferable. At the same time, as a result of the energy crisis in 2021–2022, in some European countries there was a partial deconservation of coal mines to temporarily replace less carbon-intensive natural gas at power plants. I believe that this is a temporary and necessary measure. It is certainly associated with negative environmental consequences, which, of course, will lead to human and economic losses.

Using the model developed by the author, it was possible to determine the socioeconomic benefits of using wind and solar generation instead of coal, taking into account the dynamics of decarbonization, the economic cost of living, the social cost of carbon, and the social discount rate. The consistency of the proposed model is strengthened by the calculations carried out and the receipt of specific quantitative estimates.

Based on calculations, it is proved that wind and solar generation have great potential in the electric power industry. The model can be useful for improving assessments in the environmental section of ESG for greater motivation of investors, for compiling ratings when comparing enterprises, and for training specialists.

Conflicts of Interest

The author declares that he has no conflicts of interest to this work.

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