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In Search of Non-Obvious Relationships between Greenhouse Gas or Particulate Matter Emissions, Renewable Energy and Corruption

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Abstract: The article concerns the issue of the existence of non-obvious relationships and of potential correlations between the emission of greenhouse gases and particulate matter (PM), renewable energy and corruption perceptions. Additionally, it analyses the possible impact of these above-mentioned connections on the economic, environmental and social situation in the context of further economic development, including during the COVID-19 pandemic and in relation to European countries. The issue of reducing dirty energy sources and corrupt activities is not only a problem considered at the state level, but it is very closely related to the operation of many private enterprises. The conducted research applied methods of desk research as well as comparative quantitative analyses and used extensive statistical data of most European Union member states as well as the United Kingdom and Norway. The ambiguity of the results obtained in the research does not allow for an explicit verification of the existence of relationships between corruption and the pro-ecological initiatives influencing the lower intensity of greenhouse gases and particulate matter (PM) to the atmosphere or increasing share of renewable energy in the whole energy consumption. However, in many analysed cases it is possible to observe the occurrence of the indicated relationships, which, although not considered to be a rule, may give direction to further detailed research in this area, in particular in order to show the resulting beneficial or unfavourable implications for the performance and development of companies and the economy as a whole with rules of sustainability.

Keywords: environmental protection; environmental problems; greenhouse gas; particulate matter (PM); renewable energy; corruption

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1. Introduction

Environmental greenhouse gas pollution, in particular CO2 emissions resulting from energy generation as well as dust emissions into the atmosphere, have been a key problem in the international fora for many years. As a result, many pro-ecological initiatives are being undertaken in the context of further development of the global economy in order to reduce the scale of this phenomenon. An example to be cited may be 17 Sustainable Development Goals set under the 2030 Agenda and a strong emphasis laid there on activities in favour of green energy solutions and clean air [1–5]. Similarly to the actions of the European Commission, which on 14 July 2021, adopted a package of legislative proposals "Fit for 55" [6]. This was done under the European Green Deal, whose priority is to strengthen the EU's position as a global climate leader. This will be a challenge for many Member States and is already the subject of harsh domestic criticism and purely political disputes, especially when the exceptionally strong lobby of industry organizations and trade unions in the "dirty" energy sectors in some countries is taken into account. The question is, how can progress in this area be operationalized and possible obstacles

and limitations identified, bearing in mind numerous comments and even questioning the measures of achieving the sustainable development goals [7–9]?

The problem of reducing the greenhouse gas emissions intensity of energy consumption has been studied for many years, but there are no clear deadlines for its solution yet [10–14]. The same applies to the intensity of emissions of air pollutants, in particular as a consequence of industrial activity. Here, too, despite enormous efforts at the level of international settlements and agreements as well as national activities, often forced by pressure from environmentalists, no success, even a relative one, can be seen and further pro-ecological initiatives in this area are still needed [15–17]. On the other hand, changes in the share of renewable energy in gross final energy consumption on a national scale are much more positive. It should determine not only further actions in the area of reduction in conventional energy sources, but also contribute to the reduction in environmental pollution [18–21].

Having decided to conduct in-depth desk research in these areas, the authors of this article made an attempt to go beyond the existing analytical schemes and to indicate the factor which may positively affect the incomplete implementation of energy goals in the aspect of lower energy consumption and air pollution, and at the same time convergent with the aforementioned Agenda 2030. Importantly, according to the authors, the issue of reducing dirty energy sources is not only a problem considered at the state level, but it is very closely related to the operation of many private enterprises. It is obvious that large energy companies are often transnational corporations whose power of impact often exceeds the capabilities of many countries in the world and which, like most companies, give priority to the shareholder profit maximisation [22,23]. Can one risk a hypothesis then that if, in the countries where corruption phenomena, which are really a sign of weakness of certain public administrative bodies, occur more often, they become a factor inhibiting many processes including, for example, decarbonisation of air, reduction in the emissions of particulate matter and other air pollutants and implementation of renewable energy sources? It is an important issue because corruption, most often measured by the indicator of its perception, does not only destroy citizens' trust in the state [24], but also blocks investor activities, including those in the area of environmental protection. Generally, its occurrence makes these processes run more slowly and does not attract anybody's interest due to the high costs of their implementation and the lack of financial aid from the state. In this situation, in the countries suffering from a high level of corruption, investors do not want to carry out investment activities so as not to expose themselves to the risk of their failure and consequently to financial losses [25,26].

Hence, this article is primarily aimed at the verification of the existence of relationships between the corruption perceptions and the greenhouse gas emissions intensity from energy consumption, the air emissions (particulate matter) intensity from industry and the share of renewable energy in gross final energy consumption by sector. That means, we set ourselves the task of verifying whether it is possible to combine and draw conclusions from two seemingly different research areas: the first one concerning air emissions, greenhouse gases or energy production, and the second, typically socio-economic, which is the corruption measure. Facing the research gap thus defined highlights the originality of our studies; in particular, the literature review shows no previous studies in this scope. The authors noticed the need, apart from cyclical measurement of standard indicators of pollutant emissions, greenhouse gases or energy production, to also identify variables that may significantly affect them. The potential value of the approach we propose will allow for the extension of the field of previous research to include socio-economic aspects and to include non-obvious variables in future analyses.

The conducted research applied the methods of desk research as well as comparative and quantitative analyses, as presented in the section on data and research methodology. For the purpose of this goal, the authors used extensive statistical data on the implementation of some sustainable development goals, the greatest advantage of which is a clear methodology and the possibility of international comparisons.

The authors of the article began this research with a thorough and detailed study of the scientific literature on the subject in the selected area, which allowed highlighting the research gap indicated above. Then, the selection of diagnostic indicators and the selection of countries for the research sample was made, mainly taking into account the complementarity of the variables. The next stage was the presentation of the research results, highlighting their most important elements, which formed the background of the in-depth discussion carried out later. At the end, the final conclusions were presented, including our theoretical contribution, research limitations and quite clear practical implications. All research stages undertaken by the authors were reflected in the structure of the article.

2. Theoretical Framework

A prerequisite for the development of civilisation is a high rate of economic growth, which often results in serious ecological problems, usually overlooked in the corporate accounts due to the classical paradigm of economic rationality generally followed by business companies. As a result, a growing development of civilisation intensifies ecological crises which include a climate crisis, the effects of which are currently so clearly seen by people [27]. Nevertheless, the ecological crisis is manifested not only in the deteriorating state of climate or standard of living of a large part of population, but also in the changes of the entire natural system as well as rising unemployment or financial and economic crises [28–30]. At this point, it is worth emphasising that, to a large extent, this crisis is related to the crisis of human behaviour in the modern world dominated by consumerism, relativism and widespread ignorance [31], all of which degrade all possible manifestations of ethical attitudes, and, consequently, man's responsibility towards other people and the environment often becomes superficial. However, some initiatives are being launched to take into account the Sustainable Development Goals, which can be seen in the financial sector, where financing projects which harm the environment is often abandoned [32]. There is a question, however, to be asked as to why the largest financial institutions did not revise their policy in this area until recently. After all, the significance of the problem of human responsibility for the natural environment was already indicated in the 1980s, with emphasis laid on the relevance of this phenomenon as well as its increasing importance caused by the development of civilisation and growing globalisation [33]. In addition, a strong disruption of the system of values is being observed in science, which is supposed to be based on the truth, freedom, honesty and other axiological foundations [34].

The issues related to the exploitation of the natural environment are the subject to be considered not only by scientists and pro-ecological organisations, but also by every country or business company [35]. The ongoing ecological crisis may soon lead to an ecological catastrophe with unpredictable consequences for the entire world economy as well as human existence and our planet as a whole [36,37]. Therefore, in face of the aforementioned crisis, we need a collective determination to protect our planet [38], bold and fundamental changes in the economic and population policies of states [30], which will also result in the strengthening of the conducted environmental policy. The problem of environmental protection is one of the greatest challenges of humanity in the history of the world, because without maintaining the ecological balance, not only can conducting economic activity turn out to be seriously threatened or even impossible in the near future, but there is also a direct threat to human life [38]. Nowadays, the most important environmental problems include those related to the abuse of natural resources and a negative impact of the global economic system on air, water and soil [39]. It is thought that one of the most urgent solutions is to reduce the concentration of greenhouse gases produced by the power generation sector and industry; they include: carbon dioxide, nitrogen oxide, sulfur oxides or methane [40], and to reduce excessive air pollution with particulate matter, which includes different types of dust: combustible, cement-lime, refractory material, silicon, artificial fertilisers, carbon-graphite, soot and other dusts [41]. Greenhouse gases result in a greenhouse effect, and the emission of particle pollutants PM2.5 and PM10, discharged into the atmosphere as a result of production processes and combustion of solid fuels by industrial plants and

households affects human health; and in the long run, it may have consequences for the smooth functioning of the global economy [42,43]. Naturally, there are also other problems, namely: excessive consumerism resulting in a predatory economy of natural resources and overproduction of waste, climate changes resulting from environmental erosion [28], and the phenomenon of the world demographic explosion lasting since the beginning of the last century [44] or broadly perceived urbanisation [45].

It is not difficult to notice that undertaking pro-ecological activities, conducive to the sustainable development of the modern economy, and more broadly to ecological security, has been a leitmotif in the activities of many countries and non-governmental global organisations for a long time [46]. Initiatives in favour of energy production from renewable sources, i.e., those that do not wear out during their operation, play a special role here. This energy is commonly referred to as renewable or green energy and comes from the sun, wind, river water and sea waves, biomass, biogas, biofuels, nuclear energy as well as heat obtained from land, air and water [47]. Its ecological, economic and social benefits are currently undeniable, which is seen by more and more societies, companies as well as countries which are willing to grant subsidies for the development of renewable energy sources [48]. It is worth emphasising that despite the negative effects of the COVID-19 pandemic, "renewable energy set a record in new power capacity in 2020 and was the only source of electricity generation to register a net increase in total capacity", China strengthened its commitment to overcome the climate crisis, and the United States re-acceded to the Paris Agreement at the beginning of 2021 [49].

Bearing this in mind, it is worth popularising activities aimed at the environmental protection and reduction in the use of non-renewable fossil fuels. Unfortunately, on a global scale, most economic entities do not have adequate financial resources and need incentives or aid from the state in the form of appropriate financial and/or legal mechanisms to implement green economic initiatives in favour of energy saving, waste reduction, clean production or technological eco-innovations. Such a situation does not have to, although it may, be conducive to the emergence of corruption, which is often defined as abuse of power to achieve private goals, while it must be remembered that corruption occurs not only in the public but also in the private sector [50], and its effect is a higher cost and longer duration of project implementation, lower quality and reduced benefits for most stakeholders [51].

Generally, corruption is born as a result of socio-economic inequalities, but it exists everywhere, knows no borders and is considered a real threat to economic development on both a micro and macroeconomic scale [52]. For example, the level of corruption in the European Union has not improved in the last 12 months, as almost 1/3 of its citizens confirm that the scale of corruption in their country has increased, and 44% of them say that its level has remained unchanged [53]. Such a situation may cause concern, especially since, as a rule, corruption distorts the functioning of market mechanisms, limits the investment potential of entities and inhibits economic growth [54]. In addition, it distorts the transparency and structure of public spending, reduces the profitability of public investments, disrupts the implementation of social goals, bureaucratises state administration, creates ineffective administrative structures and reduces the level of public trust in state authorities [55] and entrepreneurs participating in corruption processes. As a result, the search for relationships which do not always prove explicit between corruption, its perception and undertaking these pro-ecological initiatives seems to be an interesting subject of theoretical deliberation as well as a justified research topic.

3. Data and Research Methodology

The quantitative data obtained for the research presented in the article come from official statistics published by Eurostat on the implementation of the Sustainable Development Goals by 2030. The authors analyzed over several dozen different indicators in this area and chose the ones related to the energy sector. The member states of the European Union, Norway and the United Kingdom were selected for the analysis. The adopted period

of time of the analysed data was determined by their availability, it covers the period of 2012–2019. It is also worth emphasizing that the data selected by the authors had a very high degree of completeness, i.e., for most countries they were up-to-date and usable for all the years covered by the study. As new data flow in, the authors will continue their research in the future.

The study examined primarily the correlations between four indicators at the level of each country in the analysed group. The indicators analysed in the study were: corruption perceptions index, greenhouse gas emissions intensity of energy consumption, the air emissions intensity from industry and the share of renewable energy in gross final energy consumption by sector. The detailed definitions of each indicator are as follows:

- Corruption Perceptions Index (CPI) is a composite index based on a combination of surveys and assessments of corruption from up to thirteen different sources and scores and ranks countries based on how corrupt a country's public sector is perceived to be. Importantly, the CPI includes only sources that provide a score for a set of countries or territories and that measure perceptions of corruption in the public sector. For a country or territory to be included in the ranking, what should be emphasized is that it must be included in a minimum of three of the CPI's data sources. The CPI is published on a regular basis, usually annually by the widely recognized and trusted international organization, which is Transparency International [56].
- Greenhouse Gas Emissions Intensity of Energy Consumption (GHGEI) is an indicator calculated as the ratio between energy-related GHG emissions and gross inland consumption of energy [57]. It expresses how many tones CO2 equivalents of energy-related GHGs are emitted in a certain economy per unit of energy that is consumed. Such data on energy emissions are sourced from the GHG emissions reported to the United Nations Framework Convention on Climate Change (UNFCCC) [58].
- Air Emissions Intensity from Industry (AEI) measures the emissions intensity of fine particulate matter (PM2.5) from the manufacturing sector (NACE Rev. 2 sector 'C') [59]. Fine and coarse particles (PM10) are less than 10 micrometres in diameter and can be drawn deep into the lungs, where they can cause inflammation and exacerbate the condition of people suffering from heart and lung diseases. More specifically, fine particles (PM2.5) are less than 2.5 micrometres in diameter and are therefore a subset of the PM10 particles. Note that their negative health impacts are more serious than those of PM10 because they can be drawn further into the lungs and may be more toxic. Whereas emissions intensity is calculated by dividing the sector's PM emissions by its gross value added (GVA), which is defined as output (at basic prices) minus intermediate consumption (at purchase prices).
- Share of Renewable Energy in Gross Final Energy Consumption by Sector (SRE) is an indicator that measures the share of renewable energy consumption in gross final energy consumption according to the Renewable Energy Directive. In this case, the important thing is that the gross final energy consumption is the energy used by end-consumers (final energy consumption) plus grid losses and self-consumption of power plants [60].

We have fully assumed the credibility of the data obtained from the sources and institutions collecting the data we use. Individual deficiencies in the data were shown and they did not affect the analyses performed. The authors carried out a comparative analysis of all indicators in the selected countries, using basic descriptive statistics. In general, they focused on calculating the dynamics of changes of each indicator and measuring the correlations between them, using standard characteristics and strength ranges of correlation: 0.90–1.00 (−0.90 to −1.00)—very high correlation; 0.70 to 0.89 (−0.70 to −0.89)—high correlation; 0.50–0.69 (−0.50 to −0.69)—moderate correlation; 0.30–0.49 (−0.30 to −0.49)—low correlation; 0.00–0.29 (0.00 to −0.29.)—negligible correlation. Due to the limited volume of the article, the authors cannot present all the results, but only the selected ones, which, in their opinion, may constitute valuable research material and a starting point for further

research in the future. Including the potential expansion of research with new indicators, such as macro-economic aggregates or financial results of energy companies.

4. Results of the Authors' Own Research

Within the statistical analysis, the authors examined the aforementioned four indicators in nearly thirty countries. Unfortunately, we had to limit the number of countries surveyed due to the problem with the availability of complete statistical data.

Table 1 shows the observed correlations between the indicators examined in each country. Additionally, in order to expose all very strong and strong correlations (both positive and negative), they were highlighted in gray color in the table. In many cases, there were relationships between the emissions of gases or pollutants and the share of renewable energy as well as strong relationships between these indicators and corruption (for example, Austria, Lithuania, Greece, Hungary or Italy). Although there are not enough cases to consider them a rule, this situation points to another area, i.e., corruption, that may have an impact on the lack of more intensive activities in the field of pro-ecological initiatives in each country. It should be noted, however, that in the countries of the so-called Old Union, these relationships are weaker than in the case of the new member states, in which modernisation processes in industry, aimed at switching to cleaner energy sources, began much later and are still in progress (the effect of belonging to an economic system based on central planning and state ownership).

Table 1. Correlation matrices between the analyzed indicators in individual countries.

Country	Indicator	CPI	GGE	AEI	SRE
Austria	CPI	1.0000	−0.4909	−0.8593	0.8331
	GGEI	−0.4909	1.0000	0.4340	−0.6982
	AEI	−0.8593	0.4340	1.0000	−0.9366
	SRE	0.8331	−0.6982	−0.9366	1.0000
Belgium	CPI	1.0000	0.0520	0.1814	−0.1526
	GGEI	0.0520	1.0000	0.6113	−0.6814
	AEI	0.1814	0.6113	1.0000	−0.9133
	SRE	−0.1526	−0.6814	−0.9133	1.0000
Bulgaria	CPI	1.0000	−0.4594	0.2987	0.4542
	GGEI	−0.4594	1.0000	−0.5984	−0.9580
	AEI	0.2987	−0.5984	1.0000	0.6554
	SRE	0.4542	−0.9580	0.6554	1.0000
Croatia	CPI	1.0000	−0.2224	−0.4458	0.6369
	GGEI	−0.2224	1.0000	0.8680	−0.5759
	AEI	−0.4458	0.8680	1.0000	−0.3324
	SRE	0.6369	−0.5759	−0.3324	1.0000
Cyprus	CPI	1.0000	0.4981	−0.6426	−0.6090
	GGEI	0.4981	1.0000	−0.4487	−0.9310
	AEI	−0.6426	−0.4487	1.0000	0.7408
	SRE	−0.6090	−0.9310	0.7408	1.0000
Czechia	CPI	1.0000	−0.4841	−0.9652	0.6922
	GGEI	−0.4841	1.0000	0.4398	−0.8019
	AEI	−0.9652	0.4398	1.0000	−0.6127
	SRE	0.6922	−0.8019	−0.6127	1.0000
Denmark	CPI	1.0000	0.8451	0.5774	−0.7962
	GGEI	0.8451	1.0000	0.5069	−0.9454
	AEI	0.5774	0.5069	1.0000	−0.4743
	SRE	−0.7962	−0.9454	−0.4743	1.0000

Table 1. *Cont.*

Country	Indicator	CPI	GGE	AEI	SRE
Estonia	CPI	1.0000	−0.6694	0.0122	0.8938
	GGEI	−0.6694	1.0000	0.1457	−0.7849
	AEI	0.0122	0.1457	1.0000	0.0907
	SRE	0.8938	−0.7849	0.0907	1.0000
Finland	CPI	1.0000	0.7067	0.8968	−0.7605
	GGEI	0.7067	1.0000	0.7563	−0.9348
	AEI	0.8968	0.7563	1.0000	−0.9222
	SRE	−0.7605	−0.9348	−0.9222	1.0000
France	CPI	1.0000	0.2996	nd	−0.2164
	GGEI	0.2996	1.0000	nd	−0.7086
	AEI	nd	nd	1.0000	nd
	SRE	−0.2164	−0.7086	nd	1.0000
Germany	CPI	1.0000	−0.2701	nd	0.4695
	GGEI	−0.2701	1.0000	nd	−0.9521
	AEI	nd	nd	1.0000	nd
	SRE	0.4695	−0.9521	nd	1.0000
Greece	CPI	1.0000	−0.8453	0.3693	0.8037
	GGEI	−0.8453	1.0000	−0.2513	−0.8536
	AEI	0.3693	−0.2513	1.0000	−0.0784
	SRE	0.8037	−0.8536	−0.0784	1.0000
Hungary	CPI	1.0000	0.6808	−0.5028	0.8895
	GGEI	0.6808	1.0000	−0.2197	0.7475
	AEI	−0.5028	−0.2197	1.0000	−0.7378
	SRE	0.8895	0.7475	−0.7378	1.0000
Iceland	CPI	1.0000	0.4814	0.8476	−0.3920
	GGEI	0.4814	1.0000	−0.2092	−0.5929
	AEI	0.8476	−0.2092	1.0000	−0.1706
	SRE	−0.3920	−0.5929	−0.1706	1.0000
Ireland	CPI	1.0000	−0.4326	−0.5705	0.6176
	GGEI	−0.4326	1.0000	0.8261	−0.9548
	AEI	−0.5705	0.8261	1.0000	−0.8243
	SRE	0.6176	−0.9548	−0.8243	1.0000
Italy	CPI	1.0000	−0.9181	−0.8778	0.7966
	GGEI	−0.9181	1.0000	0.9974	−0.9361
	AEI	−0.8778	0.9974	1.0000	−0.9138
	SRE	0.7966	−0.9361	−0.9138	1.0000
Latvia	CPI	1.0000	−0.0638	0.0544	0.6870
	GGEI	−0.0638	1.0000	0.0010	−0.5143
	AEI	0.0544	0.0010	1.0000	0.0818
	SRE	0.6870	−0.5143	0.0818	1.0000
Lithuania	CPI	1.0000	−0.8027	−0.9219	0.9148
	GGEI	−0.8027	1.0000	0.9416	−0.8552
	AEI	−0.9219	0.9416	1.0000	−0.9219
	SRE	0.9148	−0.8552	−0.9219	1.0000
Luxembourg	CPI	1.0000	−0.2037	−0.1051	0.0258
	GGEI	−0.2037	1.0000	0.8741	−0.8753
	AEI	−0.1051	0.8741	1.0000	−0.8000
	SRE	0.0258	−0.8753	−0.8000	1.0000
Malta	CPI	1.0000	0.3630	−0.2282	−0.5324
	GGEI	0.3630	1.0000	−0.3176	−0.9384
	AEI	−0.2282	−0.3176	1.0000	0.3084
	SRE	−0.5324	−0.9384	0.3084	1.0000

Table 1. *Cont.*

Country	Indicator	CPI	GGE	AEI	SRE
Netherlands	CPI	1.0000	0.6125	0.8367	−0.7540
	GGEI	0.6125	1.0000	0.6027	−0.5575
	AEI	0.8367	0.6027	1.0000	−0.8450
	SRE	−0.7540	−0.5575	−0.8450	1.0000
Norway	CPI	1.0000	0.3138	0.4084	−0.5079
	GGEI	0.3138	1.0000	−0.3550	0.0723
	AEI	0.4084	−0.3550	1.0000	−0.9138
	SRE	−0.5079	0.0723	−0.9138	1.0000
Poland	CPI	1.0000	0.2743	−0.4510	0.1662
	GGEI	0.2743	1.0000	0.7444	−0.5886
	AEI	−0.4510	0.7444	1.0000	−0.1702
	SRE	0.1662	−0.5886	−0.1702	1.0000
Portugal	CPI	1.0000	0.4762	−0.3076	0.1801
	GGEI	0.4762	1.0000	−0.1426	−0.2473
	AEI	−0.3076	−0.1426	1.0000	−0.8055
	SRE	0.1801	−0.2473	−0.8055	1.0000
Romania	CPI	1.0000	−0.3982	−0.6349	0.3426
	GGEI	−0.3982	1.0000	0.8014	−0.1665
	AEI	−0.6349	0.8014	1.0000	−0.5609
	SRE	0.3426	−0.1665	−0.5609	1.0000
Slovakia	CPI	1.0000	−0.6940	−0.8675	0.5028
	GGEI	−0.6940	1.0000	0.9095	−0.8554
	AEI	−0.8675	0.9095	1.0000	−0.8128
	SRE	0.5028	−0.8554	−0.8128	1.0000
Slovenia	CPI	1.0000	0.0007	−0.8051	−0.7389
	GGEI	0.0007	1.0000	−0.3230	0.0168
	AEI	−0.8051	−0.3230	1.0000	0.8200
	SRE	−0.7389	0.0168	0.8200	1.0000
Spain	CPI	1.0000	0.0590	0.8761	−0.4871
	GGEI	0.0590	1.0000	0.4668	−0.7642
	AEI	0.8761	0.4668	1.0000	−0.7874
	SRE	−0.4871	−0.7642	−0.7874	1.0000
Sweden	CPI	1.0000	0.8712	0.6010	−0.7199
	GGEI	0.8712	1.0000	0.7346	−0.8732
	AEI	0.6010	0.7346	1.0000	−0.9649
	SRE	−0.7199	−0.8732	−0.9649	1.0000
United Kingdom	CPI	1.0000	−0.6728	−0.1733	0.5667
	GGEI	−0.6728	1.0000	0.4690	−0.9784
	AEI	−0.1733	0.4690	1.0000	−0.3634
	SRE	0.5667	−0.9784	−0.3634	1.0000

Source: Authors' own material.

The process of switching to green energy sources is noticeable, which should be an encouragement for those countries where such transformations are just in their infancy. Of course, the power of corruption on such processes remains an open question, but the potential impact is perceptible. The results highlighting the inverse relationship between the greenhouse gas emissions intensity of energy consumption indicator and the share of renewable energy in gross final energy consumption by sector indicator (as in Belgium, Finland, Ireland or even Lithuania) are definitely optimistic. This should direct further intensive actions in this area, by other countries too.

Table 2 presents the dynamics of changes of these indicators in each country in the years 2012–2019. In most cases, the results are disappointing, especially in the area of reduction in greenhouse gas or particulate matter emissions, as quite small year-on-year

decreases were observed here, and sometimes there were also increases. Such a situation definitely proves an ineffective national environmental policy and the need to intensify activities in this area. If we add to this the lack of systematic declines in the corruption perceptions indexes in the analysed countries, then we can presume an obvious lack of consistency and firm decisions in environmental aspects on the part of the government or legislators. For example, repeated announcements of a complete withdrawal from energy production based on fossil fuels, e.g., when using coal (lignite or hard coal), in many countries are not implemented. In addition, what is worrying is the share of green energy sources in total energy production, which is not high enough in many analysed countries all the time.

Table 2. Comparison of the dynamics of the analysed indicators in 5 selected countries in the years 2012–2019.

Country	Indicator	2013/2012	2014/2013	2015/2014	2016/2015	2017/2016	2018/2017	2019/2018
Austria	CPI	100.00	104.35	105.56	98.68	100.00	101.33	101.32
	GGEI	99.19	96.61	100.85	100.84	101.31	99.76	98.82
	AEI	100.00	75.00	100.00	100.00	100.00	66.67	-
	SRE	99.79	102.72	99.85	99.62	99.30	102.01	99.47
Belgium	CPI	100.00	101.33	101.32	100.00	97.40	100.00	100.00
	GGEI	95.92	98.73	105.01	92.90	99.76	103.95	97.47
	AEI	88.89	100.00	100.00	100.00	87.50	100.00	-
	SRE	107.91	105.14	99.79	109.05	104.12	104.01	104.71
Bulgaria	CPI	100.00	104.88	95.35	100.00	104.88	97.67	102.38
	GGEI	94.43	101.10	101.64	95.25	101.79	91.40	98.18
	AEI	111.76	115.79	118.18	107.69	100.00	96.43	-
	SRE	119.33	95.51	101.17	102.73	99.69	110.11	104.72
Croatia	CPI	104.35	100.00	106.25	96.08	100.00	97.96	97.92
	GGEI	97.81	99.25	97.20	101.44	98.80	96.80	98.75
	AEI	100.00	88.89	95.83	86.96	105.00	90.48	-
	SRE	104.80	99.20	104.14	97.58	96.51	102.81	101.49
Cyprus	CPI	95.45	100.00	96.83	90.16	103.64	103.51	98.31
	GGEI	99.51	100.69	99.61	99.31	97.41	96.11	100.96
	AEI	150.00	142.42	97.87	91.30	111.90	102.13	-
	SRE	118.48	108.48	108.24	99.29	106.53	132.32	99.29
Czechia	CPI	97.96	106.25	109.80	98.21	103.64	103.51	94.92
	GGEI	94.34	100.26	101.02	102.27	96.55	97.32	96.46
	AEI	100.00	100.00	71.43	100.00	80.00	100.00	-
	SRE	108.69	108.23	99.96	99.05	99.14	102.31	107.31
Denmark	CPI	101.11	101.10	98.91	98.90	97.78	100.00	98.86
	GGEI	104.46	94.38	93.66	101.93	92.95	99.85	92.12
	AEI	100.00	100.00	100.00	100.00	50.00	200.00	-
	SRE	106.71	107.91	105.26	103.84	108.19	102.12	105.06
Estoni	CPI	106.25	101.47	101.45	100.00	101.43	102.82	101.37
	GGEI	99.09	102.55	90.67	100.55	110.57	89.16	88.07
	AEI	121.31	79.73	164.41	69.07	137.31	47.83	-
	SRE	99.22	103.24	109.13	100.66	101.58	102.83	106.32
Finland	CPI	98.89	100.00	101.12	98.89	95.51	100.00	101.18
	GGEI	102.83	90.15	96.44	103.03	93.35	100.82	94.57
	AEI	90.91	100.00	100.00	100.00	90.00	100.00	-
	SRE	106.95	105.59	101.40	99.22	104.88	100.59	104.67
France	CPI	100.00	97.18	101.45	98.57	101.45	102.86	95.83
	GGEI	99.53	93.93	100.25	103.10	100.36	95.80	99.50
	AEI	100.00	100.00	100.00	100.00	100.00	100.00	-
	SRE	104.78	103.70	103.04	104.31	102.60	103.40	104.69

Table 2. *Cont.*

Country	Indicator	2013/2012	2014/2013	2015/2014	2016/2015	2017/2016	2018/2017	2019/2018
Germany	CPI	98.73	101.28	102.53	100.00	100.00	98.77	100.00
	GGEI	100.00	99.27	100.21	99.79	96.94	98.04	96.89
	AEI	100.00	100.00	100.00	100.00	100.00	100.00	-
	SRE	101.60	104.54	103.62	99.89	103.94	107.73	104.08
Greece	CPI	111.11	107.50	106.98	95.65	109.09	93.75	106.67
	GGEI	99.89	95.93	95.20	95.77	101.72	98.07	92.01
	AEI	96.00	112.50	103.70	92.86	96.15	100.00	-
	SRE	111.53	102.33	100.04	98.09	112.40	104.34	109.01
Hungary	CPI	98.18	100.00	94.44	94.12	93.75	102.22	95.65
	GGEI	97.77	98.99	100.38	100.64	99.24	99.23	99.36
	AEI	87.50	114.29	87.50	114.29	100.00	112.50	-
	SRE	104.35	90.21	99.16	99.19	94.20	92.56	100.63
Iceland	CPI	95.12	101.28	100.00	98.73	98.72	98.70	102.63
	GGEI	93.66	100.66	105.42	102.47	96.39	92.92	100.45
	AEI	85.11	90.00	102.78	75.68	92.86	-	-
	SRE	100.08	98.90	97.86	104.62	98.21	104.36	101.96
Ireland	CPI	104.35	102.78	101.35	97.33	101.37	98.65	101.37
	GGEI	101.23	97.57	99.32	98.40	98.73	98.36	94.99
	AEI	100.00	100.00	50.00	100.00	100.00	100.00	-
	SRE	108.22	113.00	105.56	101.34	114.18	104.04	110.07
Italy	CPI	102.38	100.00	102.33	106.82	106.38	104.00	101.92
	GGEI	95.55	99.89	99.54	100.00	95.31	100.36	98.21
	AEI	87.50	100.00	100.00	100.00	85.71	100.00	-
	SRE	108.42	102.04	102.60	99.37	104.89	97.42	102.16
Latvia	CPI	108.16	103.77	101.82	101.79	101.75	100.00	96.55
	GGEI	100.47	97.87	103.26	100.70	96.29	100.96	100.00
	AEI	104.65	116.67	95.24	90.00	93.33	104.76	-
	SRE	103.72	104.30	97.18	98.93	105.06	102.59	102.36
Lithuania	CPI	105.56	101.75	101.72	100.00	100.00	100.00	101.69
	GGEI	100.45	96.07	97.95	100.66	95.00	101.39	100.49
	AEI	90.00	66.67	83.33	100.00	80.00	100.00	-
	SRE	105.84	103.98	109.14	99.47	101.66	94.84	103.10
Luxembourg	CPI	100.00	102.50	103.66	95.29	101.23	98.78	98.77
	GGEI	97.63	97.58	95.83	96.58	98.82	99.35	101.09
	AEI	80.95	129.41	72.73	87.50	85.71	91.67	-
	SRE	112.36	127.72	111.59	107.50	115.61	144.77	78.54
Malta	CPI	98.25	98.21	109.09	91.67	101.82	96.43	100.00
	GGEI	98.32	98.97	83.66	85.28	96.61	96.16	101.91
	AEI	66.67	100.00	100.00	100.00	150.00	100.00	-
	SRE	131.38	126.17	107.90	121.27	116.29	110.38	106.53
Netherlands	CPI	98.81	100.00	101.20	98.81	98.80	100.00	100.00
	GGEI	101.70	100.84	102.38	98.48	97.13	99.47	98.41
	AEI	100.00	100.00	100.00	100.00	83.33	100.00	-
	SRE	100.69	115.43	104.67	102.36	111.27	113.69	119.46
Norway	CPI	101.18	100.00	102.33	96.59	100.00	98.82	100.00
	GGEI	93.75	113.33	98.40	101.41	93.78	97.94	103.38
	AEI	105.26	85.00	105.88	94.44	94.12	100.00	-
	SRE	101.97	103.78	100.00	101.25	102.22	101.71	103.93
Poland	CPI	103.45	101.67	103.28	98.41	96.77	100.00	96.67
	GGEI	98.20	99.57	100.11	98.59	99.23	98.01	97.06
	AEI	105.41	92.31	94.44	94.12	106.25	94.12	-
	SRE	104.49	101.32	102.36	95.90	97.52	103.24	105.99
Portugal	CPI	98.41	101.61	101.59	96.88	101.61	101.59	96.88
	GGEI	95.14	97.39	105.98	97.81	104.71	96.07	91.93
	AEI	95.33	99.02	96.04	95.88	95.70	97.75	-
	SRE	104.58	114.82	103.41	101.15	99.18	98.67	101.37

Table 2. *Cont.*

Country	Indicator	2013/2012	2014/2013	2015/2014	2016/2015	2017/2016	2018/2017	2019/2018
Romania	CPI	97.73	100.00	106.98	104.35	100.00	97.92	93.62
	GGEI	99.57	100.11	100.11	96.46	98.44	100.23	96.51
	AEI	87.88	89.66	103.85	96.30	88.46	95.65	-
	SRE	104.65	104.01	99.76	101.00	97.69	97.63	101.74
Slovakia	CPI	102.17	106.38	102.00	100.00	98.04	100.00	100.00
	GGEI	97.93	97.77	99.28	100.12	97.94	100.62	95.34
	AEI	100.00	75.00	88.89	100.00	100.00	75.00	-
	SRE	96.94	115.59	109.99	93.37	95.31	103.76	142.01
Slovenia	CPI	93.44	101.75	103.45	101.67	100.00	98.36	100.00
	GGEI	97.89	91.79	101.90	102.96	97.76	99.78	98.03
	AEI	114.29	106.25	94.12	87.50	100.00	100.00	-
	SRE	107.48	96.98	101.87	96.05	98.55	98.71	102.79
Spain	CPI	90.77	101.69	96.67	100.00	98.28	101.75	106.90
	GGEI	96.69	102.00	102.43	94.70	100.72	98.22	96.02
	AEI	76.92	90.00	111.11	90.00	100.00	111.11	-
	SRE	107.22	105.27	100.64	107.16	100.80	99.38	105.20
Sweden	CPI	101.14	97.75	102.30	98.88	95.45	101.19	100.00
	GGEI	97.72	96.90	105.61	93.68	96.63	97.63	97.71
	AEI	100.00	88.89	87.50	85.71	100.00	100.00	-
	SRE	101.53	102.02	102.18	100.72	101.55	100.91	103.18
United Kingdom	CPI	102.70	102.63	103.85	100.00	101.23	97.56	96.25
	GGEI	98.99	96.93	94.61	96.09	97.79	98.93	98.32
	AEI	108.33	107.69	92.86	92.31	100.00	100.00	-
	SRE	123.83	121.96	124.46	107.72	109.15	112.98	110.76

Source: Authors' own material.

A very positive aspect is the increase in the share of renewable energy in gross final energy consumption in former post-communist countries and new members of the European Union, such as the Czech Republic, Poland, Slovakia and Estonia. On the other hand, the high value of air emissions intensity from industry is still worrying in many of the surveyed countries (such as France, Greece, Spain), where much more emphasis should be placed on gradual reduction in this indicator. Finally, the minimization of gas emissions intensity of energy consumption at the level of most countries is also not visible. Despite many declarations, even among the leaders of "clean climate" (in Sweden, Finland or Norway), it is difficult to emphasize here significant progress in this area.

5. Discussion

The ambiguity of the results obtained in the research does not allow for an explicit verification of the existence of relationships between corruption and the analysed pro-ecological initiatives in terms of the greenhouse gas emissions intensity of energy consumption, the air emissions intensity from industry (particulate matter) or the share of renewable energy in gross final energy consumption by sector. Certainly, some interdependencies between the analysed indicators are conspicuous, but their direction and strength are different in each analysed country. Thus, despite some similarities in the results obtained, it is not possible to make generalisations and create a thesis about the existence of correlations between the analysed indicators.

However, on the subject of the relationships between the indicators under consideration, it is worth trying to have a broader discussion in order to show the resulting beneficial or unfavourable implications for the performance and development of companies and the economy as a whole, in particular the green economy. It should be noted that in the case of the sought relationships, it would be desirable to have a negative correlation, which means that the increase in the value of the corruption index is accompanied by a decrease in the average values of indicators describing pro-ecological initiatives. Such a situation

would be beneficial both for stimulating initiatives to protect the natural environment and eliminating or significantly reducing corruption.

Corruption is a serious threat in many countries around the world, and the results of research into the causes and consequences of corruption are so diverse that it is worth examining this issue in relation to other variables, especially those representing environmental issues. Corruption has a significant impact on economic and social development as it affects investment, capital flows, economic growth, trade and services, social inequalities, government spending, the shadow economy and crime and is subject to many institutional, jurisdictional, social and economic determinants [55]. The estimation of the World Bank shows that the annual amount of bribes paid is about one trillion USD and total costs of corruption are approximately equal to up to four percent of the global GDP [61].

According to other empirical studies, corruption affects the economy and hinders both public and private investment, and high levels of corruption correspond to a higher share of the informal economy in percentage of GDP and vice versa [62]. Research shows that a high level of corruption may significantly limit the generation of financial resources and affect the size and scope of government spending, and a high share of government spending usually results in lower corruption rates [63,64]. The analysis of the impact of corruption on total investment also indicates a possible impact of corruption on GDP, which is confirmed by a strong correlation between GDP per capita and corruption, where countries with a higher GDP per capita score better in the Corruption Perceptions Index [62]. In the group of several European countries, there is also a correlation between the predictability of corruption and investment in relation to GDP and the existence of a negative correlation between the distribution of income and the level of corruption, the latter of which is not particularly high, which makes it difficult to explain it in a simple way [62]. Hessami [65] also writes about the fact that corruption can affect public spending. Interestingly, he observes that higher levels of corruption lead to distortions and higher public spending in sectors based on public procurement, such as health and environmental protection together with waste management, and lower spending on recreation, culture and religion. However, there is some doubt as to whether this increase in spending goes together with an improved quality of projects carried out in these sectors. On the other hand, the quality of public institutions, expressed in the rule of law and effectiveness of action, has a positive impact on reducing the level of corruption [66].

It is worth noting that corruption has a negative impact not only on the economy, but also on the integrity of people, which is expressed in the strong correlation between the intrinsic, individual honesty of people and the prevalence of rule violations by them [67].

The cited research results justify the need to determine the impact of corruption on environmental issues, for instance to make the government aware that its existence may have a negative impact on the speed and effectiveness of initiatives and implementation of indispensable pro-ecological solutions.

Nowadays, however, initiatives to protect and improve the state of the natural environment should be undertaken not only on a macro or meso scale, but primarily on a microeconomic scale. Besides, they should be correlated with the activities of state institutions and supported by the state ecological policy, creating all standards, regulations and other mechanisms concerning environmental issues [68]. Furthermore, these initiatives should be a consequence of extensive environmental education of the society, including teaching people the respect for the natural environment [69,70], as well as the result of disseminating ecological knowledge at the level of business enterprises, especially in the aspect of educating specialists in the field of environmental protection, providing environmental knowledge to engineers or using new technologies to generate renewable energy [71]. The development of the Internet may be useful here, as it has a significant impact on improving Industrial Green Total Factor Productivity (IGTFP) in some regions of China, and its long-term effect may encourage the use of Chinese experiences in other countries [72].

Of course, extensive cooperation between people, governments, industry and the energy sector is also needed to deal effectively with the various aspects of environmental pollution, especially air pollution, which has become a major environmental cause of premature death and numerous human health problems, which sooner or later will affect world economic development [73]. Thus, the most important thing is that the policymakers promote the transformation of high-carbon industries, encourage investments in pro-ecological technologies and improve energy efficiency as part of the synergistic reduction in pollutant emissions [74].

From the economic, political and human point of view, alternative (renewable) energy sources seem to be the best solution, the main advantage of which is neutral impact on the environment. Their use is generally not associated with the formation of harmful substances, which has a significant impact on improving the condition of the environment and counteracting the climate crisis. In many countries, however, the development of the renewable energy sector is still not properly supported by decision-makers and largely depends on their political sympathies or beliefs about the importance of alternative energy sources for socio-economic development and environmental sustainability in the future [75] (e.g., EU members are obligated to increase the share of renewable energy sources, the situation is not very optimistic). Other studies show that in the years 2020-2021, companies from the alternative energy sector turned out to be the largest stock exchange beneficiaries, which may suggest a growing social awareness for environmental protection, even with the raging COVID-19 pandemic, which has even become a driving force behind pro-ecological thinking [75].

The existing situation confirms the legitimacy of changes in the energy sector and the need for a definite resignation from the use of conventional energy sources. Therefore, companies from the energy sector should increase their efforts to increase the use of renewable energy sources and implement all kinds of technological innovations or eco-innovations, contributing to the creation of a green economy. The use of ecological innovations (eco-innovations), whose primary goal focuses on the environmental issues [76], will also be extremely useful here, but their implementation also has a positive effect on the cost reduction, greater production efficiency or improved product quality [77]. Ecological innovations, which are assumed to bring economic benefits and lead to an increase in the company's value, combine innovations with ecology in such a way as to create sustainable and environmentally friendly solutions, the implementation of which results in both better environmental protection and increased competitiveness of the companies implementing them [78]. As a result, ecological innovations fulfill the ecological and economic goals of the company, creating a coherent whole in this respect, which in turn is consistent with the principles of the concept of sustainable development [79] and should be an effective way of mitigating the current ecological crisis and preventing it in the future.

A good solution may be the promotion of electromobility, which essentially contributes to an increase in energy efficiency and reduction in pollution to the environment, especially lower air pollution, while being an important element of actions for sustainable transport [80,81]. Thanks to appropriate measures to govern changes in the transport system, they can effectively reduce the amount of particulate matter and positively counteract climate change [82]

An important, but rather temporary and quite expensive market tool that stimulates economic growth while reducing carbon dioxide emissions can be trading in carbon dioxide emissions, which not only contributes to cost reduction and further development of low-emission technologies by reinvesting income, but also promotes low-carbon technological innovation [83]. In addition, this carbon trading may, in part, contribute to the faster structural adjustment of a highly polluted industry and eliminate obsolete manufacturing solutions [84].

The creation of a green economy as a result of the implementation of pro-ecological initiatives is the right direction for the development of the global economy, because it forces greater economic efficiency, creates new jobs, attracts investors, protects nature,

meets social expectations, and at the same time generates profits. A green economy, as a UN initiative designed to motivate policymakers to support environmental investments, builds social equity while reducing environmental risks and scarcities [85]. Thanks to this "an inclusive green economy is an alternative to today's dominant economic model, which exacerbates inequalities, encourages waste, triggers resource scarcities, and generates widespread threats to the environment and human health" [85]. Unfortunately, as already mentioned, changes in the approach to the environment involve additional capital, because pro-ecological solutions are very expensive and require significant financial outlays [86], especially in the implementation of innovative ecological technologies which should simultaneously ensure environmental protection and corporate development [78,87]. Where there is a lot of money, there is always a temptation towards financial abuse and corruption phenomena, even at the expense of polluting the environment or even a complete lack of its protection. Even more so, because many enterprises and entrepreneurs cannot afford (for economic reasons) to introduce the postulated environmental changes without the aid from the state or international organisations.

Therefore, it should be assumed that corruption or its perception may also have a negative impact on the implementation of pro-ecological initiatives aimed at reducing and/or eliminating greenhouse gas or particulate matter emissions or investments in the development of renewable energy, which is an alternative to energy generated from fossil fuels. On the example of non-democratic countries rich in natural resources, where there are weak public institutions, it can be seen that high profits from the exploitation of natural resources definitely favor the growth of corruption [88]. The lack of transparency in the distribution of environmental funds, payment delays or embezzlement may further discourage entities from taking these actions, for example for the fear of threat to corporate development, higher costs of doing business or promotion of ineffective companies that do not meet the project requirements, but pay bribes or are well connected [63]. Furthermore, there are also unjust rules for the assessment of submitted investment projects or the need to pay additional fees to win favour or protectionism of officials, which is particularly conspicuous in the context of acquisition of public funds and in relations with the public sector [62].

To confirm that the described situation is true and extremely important not only in the practical aspect of socio-economic life, but also in the scientific approach to this problem, one can cite the global initiative of the member states of the United Nations, such as The Sustainable Development. This initiative is a common plan for peace and prosperity for people and the planet now and in the future, in which economic growth depends on fighting climate change and working to protect our oceans and forests [89]. As mentioned, this initiative has 17 goals that humanity should strive to achieve. Among them, we can find two goals: 7 and 16, which relate directly to the issues addressed in this article. Therefore, Goal 7 relates to "Ensure access to affordable, reliable, sustainable and modern energy" and Goal 16 is to significantly reduce corruption in all its forms following the recommendations: "Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels" [89]. Goal 16 is especially important, because corruption causes ineffectiveness in many areas of socio-economic life, undermines the credibility and competitiveness of the country, lowers its GDP, increases inequalities in society, causes a decline in the quality of public services and limits government spending [52,53], and certainly does not encourage the implementation of Goal 7. The consequence of accepting corruption will be lower tax revenues, distrust of public institutions, difficulties with implementing regulations and maintaining law and order, or a lack of funds for the implementation of important public investments, not to mention environmental protection activities.

6. Conclusions

To recapitulate, the authors attempted to investigate and verify the existence of relationships between the corruption perceptions and the greenhouse gas emissions intensity of

energy consumption, the air emissions intensity from industry and the share of renewable energy in gross final energy consumption. It seems that the very fact of recognising a possibility of correlation between the indicators discussed in the article should lead to such reasoning, especially since pro-ecological initiatives are inextricably related to the Sustainable Development Goals. Environmental pollution through dust emissions or climate changes as a consequence of greenhouse gas emissions are a sufficient reason to firmly reduce any incentives aimed at blocking activities in this area, especially bearing in mind corruption. Although it was not possible to unequivocally confirm the existence of the above-mentioned relationships, several interesting conclusions can be drawn on the basis of the results.

Firstly, especially during the COVID-19 pandemic, which has radically changed the business landscape around the world, economic activity and interpersonal relationships should be dominated by honesty, trust and responsibility, because it is these characteristics of people that seem to be the panacea for the current global ecological crisis. This trust and responsibility facilitate cooperation between entities of economy, improving the government's and the economy's quality and in turn reducing the level of corruption [90]. Of course, the high level of democracy plays an important role here, as it guarantees economic freedom that reduces the level of corruption, and, at the same time, points out an interesting relation between democracy and corruption [64,91]. However, it should be remembered that democracy reduces corruption, but only when public institutions operate quickly and effectively and are fully functional and have strong democratic roots, and are not devoid of them [63]. For example, only 4 in 10 people in the EU believe their governments fought the epidemic in a transparent manner, and more than half of the population in the EU believe their governments are driven by private interests rather than public interests [92]. This allows us to assume that governments are not fully committed to environmental protection issues, including the reduction in the emission of greenhouse gases and particulate matter (PM) or the greater use of renewable energy and therefore it is worth talking and writing about.

Secondly, if we want to prevent the emergence of corruption, which may inhibit the implementation of pro-ecological initiatives aimed at reducing and/or eliminating greenhouse gas and particulate matter emissions and investments in the development of renewable energy, it is necessary not only to fight it, but first of all to ensure a large-scale promotion of the principles of business and clerical ethics. Besides, what is also needed is a stable and well-managed economy and strong and efficient state institutions which do not tolerate corrupt behaviours, reduce the corruption level and make it remain low [93]. Research on corruption in European Union countries shows that the governments of the Member States and EU institutions still have a lot to do to ensure their citizens a life free from corruption [92]. Therefore, it is already necessary to take and/or continue activities aimed at, among others: constantly building people's trust in rulers and institutions, transparent decision-making and law-making processes, counteracting protection, increasing transparency and access to public services, and increasing accountability for abuses of power.

Thirdly, it is necessary to radically change the approach to the problem of pollution caused by the conventional energy sector, primarily by promoting the development of renewable energy and encouraging energy companies to systematically increase the share of clean energy production, i.e., from renewable sources.

It is worth emphasizing that renewables energy may eliminate the use of fossil fuels for electricity by 2035 and replace fossil fuel usage altogether by year of 2050 [94], but consistency in action and concrete decisions of all decision-makers on a global scale are needed. Except that, the concept of the green economy should emerge as a strategic priority for all governments [85] and be developed with the active participation of various stakeholder groups, as well as appropriately communicated to the public. This is so important that, according to many scientists, without fully appreciating and broadcasting the scale of the environmental problems as well as the proposed solutions, society will fail to achieve even small sustainability goals (including the energy sector) and will not contribute to overcoming the ecological crisis [95].

Our research, to some extent, supplemented the previous theoretical considerations on the relationship between indicators concerning gas emissions, pollutants or energy production and other potential variables. In our case, the choice fell on an indicator of corruption perception, that allows to take into account the meaning of the socio-economic background in the aspect of the influence of energy production and consumption on the condition of the natural environment. We argue that the diagnostics of the corruption perception indicator we have chosen covers the entire spectrum of the functioning of the political or administrative sphere in individual countries. This, in turn, makes our research attempt more comprehensive and repeatable by other researchers (whether for other countries or periods). Additionally, based on research precaution, we anticipate more than we postulate that the academic consequences of this research for the future of scientific literature will be further analysed in the field of identifying other variables and factors that, indirectly, but nevertheless affect the results and harmfulness of the energy sector, and in particular the so-call dirty part of energy sector (based on fossil fuels), that is most dangerous for the environment and climate change. Besides, research shows that researching the relationships between greenhouse gas or particulate matter emissions or the volume of renewable energy production and the level of corruption may contribute to the popularization of pro-ecological activities aimed at building and developing a green economy, which is desirable in the face of contemporary environmental threats.

Regarding the limitations and possible future research directions, it should be noted that a barrier in the research was the inability to analyze the strength and direction of the impact of corruption on the presented indicators. Therefore, in the future it would be worth using the case study method, which could solve the mentioned problem. As a continuation of this initiative, the authors intend to focus further research on the analysis of cases of specific countries where green energy sources are still marginal and the "dirty energy" lobby exerts strong pressure on the government to constantly extend the deadline for ceasing the use of hard coal or lignite for energy production.

7. Implications

We consciously resign from dividing the implications into managerial, practical or social ones, taking into account the importance and scale of the problem we are discussing. It is difficult to question many years of and various international initiatives, such as those undertaken at the level of the United Nations, the European Union, and indirectly at various climate summits, which concern the protection of the natural environment, clean air and climate. Hence, the global focus on more and more detailed initiatives and activities aimed at reducing the production of dirty energy and pollutant emissions should encourage joint ownership and cooperation in this area by governments, large energy companies, but also non-governmental organizations. The crowned example of this is the corruption problem we diagnose, which may, after all, be a significant obstacle in the implementation of the goals resulting from the principles of sustainable development and the 2030 agenda or the Fit for 55 package. Here, therefore, we see a huge role of experts, specialists from non-governmental organizations, but also control bodies in individual countries, in order not only to monitor the results of the energy industry and its harmfulness to the environment and climate, but also to point out potential obstacles hindering the achievement of the assumed goals. Social context, and even acceptance of corrupt behavior, is still an unimaginably great problem in some of the surveyed countries. That is why the continuous education of the society in the area of producing clean energy and minimizing the emission of harmful pollutants and gases must also be maintained. Only with work on the ground and, of course, with appropriate legal regulations and effective enforcement of regulations, it will be possible to influence global energy companies (but also some governments) in terms of reducing the harmfulness of the energy sector and its transformation towards the production of clean (renewable) energy.

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