

Problems of the Implementation of the Paris Agreements in the Post-pandemic Reality

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Abstract: The COVID-19 pandemic and its aftermaths impede the achievement of sustainable development goals, including reducing the carbon footprint and tackling climate change. The purpose of the study is to identify the main problems and assess the prospects for the implementation of the Paris Agreement in the post-pandemic world, taking into account the specifics of individual countries. Research methods – analysis of the growth rates of greenhouse gas emissions by countries of the world, descriptive statistics, correlation analysis, GAP analysis. As a result, it was found that most countries in the world fulfil the obligations of the Paris Agreement (especially the countries of the European Union), but the largest emitters of greenhouse gases (China, India, Brazil, Australia, etc.) increased their emissions in 2019 compared to 2015. Growth in greenhouse gas emissions in China more than its decline in the European Union. In general, the variation in the growth rate of greenhouse gas emissions is very large. Consequently, the goals of the Paris Agreement are being implemented extremely unevenly. The study highlights the main barriers to this, and formulates a number of measures to reduce them. In particular, it is necessary to develop an international consensus with the participation of the largest emitters of greenhouse gases on the imposition of obligations on individual countries within the framework of international law. Developing countries must be provided with resources and expertise to reduce their carbon footprint. However, the decisive importance for the implementation of the Paris agreements will be the removal of technological restrictions on carbon-free energy.


1 INTRODUCTION


The coronavirus pandemic and the resulting global economic crisis have sharply exacerbated many global problems, although even before the pandemic, progress in most countries of the world in achieving the sustainable development goals was insufficient (Shulla et al., 2021). The spread of the new coronavirus infection COVID-19 also influenced the possibility of realizing the Thirteenth UN Sustainable Development Goal, which, as you know, implies “Take urgent action to combat climate change and its impacts” (Campbell et al., 2018: 13).


On the one hand, it could be assumed that lockdowns, restrictions on business life, and social activity would lead to a decrease in the use of fossil fuels, a reduction in the carbon footprint, at least to

some extent (Heggen, Sandseta & Engebretsen, 2020). On the other hand, vital economic activities, such as mining or agriculture, continued as usual, and the overall potential for reducing greenhouse gas emissions was not so great (Wang & Huang, 2021). At the same time, the economic crisis has reduced the resource opportunities for investment in reducing the carbon footprint, especially in developing countries. Many are looking to use cheap fuel to rebuild their economies (Ekwebelem et al., 2021). Therefore, it will be even more difficult for all countries of the world to achieve carbon neutrality after the pandemic.

The impact of the COVID-19 pandemic on the achievement of sustainable development goals related to mitigating climate change, reducing the carbon footprint and reducing greenhouse gas emissions are discussed in separate studies.

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According to estimates presented in a press release from the United Nations Environment Program, the COVID-19 pandemic, the ensuing restrictions and bans on economic activities led only to a temporary reduction in greenhouse gas emissions, the effect of which quickly disappeared in 2021. In particular, carbon monoxide emissions in 2020 declined by 5.6%, well below the slowdown in the global economy, and the concentration of major greenhouse gases continued to rise in 2020 and the first half of 2020 (United Nations, 2021).

It should be noted that the decrease in greenhouse gas emissions in 2020 is largely due to the minimization of civil aviation flights, a decrease in cargo turnover on sea routes, as well as the limitation of travel by private vehicles (Le Quéré et al., 2020). Emissions from thermal power plants remained virtually unchanged (Forster et al., 2020). Since measures to restrict movement, tourism, and social contacts cannot last forever (Sarfraz et al., 2021), in a post-pandemic situation, no new fundamental factors arise that could affect the reduction of greenhouse gases. Rather, on the contrary, the pandemic has reduced human resources to combat climate change (Heyd, 2020).

Reviewed by Kumar et al. (2021) states a scientific consensus on the short-term effect of the COVID-19 pandemic in reducing greenhouse gases and the new challenges of reducing the carbon footprint in the complex post-pandemic reality. Therefore, further research is needed on how various countries around the world could reduce greenhouse gas emissions in difficult economic conditions. As you know, the obligations of countries to reduce their carbon footprint are established by the Paris Agreement of 2015. However, its implementation even before the pandemic was associated with great difficulties, and states were only morally responsible for ignoring their goals (Mitchell et al, 2018). Therefore, the purpose of the study is to identify the main problems and assess the prospects for the implementation of the Paris Agreement in the post-pandemic world, taking into account the specifics of individual countries.

2 RESEARCH METHODOLOGY

The study employs a blended research strategy combining quantitative and qualitative methods to analyse empirical data on the level of implementation of the Paris Agreement and its prospects for the future. The study design includes two stages. At the first stage, using standard methods of descriptive

statistics, the results of the implementation of the Paris Agreement in 2015-2020 were assessed, on the basis of correlation analysis; the relationship between carbon tax and emission reductions in European countries was investigated. Greenhouse gas emissions data were obtained from The World Bank (2020, 2021).

At the second stage of the study, a GAP analysis was carried out to improve understanding of the main problems associated with the implementation of the Paris Agreement in the post-pandemic world. For this, expert assessments were used, presented in various sources in natural language, collected and summarized by the authors. Based on the identified problems and deviations, key tasks and activities were formulated that can contribute to a more complete implementation of the Paris Agreement.

3 RESEARCH RESULTS

Table 1 presents data on the dynamics of greenhouse gas emissions in the largest countries of the world in 2019 compared to 2015. We do not consider 2020 in our study, because this year, greenhouse gas emissions have decreased in almost all countries of the world under the influence of an external shock (COVID-19 pandemic and lockdowns). We focused on the largest emitters of greenhouse gases such as China, India or Russia, as well as the European Union countries where many measures are used to reduce their carbon footprint, including a carbon tax.

Table 1: Dynamics of greenhouse gas emissions by countries of the world, 2019 to 2015.

Countries	2015, MtCO _{2e}	2019, MtCO _{2e}	Growth rate,%
Iceland	4	2	-50.0
Ireland	60	37	-38.3
Liechtenstein	4	3	-25.0
Sweden	4	3	-25.0
Portugal	53	41	-22.6
Denmark	6	5	-16.7
Norway	7	6	-14.3
Poland	313	280	-10.5
Germany	904	810	-10.4
Japan	1220	1110	-9.0
Switzerland	41	38	-7.3
Spain	288	271	-5.9
France	339	324	-4.4
Finland	55	53	-3.6
South Korea	697	676	-3.0
United States	6671	6558	-1.7
United Kingdom	505	498	-1.4
Estonia	12	12	0.0

Latvia	4	4	0.0
Ukraine	4	4	0.0
Brazil	1056	1068	1.1
Russia	2094	2119	1.2
Australia	533	545	2.3
Canada	707	730	3.3
Argentina	344	356	3.5
Indonesia	835	872	4.4
Turkey	473	506	7.0
China	12698	13633	7.4
South Africa	550	600	9.1
India	2797	3153	12.7
Slovenia	6	7	16.7

The data in Table 1 show that not all countries demonstrate progress in the implementation of the Paris Agreement. Out of 31 countries, only 17 (about 55%) reduced greenhouse gas emissions, while 11 countries (about 35%) increased them. In another 3 countries, emissions did not change significantly. But it is important that the reduction in emissions is observed in those countries that had minimum volumes already in 2015. For example, in Iceland, greenhouse gas emissions have decreased by 50%, in Ireland – by more than 38%. But in absolute terms, it is only 25 MtCO₂e, which is not a significant value on a global scale.

In 17 countries, emissions were reduced by 456 MtCO₂e in total. At the same time, China's greenhouse gas emissions increased by 935 MtCO₂e, leading to an increase in global emissions. As can be seen from the data in Table 1, economically developed countries, mainly the countries of the European Union, as well as the USA, Japan and South Korea, have reduced their greenhouse gas emissions. In developing and transitional countries, greenhouse gas emissions increased, in India the increase was 12.7%, in South Africa – by 9.1%. Even economically advanced Canada has not been able to move towards carbon neutrality.

Consequently, almost all of the efforts to reduce carbon footprint are in the European Union, the United States and Japan. Other states are unwilling or unable to take real steps to reduce greenhouse gas emissions. The large stratification of countries in the world in terms of the dynamics of greenhouse gas emissions is confirmed by the descriptive statistics calculated by the authors (Table 2). We analysed only the relative reduction in emissions, since the absolute decline depends on the size of the population, the volume of the gross domestic product and is characterized by an even higher variation.

Table 2: Descriptive statistics of the indicator “growth rate of greenhouse gas emissions” in 2019 relative to 2020.

Arithmetic mean	-5.82
Modal meaning	0.00
Median value	-1.70
Swipe variation	66.70
Average linear deviation	10.66
Corrected (unbiased) variance	209.07
Standard deviation	14.22
Variation coefficient, percent	244.43 (strong)
Oscillation coefficient, percent	-1146.18
Torque asymmetry coefficient	-1.25 (Left-sided)
Distribution kurtosis	1.58

The data in Table 2 show that the arithmetic mean, mode and median differ significantly: the median is much larger. However, it is more typical for the sample to reduce emissions by at least 1-5%. At the same time, the variation is quite large; the coefficient of variation exceeds 240%, which indicates a very high variation. The range of variation reaches almost 67%. The presence of left-sided (positive) asymmetry is a consequence of the fact that values below the average are more often found, i.e. most countries have reduced their emissions to a greater extent.

The distribution of the studied indicator is not normal. The observed value of Pearson's statistics was 168.41 with an interval width of 11.70, while the critical value is at 37.65. If the observed value of the Pearson statistic falls into the critical region, it is necessary to reject the hypothesis that the distribution is normal. Consequently, there is considerable variation at the level of different countries of the world. While most governments, as discussed above, have reduced their emissions, several large greenhouse gas emitters have discounted these efforts. Reduction of emissions by 10% or more was observed in those countries where the absolute emissions are low: from 5-7 to 50-60 MtCO₂e. In countries with large absolute greenhouse gas emissions (2000 MtCO₂e and more), the reduction was minimal (1-3%) or an increase was observed.

In general, developing countries and countries with economies in transition, as well as some developed countries, such as Canada or Australia, in 2016-2019 increased greenhouses gas emissions by 1496 MtCO₂e or 6.8% in relation to the level of 2015. Thus, the unevenness of efforts and the results of different countries in reducing greenhouse gas emissions lead to the fact that the Paris Agreement is not being implemented.

An important economic mechanism for reducing greenhouse gas emissions is considered to be the carbon tax, which is often used in the countries of the European Union. Table 3 shows the carbon tax rates

according to the growth rate of greenhouse gas emissions in Europe.

Maximum carbon tax rates (around € 100 per metric ton of CO₂) have been introduced in Sweden, Liechtenstein and Switzerland. In countries such as Poland and Ukraine, they are very low and are more of a formal political declaration of commitment to fight than a current method of influencing emissions. The study calculated the Pearson correlation coefficient to assess the impact of the carbon tax on the potential for emission reductions under the Paris Agreement.

Table 3: The relationship between carbon tax rates and the dynamics of greenhouse gas emissions in Europe.

Countries	Growth rate,%	Carbon tax rate, € per metric ton
Sweden	-25.0	108.81
Liechtenstein	-25.0	90.53
Switzerland	-7.3	90.53
Finland	-3.6	62.18
Norway	-14.3	48.46
France	-4.4	44.81
Iceland	-50.0	27.43
Ireland	-38.3	25.60
Portugal	-22.6	23.77
Denmark	-16.7	23.77
United Kingdom	-1.4	20.12
Slovenia	16.7	17.37
Spain	-5.9	14.63
Latvia	0.0	9.14
Estonia	0.0	1.83
Ukraine	0.0	0.37
Poland	-10.5	0.09

The correlation coefficient was -0.2761 , which is below the level of statistical significance (with the number of degrees of freedom about 30, the module of the critical value, the correlation coefficient should be higher than 0.3494 at the 5% significance level). Consequently, the amount of the carbon tax is not related to the rate of emission reduction. Implementation of the Paris Agreement requires the use of new instruments.

4 THE DISCUSSION OF THE RESULTS

The survey results show that the Paris Agreement faced significant challenges during the period 2016-2019. A large number of developed countries have made significant progress towards carbon neutrality, but the amount of greenhouse gas emissions in them is too small for even a 30-50% reduction to

significantly affect the concentration of CO₂ in the Earth's atmosphere. The growth in greenhouse gas emissions in China or India is much higher than the decline in the entire European Union. As noted above, the COVID-19 pandemic and lockdowns have contributed to some reduction in greenhouse gas emissions, but this is a temporary short-term effect. In the period of recovery from the pandemic and the recovery of the global economy, greenhouse gas emissions will continue to grow, and human resources for the transition to a low-carbon economy have already sharply decreased. In this regard, in Table 4, the authors present a GAP analysis of the implementation of the Paris Agreement in the post-pandemic period of the development of the global economy. For the GAP analysis, the following groups of problems were identified.

1. The Paris Agreement is not a legally binding document; rather, it is a declaration of intent that may not be implemented by individual countries. The agreement does not contain specific sanctions for abandoning emission reduction targets and a mechanism for their application. Ratification of the Paris Agreement does not impose legal obligations on the country in the understanding of modern international law.

2. Objective very large technical difficulties in the use of renewable energy sources with a low or zero carbon footprints. The practice of recent years has shown that it is extremely difficult for wind and solar energy in developed countries to meet the needs of industry and a population accustomed to a high level of comfort. This is especially pronounced during the period of unfavourable weather conditions (anticyclones, calm, and frost). In addition, a significant amount of solid waste accumulates over time in renewable energy. Alternative promising energy sources, such as thermonuclear reaction or hydrogen energy, cannot yet provide the bulk of humanity's energy needs for technological reasons.

3. For many countries around the world, there is a lack of both economic opportunity and motivation to move to a low-carbon economy. In contrast, emerging developing countries such as Indonesia and the Philippines are declaring plans to increase production of the most greenhouse fossil fuels (coal) as a source of cheap energy and currency. Turkey is also pursuing a policy of expanding coal consumption. The financial and technological capabilities of these countries are significantly lower than that of the United States or the European Union, and politicians and the population are often negatively disposed towards everything that comes from Brussels or Washington. In many developing countries, there is a

perception of the use of decarbonization instruments as a measure of unfair competition. All this leads to ignorance of the Paris Agreement by many states.

4. The imbalance of the used technical and economic solutions to reduce the carbon footprint, due, inter alia, to political competition and lobbying of various groups of influence. The focus is on the direct reduction of carbon emissions from burning fossil fuels, while CO₂ is a resource that can be used in various industries as well as in agriculture.

4. The imbalance of different directions for reducing greenhouse gas emissions	Smart selection of tools for absorbing generated CO ₂ or reducing its emissions by efficiency parameter	Implementation of projects involving the growth of green mass (planting forests) and the absorption of excess CO ₂ by crop production Reduction or transfer to new technologies, first of all, of those facilities that give maximum emissions with minimum energy efficiency
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Table 4: GAP analysis of the implementation of the Paris Agreement in the post-pandemic period of the development of the global economy.

Identified deviations	Key tasks	Response plans
1. The Paris Agreement is more a declaration of intent than a binding document	Creation of a mechanism of international legal responsibility, taking into account the inalienable rights of sovereign states	Development and signing under the Paris Agreement of an additional document with legally significant obligations Progress towards climate goals as a condition for inclusion in the development agenda and support for developing countries Broad international discussion with the aim of developing mechanisms to control and stimulate the implementation of climate goals in the framework of international law
2. Technical problems and limitations of carbon-free energy	Development of fundamentally new technologies for generating energy with a minimum carbon footprint	Stimulating and supporting research that may result in fundamentally new energy technologies Use of nuclear energy technologies with minimal or zero hazard to obtain electrical and thermal energy Development and replication of fossil fuel combustion technologies with capture of greenhouse gases for their subsequent use
3. Lack of opportunity and motivation in many developing countries	Normalization of international relations, the search for new forms of productive interaction	Creation of investment funds and financial institutions that provide long-term investment instruments for the transition of developing countries to low-carbon energy and economics

Achieving climate targets in a post-pandemic reality will be challenging. Lack of resources, motivation and technology creates powerful barriers to reducing your carbon footprint. It can be assumed that the transition to a low-carbon economy is possible only with the development of an international consensus on the need to impose legal, not just political, obligations to reduce the carbon footprint.

However, the main thing for the implementation of the Paris Agreement and other documents on climate, which may be developed later, is the emergence of fundamentally new energy technologies that do not depend or are weakly dependent on minerals. Existing energy technologies either do not meet the requirements of carbon neutrality, or have low productivity, or too high energy costs. Therefore, it is critically important to develop innovative ecosystems where basic energy innovations can emerge.

5 CONCLUSIONS

The study showed that after the COVID-19 pandemic, during the period of global economic recovery, the implementation of the Paris Agreement will be very difficult. Analysis of the dynamics of greenhouse gas emissions in 2019 compared to 2015 (to exclude the impact of the pandemic) showed that not all countries of the world are committed to the idea of implementing the Paris Agreement and reducing the carbon footprint. The countries of the European Union, as well as Japan, South Korea and the United States have achieved significant reductions in CO₂ emissions.

However, these efforts have failed to offset the rapid growth in carbon emissions in China, India, some other developing countries, and even some developed ones. The increase in greenhouse gas emissions only in China was higher than their decrease in the European Union. The growth rates of emissions are highly differentiated across the

countries of the world. Most of the countries in the study have significantly reduced their emissions, but the largest emitters of greenhouse gases have ignored the requirements of the Paris Agreement. If this situation continues after the COVID-19 pandemic, humankind will not be able to move towards carbon neutrality.

The study conducted a GAP analysis of the transition to carbon neutrality, which identified four main problems. First, sovereign states can ignore their obligations, since the Paris Agreement does not impose direct legal obligations. Secondly, the existing carbon-free energy technologies have significant economic or technical limitations.

Third, many developing countries lack the motivation, resources and technology to work towards reducing their carbon footprint. Fourth, the most rational and effective directions for reducing greenhouse gas emissions are not always chosen. To overcome these problems and barriers to the implementation of the Paris Agreement in a "post-pandemic" world, it will be necessary to develop a global consensus on international legal obligations to reduce greenhouse gases, to provide resources and competencies to less developed countries. However, the main thing is to create conditions for the emergence of fundamentally new carbon-free energy technologies.

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