Vilnius University Press

Contents lists available at Vilnius University Press

Ekonomika
2024, vol. 103(1), pp. 78–90

ISSN 1392-1258 eISSN 2424-6166
DOI: https://doi.org/10.15388/Ekon.2024.103.1.5

# Impact of Energy Use on Air Pollution: Evidence from OCED Countries

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**Abstract.** Air pollution poses significant environmental and health risks, with numerous studies suggesting its dire consequences ranging from respiratory diseases to global climate change implications. In this context, understanding energy consumption patterns and their impact on air pollution is critical, especially in developed nations with high energy consumption rates. This paper empirically analyzes the impact of energy use on air pollution in OECD countries – a group of nations that play a pivotal role in global energy consumption and policy-making. Despite their economic advancements, the implications of their energy choices on air quality have not been extensively studied, presenting a gap in the literature. Spanning 12 years from 2010 to 2021, our research encompasses a total of 456 observations, employing panel data. We aim to unveil the relationship between energy use, both traditional and renewable and air pollution levels. The variables studied include Energy use per capita, Alternative and nuclear energy, Greenhouse gas emissions, Energy imports, Access to electricity, and the production of renewable energy (air, water, solar, geothermal). Leveraging various econometric models such as OLS, OLS Robust, fixed, and random effects models, our findings reveal that electricity use exacerbates air pollution levels. Particularly, the increase in carbon dioxide, coupled with the rising access to electricity, deteriorates air quality. In contrast, electricity sourced from renewables like water, wind, nuclear, and geothermal energy aids in mitigating air pollution, emphasizing the importance of sustainable energy choices for future policy considerations in OECD nations.
**Keywords:** Pollution, Air, Energy.

## 1. Introduction

Air pollution is a major environmental issue that can be caused by various human activities, including energy use. Energy production and consumption, especially from fossil fuels such as coal, oil, and gas, can emit harmful pollutants into the atmosphere. These pollutants include particulate matter, nitrogen oxides, sulfur dioxide, carbon monoxide, and volatile organic compounds. Numerous studies report on the impact of factors and

**Received:** 04/04/2023. **Revised:** 16/08/2023. **Accepted:** 17/08/2023

the high impact of energy use on air pollution (Yuan, 2015; Poon, 2006; Alvarez-Herranz et al., 2017; Bose, 2010, Eom et al., 2020). However, almost all empirical studies are carried out in the continent of Asia, which is also known as one of the continents with the most polluted air from the average values of the PM[1] index, so we have very little empirical research that is carried out with OECD countries.[2] Even these countries are characterized by a high level of energy consumption, which has a large contribution to air pollution. The studies carried out for this region mainly study only the use of electricity, while we provide evidence for the use of almost all types of energy, starting from the use of energy in households, then the general use per capita, then the use of wind energy, water, solar, thermal and nuclear.

While there are extensive studies on energy use and its impact on air pollution, the majority have focused on the Asian continent. The novelty of our research lies in its focus on OECD countries. Most studies concerning this region have primarily looked at electricity consumption. In contrast, our study provides comprehensive evidence covering almost all types of energy consumption, from household usage to various renewable sources like wind, water, solar etc. This comprehensive approach in the context of OECD nations is the primary differentiator of our study from previously conducted research.

The research questions of the paper are:

1. How does energy use affect air pollution in OCED nations?
2. Does the use of renewable energies such as solar energy, wind energy, water, etc. have a positive impact on air quality improvement?

To examine the determinants of Air Pollution, the following hypotheses were raised:

H1: The use of energy has a positive impact on increasing air pollution.

H2: The use of renewable energies (solar, water, wind) has an impact on reducing the level of air pollution.

Several approaches were used to apply econometric models to test the proposed hypotheses, starting with the OLS and OLS Robust models. Two models – the fixed effects approach and the random effects method – were also used because the data in this study are of the panel type. The World Bank, the Global Economy, and the statistical agencies of the 38 OECD nations provided the data for the implementation of the empirical analysis over a 12-year period (2010–2021).

To summarize, the findings of this study show that the use of electricity has an impact on the increase in air pollution, while the use of energy produced from renewable sources has an impact firstly on the reduction of energy consumption and then on reducing the environmental pollution.

The paper is structured into five parts, where the next part presents the review of the literature which contains scientific publications relevant to our research, emphasizing the findings of other authors who have theoretically and empirically examined the impact of

[1] The PM index refers to the measurement of particulate matter (PM) concentration in the air.

[2] The Organisation for Economic Co-operation and Development (OECD) is an international organization composed of 38 member countries.

energy use on air pollution. The third part of the study contains methodology, the fourth part presents empirical results, and the fifth part includes the conclusions derived from the results.

## 2. Literature Review

Air pollution is not just a localized concern; it has emerged as a pressing global environmental issue with far-reaching implications. Chronic exposure to polluted air has been directly linked to a slew of health issues, from respiratory problems to cardiovascular diseases, resulting in millions of premature deaths annually. Beyond the human health toll, air pollution disrupts delicate ecosystems, accelerates climate change through the accumulation of greenhouse gases, and negatively impacts agricultural yields. Its pervasive nature means that no country, regardless of its developmental status, remains untouched. The urgent need to understand the driving factors behind air pollution, therefore, becomes paramount in designing effective interventions for a sustainable future. Focusing on OECD countries in the context of air pollution is of particular importance. These countries, often being more industrialized and economically advanced, are significant contributors to global energy consumption, much of which still derives from nonrenewable, pollutant-emitting sources. While they possess the financial and technological capacities to pioneer cleaner energy solutions, they also grapple with the challenges of transitioning away from entrenched fossil fuel infrastructures. Furthermore, OECD countries often set precedents in policy-making and technological innovations that are emulated by other nations. Thus, understanding the relationship between energy use and air pollution in these countries not only provides insights into their specific challenges and achievements but also offers lessons that could be applicable on a more global scale (Mansidalidis et al., 2020).

Numerous studies by different authors, which have been carried out for different countries, emphasize that in recent decades there has been an enormous and rapid increase in the use of electricity, which has had a great contribution to the increase in air pollution (Cole, 2006; Xie et al., 2020; York, 2006). While many empirical and theoretical works emphasize the importance of using renewable energy as an energy that has an impact on reducing air pollution as well as improving the quality of life and maintaining health in general (Rodriguez-Alvarez, 2021; Sarkodie, 2018; Mehmood, 2021; Asongu et al., 2019).

The relationship between China's economic development and its environment is the subject of Poon et al. (2006) study, which focuses on the impact of energy usage, transportation, and trade on the emission of air pollution. Air pollution in this work is measured by the level of sulfur dioxide and soot particles in the air. The analysis of the results of these authors finds an inverted-U relationship for sulfur dioxide but a U-shaped curve for soot particulates. So, the authors conclude that the pollution caused by carbon and soot particles constitutes a serious problem of air pollution in China. Similar to this research, Yuan et al. (2015) carry out research also focusing on the state of China, where the aim is to study the impacts of energy consumption on the emission of air pollutants. The authors conduct research with 13 years of data, the findings show that economic development can improve performance in energy consumption and air pollutant reduction as long as reasonable energy and industrial structures are put in place, energy efficiency improvements and strict environmental policies are implemented.

A study that includes 17 OECD countries in a 23-year time period, from 1990 to 2012, was carried out by Alvarez-Herranz et al. (2017). The authors examine the connection between environmental contamination and economic growth. The authors examine how the standard of living affects energy usage. The study demonstrates that higher income levels are associated with increased energy consumption. On the other hand, higher energy demand results in a greater share of fossil fuels in the energy mix, which raises greenhouse gas emissions. The research carried out by this author confirms the positive effect of the energy innovation process in reducing environmental pollution, so the paper emphasizes that the use of renewable energy sources has a positive impact on improving air quality.

In a multivariate framework, the work of Magazzino et al. (2021) examines the connection between the adoption of information and communication technologies (ICTs), electricity use, economic growth, and environmental damage. A panel of 16 EU nations was examined between 1990 and 2017. According to the findings of the Dumitrescu–Hurlin panel causality tests, there is a one-way causal relationship between the usage of ICT and power consumption, which raises CO2 emissions and boosts GDP. The panel mean-group regression results show that economic growth is a significant factor in determining energy demand, with a 1% economic growth rate being linked to an increase in per capita consumption of electricity of 0.13%. With a fresh focus on the EU, these findings present a single assessment of the relationships between ICT, power use, and environmental damage for the first time in the literature. Based on these findings, appropriate actions should be taken to address ICT's detrimental environmental consequences while cautiously implementing energy-saving measures to avoid impeding economic growth.

Khan et al. (2021) investigate how population expansion, energy use, and natural resource depletion affect carbon dioxide emissions. This research is carried out for the United States of America and the research is carried out over a long period, from 1971 to 2016. The methods used by these authors are regression using the GMM method and regression using the GLM method. The results of these econometric models show that there is an inverse relationship between natural resources and energy consumption with carbon dioxide emissions. The authors suggest that the use of renewable energy consumption has an impact on the improvement of environmental quality in the long term, moreover the authors recommend that US policymakers should promote policies that control the use of natural resources to reduce carbon dioxide.

Another study recently conducted out by Magazzino et al. (2021) explores the relationship between Information and Communication Technology (ICT) penetration, electricity consumption, economic growth, and environmental degradation. The research includes 16 countries of the European Union in the period of 28 years (1990–2017). The findings indicate a causal relationship between the use of information technology, the consumption of electricity, and the increase in emissions of substances that cause air pollution. While a 1% economic growth rate is linked to an increase of 0.13% in per-capita power consumption, the authors' fixed effects and random effects regression analyses reveal that economic growth is a significant driver of electricity demand.

Liang et al. (2020) conduct research on environmental pollution with daily electricity usage data comparing residential and commercial consumers in the state of Arizona. The authors use variable panel regression and find that air pollution in the state of Arizona is largely caused by carbon dioxide that is emitted in nature as a result of electricity production. The authors note that lower-income ethnic groups and minorities are disproportionately affected by air pollution and pay higher electricity bills associated with avoiding pollution.

A study regarding the impact of the use of renewable energy on air pollution and the environment, in general, was carried out by Khan (2021), the research was carried out for 18 years, respectively from 2001 to 2018. The findings of this research show that the consumption of renewable energy has a positive impact on improving the quality of the environment as a whole, the author emphasizes the importance of promoting policies for the use of renewable resources since they can bring economic growth and environmental sustainability.

Sarkodie and Adams (2018) carry out the research with time series data from 1971 to 2017 and use OLS, ARDL, and CUSUM regressions, the research is carried out for South Africa. Findings of the paper show that a shift from energy- and carbon-intensive industries to a service-oriented economy will cause a structural economic change, thus helping to reduce energy use which then has an impact on improving the quality of air and environment in general. Mehmood (2021) carries out the research to present the impact of the use of renewable energy on carbon dioxide emissions, including other controlling variables such as education, and economic growth, foreign direct investments and natural resources of the state. The research is conducted for the G11 countries in the period 1990–2019. From the regression analysis applied by the author, it follows that renewable energy has a positive impact on reducing carbon dioxide emissions by 0.11%, therefore the author encourages the G11 member states to develop the use of renewable energy.

A study which was carried out for Germany recently by Khan et al. (2022), includes a long-term period of time (1971–2016) and analyzes the impact of government spending and the dynamics of inflation to establish a relationship with alternative energy sources and their impact on the environment of this country. The authors apply an empirical methodology based on the application of the model with the method of small squares. The findings of these authors from empirical analysis show that government spending and the inflation rate have a negative relationship with the quality of the environment, on the other hand, economic growth has a negative relationship. The authors suggest that Germany's state policies should eliminate the subsidy for coal production as a factor that has a significant impact on air pollution, on the other hand policies, should be oriented towards encouraging the ecological policies that promote the development of the green budget and have an impact on the economic growth that comes from the emission of damage to the environment.

## 3. Methodology

The empirical analysis includes 12 years, comprising data from 2010–2021 from 38 countries of OCED. For testing the impact of energy on air pollution we use four models;

the first model executed is the model with the method of least squares (OLS), then the OLS robust model is used, which minimizes the error term, but since the research data belong to the panel data type, the two more models were executed for this data; the model with the fixed effects method and the model with the random effects method.

In a fixed effects model, the effects of the independent variables are assumed to be fixed and constant across all individuals or units in the sample. This means that any observed differences in the dependent variable are entirely due to differences in the values of the independent variables. Fixed effects models are often used in situations where the researcher is interested in making causal inferences about the effect of a particular treatment or intervention. In contrast, a random effects model assumes that the effects of the independent variables vary randomly across individuals or units in the sample. This means that the variation in the dependent variable is due not only to differences in the independent variables but also to differences in unobservable factors that vary across individuals. Random effects models are often used in situations where the researcher is interested in generalizing the findings to a larger population or when there is a hierarchical or clustered data structure.

Meanwhile, to select or compare the model with fixed effects and the model with random effects, the Hausman test was used. When deciding whether a fixed effects model or a random effects model is better suited for a given dataset, the Hausman test is a statistical test that is used. Specifically, the test compares the estimated coefficients of the independent variables in the two models to see if they are significantly different from each other. If the coefficients are significantly different, this suggests that the random effects model is a better fit for the data, while if the coefficients are not significantly different, the fixed effects model may be more appropriate. There is the formula:

$$H = (b\_fe - b\_re)\,'\,(V\_re - V\_fe)\ \hat{}\ (-1)(b_{fe} - b_{re}) \tag{1}$$

b_fe: represents the coefficient estimates obtained from the fixed effects model;

b_re: represents the coefficient estimates obtained from the random effects model;

V_fe: represents the variance-covariance matrix of the coefficient estimates from the fixed effects model;

V_re: represents variance-covariance matrix of the coefficient estimates from the random effects model;

(b_fe – b_re): represents the difference between the coefficient estimates of the fixed effects and random effects models;

(V_re – V_fe)^(–1): takes the difference between the variance-covariance matrices of the random effects and fixed effects models and then calculates its inverse;

H: This is the Hausman test statistic. It tests the null hypothesis that the difference in coefficients between the fixed and random effects models is not systematic. If H is statistically significant, it suggests that the fixed effects model is more appropriate than the random effects model.

The Hausman test follows a chi-squared distribution with degrees of freedom equal to the number of independent variables. If the calculated value of the Hausman statistic is greater than the critical value of the chi-squared distribution at the desired level of significance, then one rejects the null hypothesis that the coefficients in the two models are not significantly different, and concludes that the random effects model is more appropriate. If the calculated value of the Hausman statistic is less than the critical value of the chi-squared distribution, then you fail to reject the null hypothesis and conclude that the fixed effects model is more appropriate. Hausman test assumes that the random effects model is efficient, which means that the variance of the estimated coefficients in the random effects model is equal to or smaller than the variance in the fixed effects model. If this assumption is not met, the test results may be unreliable (Hausman, 1978).

The data were also tested for heteroskedasticity using the Breusch–Pagan test (Breusch and Pagan 1979) as well as for multicollinearity using the variance inflation factor test (Lewis, 1982).

Model specification:

$$\begin{aligned} PM2 = {} & B0 + B1(EUC) + B2(AANE) + B3(EPFRS) + B4(GGE) + B5(EI) + \\ & + B6(ATE) + B7(WEG) + B8(SEG) + B9(HEG) + B10(NEG) + \\ & + B11(GEG) + Ui \end{aligned} \tag{2}$$

The dependent variable of the study is air pollution (PM2) which is expressed as an index, a represents the constant of regression and μ is a constant term. The following are the independent or explanatory variables: EUC is energy use per capita which, following research and conclusions from various authors, is one of the primary drivers of air pollution; next, AANE is Alternative and nuclear energy, EPFRS is Electricity production from renewable sources, GGE is Greenhouse gas emissions, EI is Energy imports, ATE is Access to electricity, WEG is Wind electricity generation, SEG is Solar electricity generation, HEG is Hydroelectricity generation, NEG is Nuclear power generation and GEG is Geothermal electricity generation.

**Table 1.** Definition of research variables

| Variable | Abbreviation | Unit |
|---|---|---|
| Air Pollution | PM2 | Index |
| Energy use per capita | EUC | kilowatt-hours (kWh) per person per year |
| Alternative and nuclear energy | AANE | percent of total energy use |
| Electricity production from renewable sources | EPFRS | million kWh |
| Greenhouse gas emissions | GGE | metric tons of carbon dioxide |
| Energy imports | EI | percent of total energy use |
| Access to electricity | ATE | percent of the population |
| Wind electricity generation | WEG | billion kilowatt-hours |
| Solar electricity generation | SEG | billion kilowatt-hours |
| Hydroelectricity generation | HEG | billion kilowatt-hours |
| Nuclear power generation | NEG | billion kilowatt-hours |
| Geothermal electricity generation | GEG | billion kilowatt-hours |

## 4. Empirical data and analysis

The descriptive statistics for the study variables are shown in Table 2; according to the data presented, the average air pollution index (PM2) in OECD countries during the research period 2010–2021 is 13.66, these 38 countries are characterized by energy use per capita of 3915.88 on average. Regarding the production of energy from renewable sources on average, this variable is 27916.79 million kWh, while the pollution or emission of gas on average is 394670.87 metric tons of carbon dioxide.

**Table 2.** Descriptive statistics of the variables

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| PM2 | 455 | 13.66 | 5.70 | 4.89 | 29.80 |
| EUC | 455 | 3915.88 | 2826.56 | 684.4 | 18241.20 |
| AANE | 411 | 21.75 | 16.15 | 1.32 | 81.07 |
| EPFRS | 411 | 27916.70 | 59789.83 | 115 | 466214.03 |
| GGE | 411 | 394670.87 | 984948.75 | 2840 | 6427130 |
| EI | 411 | 14.46 | 121.8 | -611.5 | 97.29 |
| ATE | 418 | 99.91 | .37 | 96.69 | 100 |
| WEG | 418 | 15.02 | 37.99 | 0 | 337.94 |
| SEG | 418 | 5.50 | 14.20 | 0 | 130.72 |
| HEG | 418 | 37.94 | 75.22 | 0 | 390.64 |
| NEG | 418 | 50.39 | 141.70 | 0 | 809.41 |
| GEG | 418 | 1.23 | 3.12 | 0 | 15.97 |

Table 3 shows the results of the econometric models for the OECD countries. It shows the summarized results of 5 econometric models, where for interpretation we will take the results from the random effects model based on the Hausman test result (P=0.2618), so we have no evidence to reject the null hypothesis of the test (difference in coefficients is not systematic). In cases where the difference in the coefficient is not systematic, then we prefer to use the model with random effects. Based on the results of the VIF test (3.87), we consider that the presented model does not suffer from multicollinearity problems since the value of the VIF test is lower than 5. So, we have no doubts that the independent variables are strongly positively or negatively correlated with each other. Meanwhile, based on the results presented by Hettesti (P=0.0842), the model does not suffer from the problem of heteroscedasticity, so the error term has constant variance and the data are homoscedastic.

Based on the results of the Random Effect model presented in Table 3, an increase in energy use per capita for one kilowatt-hour per person per year will have a positive impact on the air pollution index by 0.19, the coefficient is significant at level 1%, this result is compatible with the findings of the authors (Cole, 2006; Xie et al., 2020; York, 2006) who find similar results where the increase in energy use affects the increase in air pollution. The results show that the production of electricity from renewable sources has an impact on reducing the air pollution index by 0.19 on average where the coefficient is significant at the 1% significance level, this result is compatible with the findings of the authors (Rodriguez-Alvarez, 2021; Sarkodie, 2018; Mehmood, 2021; Asongu et al., 2019), which emphasize that the use of renewable energies has an impact on reducing the environmental pollution.

**Table 3.** Results of econometric models

| Variables/Models | OLS | OLSR | FE | RE |
|---|---|---|---|---|
| EUC | 0.357*** | 0.357*** | 0.462* | 0.192*** |
| | (3.47) | (3.62) | (0.15) | (0.32) |
| AANE | -0.108*** | -0.108*** | -0.194*** | -0.204*** |
| | (-5.43) | (-5.94) | (-5.82) | (-7.85) |
| EPFRS | -0.977*** | -0.977*** | -0.750*** | -0.724*** |
| | (-3.77) | (-4.73) | (-4.58) | (-4.93) |
| GGE | 0.260** | 0.260** | 0.266** | 0.241** |
| | (3.05) | (3.02) | (1.77) | (1.41) |
| EI | 0.00591* | 0.00591** | 0.009 | 0.00606 |
| | (2.5) | (2.9) | (1.39) | (1.29) |
| ATE | 3.744*** | 3.744*** | 1.820*** | 1.962*** |
| | (5.72) | (7.21) | (4.78) | (5.33) |
| WEG | -0.0279 | -0.0279 | -0.0619*** | -0.0617*** |
| | (-0.89) | (-1.14) | (-3.48) | (-3.64) |
| SEG | 0.135** | 0.135** | 0.0314 | 0.0332 |
| | (3.14) | (3.14) | (1.74) | (1.88) |
| HEG | -0.0126** | -0.0126*** | -0.00016 | -0.00397 |
| | (3.07) | (5.57) | (0.01) | (0.43) |
| NEG | 0.00175 | 0.00175 | 0.00092 | 0.00198 |
| | (-0.48) | (-0.76) | (-0.21) | (-0.51) |
| GEG | -0.149 | -0.149 | -0.449*** | -0.427*** |
| | (-1.15) | (-0.95) | (-3.44) | -(3.56) |
| _cons | 392.6*** | 392.6*** | 200.3*** | 214.5*** |
| | (6.01) | (7.59) | (5.3) | (5.84) |
| Hausman Test | 0.2618 | | | |
| Hettest | 0.0842 | | | |
| Mean VIF | 3.87 | | | |
| N | 411 | 411 | 411 | 411 |

The greenhouse gas emission variable has a positive impact on increasing the air pollution index by 0.24 on average, where the coefficient is significant at the 5% significance level. The access of the population to the use of electricity has a statistically significant positive impact on air pollution with a coefficient of 1.96, which is significant at the 1%

significance level. The two variables of alternative renewable sources have an impact on the reduction of air pollution; the production of electricity from wind sources has an impact on the reduction of the air pollution index by 0.06, while the impact of energy production from geothermal sources has an impact on the reduction of the air pollution index by 0.42, both coefficients show a statistically significant impact at the 1% significance level.

Based on the established correlation between energy consumption and air pollution in OECD countries, there is a pressing need for a dual approach to policy formulation. Firstly, given the evident reduction in the air pollution index with the use of renewable energy sources, governments should actively incentivize the adoption of renewable energies like wind and geothermal. This could entail financial incentives for green energy projects, tax breaks for companies transitioning to renewable sources, and public education campaigns underscoring the environmental and long-term economic benefits of sustainable energy consumption. The positive correlation between greenhouse gas emissions and increased air pollution necessitates stringent regulatory measures. Governments should consider imposing stricter emission standards, coupled with penalties for industries surpassing permissible limits. Moreover, while expanding electricity access is vital for economic growth, it’s equally crucial to ensure that such expansion is rooted in sustainable practices, balancing growth with environmental conservation. Regular assessments and stakeholder feedback should guide these policy directions to ensure continued relevance and efficacy.

## 5. Conclusion

Air pollution is one of the most pressing environmental issues facing the world today. It is caused by the release of harmful substances into the atmosphere from various sources such as transportation, industrial processes, and the burning of fossil fuels. These substances include particulate matter, nitrogen oxides, sulfur dioxide, carbon monoxide, and volatile organic compounds. To address air pollution, it is important to reduce emissions from various sources. This can be achieved through the use of cleaner technologies, the promotion of renewable energy, and the implementation of regulations to limit pollution from industries and transportation. Additionally, individuals can help to reduce air pollution by using public transportation, reducing car usage, and supporting environment-friendly policies.

The results of this empirical study, which covered OECD countries for a period of 12 years (2010–2021), reveal that the use of electricity has a positive impact on the increase in air pollution, when increase in energy use per capita for one kilowatt-hour per person per year will have a positive impact on the air pollution index by 0.19 and coefficient is significant at level 1%, while also the increase in carbon dioxide along with access the use of electricity has an impact on the deterioration of the air pollution situation, which is significant at the 1% significance level.

The paper has enough statistical support for the first hypothesis “The use of energy has a positive impact on increasing air pollution.” Whereas the use of electricity produced from renewable sources such as water, wind, nuclear energy, and geothermal energy has an impact on reducing air pollution, also there is sufficient statistical evidence to accept the second hypothesis, since we do not find a statistically significant impact and the sign (-) does not correspond to the raised hypothesis “The use of renewable energies (solar, water, wind) has an impact on reducing the level of air pollution.”

In summary, air pollution has taken on disturbing proportions in recent times, since air pollution is a major concern for a variety of reasons. One of the most significant reasons is the negative impact it has on human health. Renewable energy has a significant impact on reducing air pollution. Unlike fossil fuels, which release harmful pollutants such as particulate matter, nitrogen oxides, and sulfur dioxide into the atmosphere, renewable energy sources such as solar, wind, and hydropower do not produce any harmful emissions. By reducing the amount of energy generated from fossil fuels, renewable energy sources help to reduce the levels of air pollution in the atmosphere. This, in turn, has numerous positive impacts on human health and the environment.

## 6. Policy Implications

Based on the results presented in the paper, countries can reflect on air pollution in the following ways.

1) Establishing emission taxes, states can apply tax policies for different types of pollution that are caused. We consider that imposing a tax on pollution will have a positive impact on improving the current situation. Taxing pollutants acts as a disincentive measure for industries to produce harmful emissions. By making pollution financially punitive, industries are more likely to adopt cleaner technologies and reduce emissions voluntarily. Introducing emission taxes would likely lead to a direct reduction in pollutants as industries seek to minimize costs. Over time, it’s anticipated that this would contribute to a tangible decline in air pollution levels.
2) OCED countries develop promotional policies to increase the use of renewable energy and in this way have a double impact on air pollution, firstly the increase in the use of renewable energy in a direct way, it has an impact on the reduction of the population that uses energy produced from nonrenewable sources (which has an impact on the increase in air pollution), and the second one affects the preservation of the environment since already these types of energy have proven that are less harmful to the environment in general. Renewable energies, unlike their fossil fuel counterparts, contribute negligible pollutants to the atmosphere. By promoting these cleaner sources of energy, nations can address the root cause of the issue, which is the dependence on polluting energy sources. As the adoption of renewable energy sources increases, there will be a dual benefit. Firstly, fewer people will rely on nonrenewable, polluting energy sources, leading to a reduction in emitted pollutants. Secondly, renewable sources themselves are less detrimental to the environment, leading to a more holistic environmental preservation.

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