sustainability

MDPI

Editorial

Current Advances in Green Governance and CO_2 Emissions towards Sustainable Development

Yongrok Choi [1] and Hyoungsuk Lee [2,*]

[1] Department of International Trade, Inha University, Incheon 22212, Republic of Korea; yrchoil@inha.ac.kr
[2] Energy Environment Policy and Technology, Graduate School of Energy and Environment (KU-KIST Green School), Korea University, Seoul 02841, Republic of Korea
* Correspondence: lhs2303@korea.ac.kr

Abstract: Energy and environmental studies (E&E) have faced a significant turning point due to the lack of reliability of the existing models, as well as the lack of policy governance. Most papers in E&E have adapted data envelope analysis due to its popularity, which is a result of its structure of having multiple inputs and outputs. However, due to its crucial weakness in statistical reliability, diverse new methodologies to gain better reliability have been developed, such as difference-in-difference and computational general equilibrium models, but they are still do not popular because the world has not shown significant progress in the abatement of carbon emissions. This comes not only from the lack of appropriate, precise research models, but also from a worldwide lack of governance. Most countries advocate for the necessity of E&E policies, yet their policies alone are not enough for sustainable performance, due to the lack of reliability and/or weakness of public–private partnerships. This Special Issue shall examine all of these new challenges to the methodologies, as well as the implications and suggestions arising from their empirical results.

Keywords: energy and environmental studies (E&E); carbon emissions; governance; multiple input/output model

Citation: Choi, Y.; Lee, H. Current Advances in Green Governance and CO_2 Emissions towards Sustainable Development. *Sustainability* **2023**, *15*, 11828. https://doi.org/10.3390/su151511828

Received: 24 July 2023
Accepted: 31 July 2023
Published: 1 August 2023

1. Introduction

As COVID-19 has negatively impacted the global economy, the public has lost concern for environmental issues surrounding climate change due to the resultant severe economic crisis. Nonetheless, many companies and governments have strongly promoted voluntary mitigation and abatement of CO_2 emissions under the Paris Agreement. The United States returned the implementation talk back to the concept of a carbon net-zero society, and many countries resumed their environmentally friendly sustainable development policies. However, even with these efforts, many policies and business strategies unfortunately do not seem to be effective in decreasing CO_2 emissions, due to a lack of governance. Many participating agents, such as industries and the private sector, do not seem to be proactive in resuming these environmental policies, due to the experience of unreliable environmental regulations. Therefore, before we evaluate the effects and efficiency of environmental policies, we need to determine some of the missing links in the regulatory policies and fill these gaps between the theory and its realized practice, in terms of a strong governance perspective.

Of course, there have been diverse issues surrounding the effectiveness of sustainable development policies, especially for a carbon net-zero society, which implies a much stronger direction than the original policy of the abatement of carbon emissions. However, ever-increasing PPM (parts per million) values in air pollution shows this direction needs more harmonized, yet voluntary participation of all economic agents. Unfortunately, the global economy is still not equipped with a unanimous consensus in this direction, and thus there are many existing back doors to avoid the regulatory policies, resulting in the

global goal of the Paris regime mission being impossible. To achieve the impossible mission of a carbon net-zero society, environmental policies should be 'transparent, measurable, and predictable'. Therefore, this Special Issue aims to develop the feasibility of a net-zero society from the levels of countries, industries, and even individual companies.

2. Current Advances in Green Governance

There have been diverse research approaches to evaluate the effectiveness of policies and business strategies in energy and environmental studies (E&E). Most of these research papers are based on the data envelope analysis (DEA) methodology, due to its characteristic of having multiple inputs and outputs [1–5]. DEA brought great popularity to E&E research due to its flexible analysis of environmental efficiency. As a basic platform, DEA simply measured the relative efficiency as the distance between the best-performing decision making unit (DMU) and current one, with the use of a production possibility curve (PPC). Soon, use of the directional distance function (DDF) began to overcome the radial issues of this distance. Based on this non-radial DDF, there have been significant upgrades to DEA approaches in terms of its subject matter, methodological measures, and heterogeneity, as shown in Figure 1.

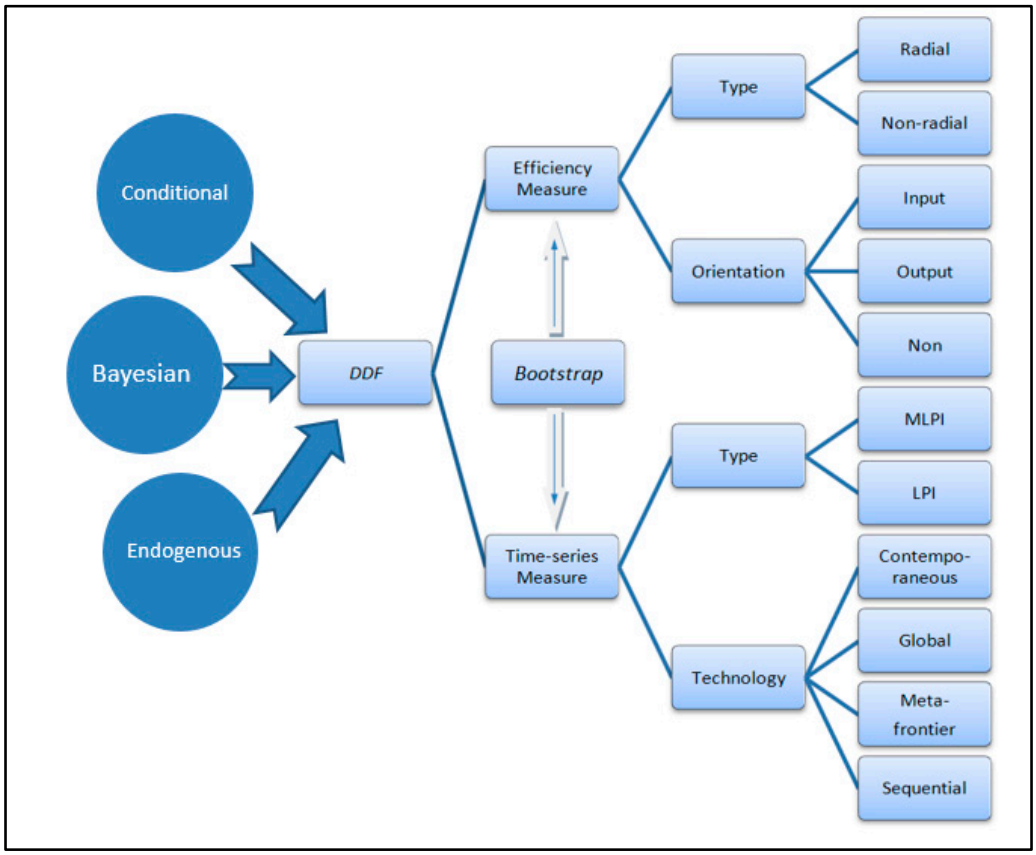

Figure 1. The methodological structure of DDF approaches [6], (p.53).

Even with this diverse, flexible evaluation of environmental efficiency, DEA must deal with the non-parametric issue of the PPC. It is not convincing to simply measure the relative distance from only one point of a realized DMU as relative efficiency, rather than from the theoretical function. To overcome this relative distance from the theoretic frontier, there have been diverse approaches. One of the most popular approaches is the stochastic frontier approach (SFA) model, which assumes a priori that one of the direct functions is the PPC, and thus measures not simply relative efficiency, but absolute efficiency. It could be more reliable, as it uses statistical significance to exclude some of the extreme performances of the DMU. However, it also has difficulty in treating multi-output issues

between desirable and undesirable outputs of greenhouse gases (GHGs). SFA treats these undesirable outputs as a negative inputs, or treats fixed outputs as a constraint, resulting in some uncomfortable implications and suggestions from the empirical results.

Recently, there have been new trials to overcome non-parametric DEA issues with more realistic smoothing of the extreme performances of some DMUs, using a time adjustment approach together with a difference-in-difference (DID) approach [7–11]. Since this is not dependent on some invisible PPC function, it could give us a more realistic, yet statistically reliable, estimation of the performance of environmental policies and business strategies. Another approach is to find out the overall, general performance by using the computational general equilibrium (CGE) model [12–15]. It could show not only the direct effects of environmental practices, but all related indirect effects as well. However, it may lead to the intrinsic pitfall that something is better than nothing, because it is based on the non-negativeness of the PPC.

However, all these approaches are successful in that they concluded that there is a huge potential to improve environmental efficiency, strongly supporting the coupling or harmonizing of issues in economic growth and environmental protection. Most papers concluded that Porter's hypothesis is workable, with strong preferences for the environmental regulation of green growth. Is it really true or feasible in the real world? Unfortunately, the world has not shown any serious GHG abatement, even with strong, market-oriented regulatory measures such as ETS, as shown in Figure 2. It seems that there is a huge gap between the empirically proven research papers and their real-world research subjects. One exemplary case can be found in solar energy industry of China. Until recently, the solar industry has had great success in its performance with almost all households in China covered with solar panels. It was very impressive to see a solar-panel-covered house even in the deep mountain area of China. Due to its initial success, many competing global companies worldwide disappeared from the market. However, many solar companies in China became bankrupt recently, due to a cut-off of government support. This implies that the source of their profit is not the market, but rather government support. Moreover, due to this distorted solar energy promotion in China, the global solar industry itself lost its future direction for obtaining better-performing solar panels, resulting in innovation lagging in other countries as well.

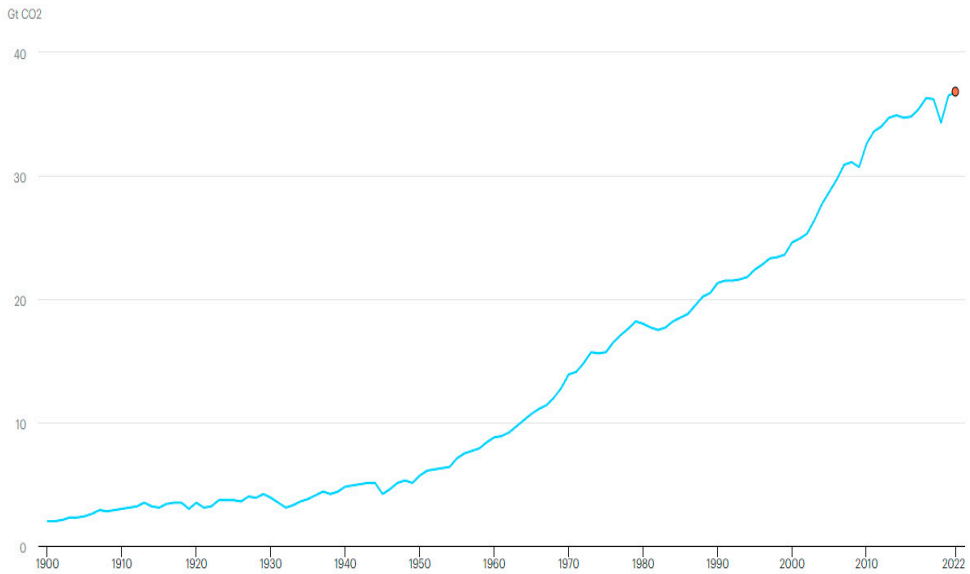

Figure 2. Global CO_2 emissions from energy combustion and industrial processes, 1900–2022 [16].

What about regulatory policies? The Kyoto protocol is the exemplary policy of market-oriented regulation. The Emission Trading Scheme (ETS) of the Kyoto protocol brought great success in its initial stage worldwide. Many countries undertook ETS policies to mitigate GHG or carbon emissions, resulting in huge reductions in carbon emissions, especially in the European Union. However, it was not successful in East Asian countries such as China and Korea. As shown in Figure 3, Korea began its ETS pilot project in 2015 and, based on the stepwise approach, it opened a nationwide ETS market in 2020. The unit price of a carbon emission allowance (CEA) has been about KRW 20,000 (approximately USD 18) for almost the entire period, except for the begging of the nationwide stage in 2020. This is much lower than an identical CEA in EU, and even lower than its potential shadow price as well. No company wants to sell CEAs at this low price, and thus ETS market is seller-oriented. Due to the extra cost burden of this CEA, the Korean government has put invisible pressure on the ETS market, suppressing the market price; thus, it could not promote companies reducing their carbon emissions and selling their ETAs on the market. Most companies, including Samsung electronics, choose penalties, which are based on the relatively low market price, instead of green technology innovation. Samsung has certainly reduced its carbon emissions, but has also produced new carbon emissions due to its production of a trillion semi-conductors. Carbon emission have increased, with the total amount ever increasing. This implies that the effectiveness of regulatory policies not only depend on their direction, but the willingness to implement them as well. If the regulatory policies do not show a transparent, predictable path for the future, most economic agents are not willing to follow it. In the United States, former president Donald Trump attempted to protect the American economy from the Paris agreement, and thus withdrew from it, resulting in a significant lost opportunity to reduce GHGs. By the same token, the Korean government stumbled in environmental regulation policies, depending on the favor of the president to resolve the environmental issues, resulting in huge claims from the industry against the challenges of climate change. If all economic agents including the president think that it is not the right time, then we cannot go forward. All economic agents can, and should, policy makers not only speaking, but see them acting as well. Otherwise, the regulation is a mere paper tiger with a lack of governance.

Figure 3. Market price of CEA in Korea [17].

Like all policies, environmental policies have two wings to fly, promoting support and regulation. Unfortunately, two above-mentioned case studies on the solar industry of China and the ETS regulation of Korea do not seem to be effective, as a result of a lack of governance. Most papers conclude that "yes, environmental policies are effective", but in reality, they do not seem to be effective. Thus, a researcher, as the professional expert, can and should always say "no, it may have a problem". Without any problem to be solved, it is not social science research. Thus, our focus should not be on the effectiveness of E&E policies, but on the bottlenecks of governance and their solutions. That is the background of this Special Issue.

3. Challenges on the Green Governance

Even if COVID-19 caused an increasing rate of GHG emissions to be halted for a while, the global emission level has rapidly increased again, and thus IPCC has warned that the time has come to implement the Paris regime as soon as possible. Nonetheless, there are very few research papers on this urgent mission, due to a lack of reliable methodology and/or missing logical links to show convincing E&E efficiency, as mentioned before. Therefore, the most important step at this moment is to reshuffle the measuring, reporting, and verifying (MRV) of GHG emission-related activities. It is not enough to simply conclude that research confirms the Porter hypothesis and thus regulatory policies could be effective measures for coupling sustainable development. Instead, the professional expert should state that we have a big battle between the public and private sector to mitigate the GHG emissions, and thus we must find the optimal path for public–private partnership. It is not enough to simply show a huge potential for environmental efficiency. Instead, we should find more field- and performance-oriented implications and suggestions on how to narrow this huge gap. All these missions should be based on the governance, defined as a workable mechanism for sustainable performance [18].

Therefore, all research papers should not conclude with common sense types of abstract or general assumptions, but more precise, appropriate, practical solutions to strengthen the governance of policies or business strategies. To enhance governance, we should consider the two wings of sustainable policies: promoting support and regulation. Regulation policies should not be intermingled with support promotion, and vice versa. Figure 4 shows these logical missing links between these two policies of promoting support and regulatory measures. The vertical axis shows the benefits of green technology to mitigate GHG emissions, and the horizontal line explains the financial burden for R&D on green technology innovations. To the left side, most of green technologies show negative costs (or additional benefits) coming from green technology adaptations. Thus, the government should strongly regulate for these green technologies to be developed and utilized, while the green technology on the right side needs promotional support by the public sector to overcome the additional burden of green technology innovation, at least during its initial stage. We saw the trial-and-error in the above two cases of the solar industry of China and the suppressed ETS market regulation in Korea. These forms of support promotion and regulation certainly showed wrong direction, resulting in a lack of governance. For these reasons, there are many papers emphasizing more customized or differentiated policies on industries or provinces. Unanimous promotional support and/or regulation, such as the current situation with ETSs in Korea, may result in very poor performance due to a lack of governance.

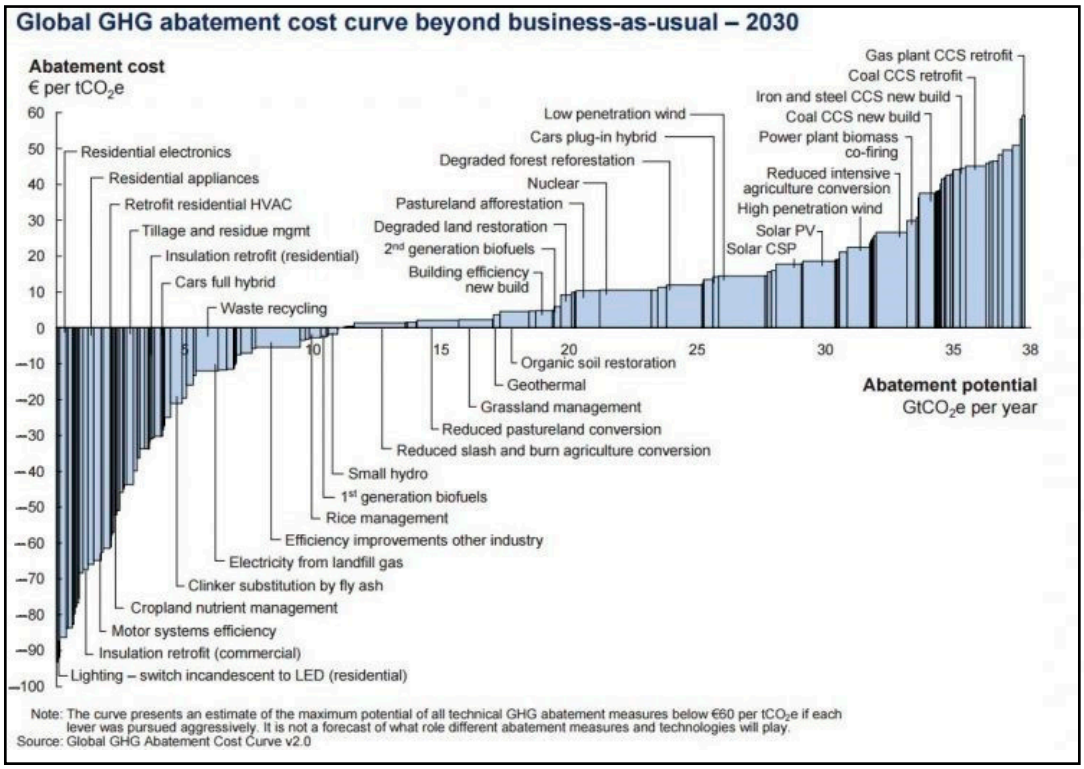

Figure 4. Global GHG abatement cost curve v.2.0 [19].

Thus, in order to boost the governance of E&E policies, the following suggestions could considered as future challenges.

First, the implications and suggestions coming from the empirical research should be more precise, appropriate, and practical so as to result in sustainable performance. For example, if the conclusion from an empirical result is that the local government should regulate more strongly, or that the government should train more people to enhance the E&E industry, these arguments are not appropriate as conclusions, because these conclusions are not the unique contribution of the research. Anyone can say this without any research; thus, the research paper may be useless in the real world. Think about how there are thousands of university graduates entering the workforce, who cannot find a job even in rapidly-growing China. Thus, simply saying that more education will be helpful is not a "workable" solution. A more practical, unique voice from the empirical results shall strengthen governance.

Second, the methodology should be more reliable, in order to reflect the real world. We cannot simply say this paper supports Porter's hypothesis, because it is not only unique, but also not a practical solution to solve the current bottleneck. It should suggest some missing link, even in the implementation of Porter hypothesis, and suggest more realistic solutions for readers to apply its suggestions to their businesses and lives. Some papers conclude with a confirming sentence stating that all the hypotheses are accepted. If so, what can we learn from the paper to improve our society? We should point out the rejected hypotheses or the variable coefficients to determine this rejection, the weak statistical confidence, or even the size of relatively smaller coefficients, and the possible unique suggestions to overcome all of these empirically difficult results, because the basic paradigm of social science research is to find a solution for the difficulties, or to solve the challenges for the sustainable performance more precisely and accurately.

Third, the comparison with other papers and suggestions should be added to the discussion and/or conclusion more prominently. Most papers argue for their basic model based on comparisons with many previous studies in the literature review, but they do not show their implications compared to previous arguments in the conclusion, resulting in a lack of governance. Governance can be easily found from the comparison and, thus, all readers should think of their own optimal implications from the comparative conclusions in the research.

4. Conclusions

It is not always easy to make your own mind up from research papers. Some papers may conclude with a simple confirmation of agreement with previous papers. Nonetheless, the researchers should remember that they are on the frontier to open the future economy, and thus workable or feasible implications from their studies are too important to not be emphasized. In this Special Issue, we welcome the development of these new challenges, to open our future in E&E policies and business strategies. We are ready to change our economy with more innovative implications and suggestions, not only from the researchers' ideas, but from the plethora of previously realized practices of trials and errors. That is the real value of this Special Issue of *Sustainability*.

Funding: This research was supported by Inha university.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Yang, F.; Lee, H. An innovative provincial CO_2 emission quota allocation scheme for Chinese low-carbon transition. *Technol. Forecast. Soc. Change* **2022**, *182*, 121823. [CrossRef]
2. Lee, H.; Choi, Y. Heterogeneity and its policy implications in GHG emission performance of manufacturing industries. *Carbon Manag.* **2018**, *9*, 347–360. [CrossRef]
3. Song, M.; Wang, S.; Liu, W. A two-stage DEA approach for environmental efficiency measurement. *Environ. Monit. Assess.* **2014**, *186*, 3041–3051. [CrossRef] [PubMed]
4. Zhang, N.; Xie, H. Toward green IT: Modeling sustainable production characteristics for Chinese electronic information industry, 1980–2012. *Technol. Forecast. Soc. Change* **2015**, *96*, 62–70. [CrossRef]
5. Choi, Y.; Lee, H.; Debbarma, J. Are global companies better in environmental efficiency in India? Based on metafrontier malmquist CO_2 performance. *Sustainability* **2020**, *12*, 8359. [CrossRef]
6. Zhang, N.; Choi, Y. A note on the evolution of directional distance function and its development in energy and environmental studies 1997–2013. *Ren. Sus. Energy Rev.* **2014**, *33*, 50–59. [CrossRef]
7. Tan, X.; Dong, H.; Liu, Y.; Su, X.; Li, Z. Green bonds and corporate performance: A potential way to achieve green recovery. *Renew. Energy* **2022**, *200*, 59–68. [CrossRef]
8. Tan, X.; Yan, Y.; Dong, Y. Peer effect in green credit induced green innovation: An empirical study from China's Green Credit Guidelines. *Resour. Policy* **2022**, *76*, 102619. [CrossRef]
9. Zhang, W.; Li, J.; Li, G.; Guo, S. Emission reduction effect and carbon market efficiency of carbon emissions trading policy in China. *Energy* **2020**, *196*, 117117. [CrossRef]
10. Yu, Y.; Zhang, N. Low-carbon city pilot and carbon emission efficiency: Quasi-experimental evidence from China. *Energy Econ.* **2021**, *96*, 105125. [CrossRef]
11. Yang, Z.; Fan, M.; Shao, S.; Yang, L. Does carbon intensity constraint policy improve industrial green production performance in China? A quasi-DID analysis. *Energy Econ.* **2017**, *68*, 271–282. [CrossRef]
12. Choi, Y.; Liu, Y.; Lee, H. The economy impacts of Korean ETS with an emphasis on sectoral coverage based on a CGE approach. *Energy Policy* **2017**, *109*, 835–844. [CrossRef]
13. Li, W.; Li, H.; Sun, S. China's low-carbon scenario analysis of CO_2 mitigation measures towards 2050 using a hybrid AIM/CGE model. *Energies* **2015**, *8*, 3529–3555. [CrossRef]
14. Britz, W.; Hertel, T.W. Impacts of EU biofuels directives on global markets and EU environmental quality: An integrated PE, global CGE analysis. *Agric. Ecosyst. Environ.* **2011**, *142*, 102–109. [CrossRef]
15. Liu, Y.; Tan, X.J.; Yu, Y.; Qi, S.Z. Assessment of impacts of Hubei Pilot emission trading schemes in China—A CGE-analysis using TermCO_2 model. *Appl. Energy* **2017**, *189*, 762–769. [CrossRef]
16. Global CO2 Emissions from Energy Combustion and Industrial Processes, 1900–2022. Available online: https://www.iea.org/data-and-statistics/charts/global-co2-emissions-from-energy-combustion-and-industrial-processes-1900-2022 (accessed on 6 June 2023).

17. Market Price of CEA in Korea. Available online: https://www.k-re100.or.kr/doc/sub2_4_1.php (accessed on 6 June 2023).
18. Choi, Y. Sustainable Governance in Northeast Asia: Challenges for the Sustainable Frontier. *Sustainability* **2017**, *9*, 191. [CrossRef]
19. Ritchie, H. How Much Will It Cost to Mitigate Climate Change? 2017. Available online: https://ourworldindata.org/how-much-will-it-cost-to-mitigate-climate-change (accessed on 6 June 2023).