

CHALLENGES IN THE IMPLEMENTATION OF POLICIES TO REDUCE CARBON EMISSION

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DOI: <https://doi.org/10.36004/nier.cecg.I.2024.18.17>

Abstract. *The implementation of policies aimed at reducing carbon emissions faces numerous challenges, both technically and socio-politically. Technological and infrastructural complexities result from the need to move from fossil fuel-based energy systems to renewable sources, which implies costly innovations, such as smart grids and carbon capture technologies. Economic resilience on the part of fossil fuel-dependent industries, along with legislative obstacles and difficulties in international cooperation, complicates the implementation of these policies. In this paper we aim to provide a clear understanding of the technological, economic and social barriers that stand in the way of adopting these measures. The aim of our research is to highlight the importance of international collaboration, technological innovation and the active participation of the public in identifying effective solutions to support the transition to a sustainable and low-carbon economy. Social opposition generated by fear of job losses or rising energy costs is an obstacle to progress, especially in regions dependent on polluting industries. Overcoming these challenges requires international coordination, technological innovation and citizen engagement to ensure an effective transition to a low-carbon economy.*

Keywords: *sustainable development, low carbon emission, renewable energy, policies*

JEL: *Q3, Q4, Q54*

UDC: *502.131*

Introduction. In this paper we aim to analyse the economic, social and technological challenges that delay the implementation of carbon reduction policies in the light of climate change. The causes of these climate changes are caused by the burning of fossil fuels (coal, oil and gas), deforestation and intensive agriculture. The accumulation of greenhouse gases (GHGs) in the atmosphere refers to the increase in the concentration of some gases that capture the heat emitted by Earth. Thus, they contribute to the increase in global temperature, affecting the climate and the environment. The Paris Agreement of 2015 established an international framework for the reduction of greenhouse gas emissions, in an attempt to keep the global temperature rise below 2°C from pre-industrial levels. According to the IPCC Report (Intergovernmental Panel on Climate Change) air concentrations of carbon dioxide reached record levels with significant effects on the environment, economy and human health (IPCC, 2021). This can be achieved through the transition to renewable

energy sources, increasing energy efficiency, promoting sustainable mobility and implementing carbon capture and storage (CCS) technologies.

The importance of this research is based on the following factors: climate crisis, international commitments, interconnectivity of global economies, sustainability of development, involvement of citizens and civil society.

Literature review. The literature on the transition to low-carbon energy sources highlights the technological challenges involved in this process. Sovacool (2015) argues that energy transitions in history have often been slow and have been influenced by factors such as existing infrastructure, technology availability and innovation. He says that the adoption of renewable technologies and the development of energy storage infrastructure are crucial to reducing emissions, but it also draws attention to the obstacles posed by dependence on traditional energy networks and fossil fuels. Stern (2021) points out that while emission reduction measures may involve significant short-term costs, these are crucial to prevent much higher spending caused by long-term climate change. Other research indicates that traditional economic sectors, especially those that depend on oil and gas, frequently oppose these measures because of the negative effects on profitability and jobs. The social and cultural aspects of the transition to a low-emission economy are also analysed in the literature. Numerous studies show that emission reduction policies often face opposition from society, due to concerns about job losses or rising living costs. At the same time, within the theory of human behaviour it addresses the relationship between attitudes towards the environment and social actions. In addition, public acceptance for renewable energies is influenced by factors such as education and engagement of local communities. Much of the literature addresses the challenges of striking a balance between climate change mitigation measures (reduction of emissions) and adaptation to existing impacts. National and international policies must include adaptation solutions to protect vulnerable regions from the impacts of climate change, such as floods and droughts. Similarly, the IPCC (Intergovernmental Panel on Climate Change, 2014) publishes numerous reports highlighting the need for a mix between adaptation and mitigation in global climate policies.

Research methodology. In the research paper we will try to take into account the technical, economic and social aspects in order to form a clear picture regarding the fight against climate change. Mixed research methods were used, including qualitative analysis, synthesis, generalization, and classification.

Cost and competition effects in international markets

Economic costs and competition in global markets are affected by the implementation of carbon reduction policies. As a result, when taking action to combat climate change, companies and governments must strike a balance between maintaining economic competitiveness and promoting sustainable growth. The high cost of the low-carbon transition is the main challenge facing governments and businesses. In most cases, the implementation of green technologies, clean energy or

efficient energy production processes requires a significant investment (Meckling, J. and Nahm, J., 2021).

- Regulatory costs - governments impose carbon taxes, emission certificates or strict emission standards, which makes companies pay more. Companies consider these regulations as a financial blow, making them pay more for their emissions or invest in greener technologies.
- Technological costs - to switch to environmentally friendly technologies such as solar, wind, green hydrogen or carbon capture and storage will require investment in research and development, and, infrastructure and adaptation of existing systems. Traditional industry, such as energy and transport, must pay for modernizing and reducing dependence on fossil fuels.
- Inequalities between developed and developing markets - emerging economies, which rely on polluting industries for economic growth, and, it face many challenges due to financial restrictions and pressure to stimulate economic growth. On the other hand, developed countries have more technological resources and are better able to implement emission reduction measures. All of these have the potential to induce unfair competition in global markets.
- The impact on small and medium-sized enterprises – due to limited resources for investments the costs associated with the implementation of emission reduction policies can be very high. The lack of access to finance for green technologies and the high initial costs of sustainable measures can prevent SMEs from adopting green solutions at the same rate as large corporations. Globally, the competitiveness of firms, in a market where regulations are not uniform, is affected because it has to face international competition and implement strict policies to reduce carbon emissions.

This situation creates more economic challenges:

- a) The resettlement effect occurs when a country or region imposes strict emission reduction policies, energy-intensive companies may decide to move production to countries with less rigid regulations. This leads to economic losses in countries that impose these policies and can increase emissions if firms move to locations where environmental standards are low. This phenomenon is known as „relocation of carbon emissions”.
- b) Competitiveness in sectors with high energy consumption. Emission reduction policies will have the greatest impact on energy-intensive sectors such as heavy industry (metallurgy, cement, chemistry) and other sectors. Costly environmental regulations may decrease the competitiveness of these sectors in international markets. Companies in these industries may suffer large financial losses or decide to outsource their production to countries with more relaxed regulations if there are no support mechanisms (Stern, N., 2021).

Despite the challenges, the transition to a low-carbon economy also brings major opportunities to global markets: innovation and market leadership. Although the initial transition to clean energy sources and sustainable technologies involves high costs, in many cases they can lead to significant long-term savings and renewable energy, such as solar and wind, it has become more affordable financially.

As technology continues to grow, costs will continue to fall, and customers have better access to markets which means that once the demand for green products and services increases, new economic opportunities are created.

In order to reduce the negative impact of costs and to support companies affected by global competition, governments and international organizations can adopt a number of measures, such as:

- The EU border adjustment mechanism has proposed the imposition of duties on imports from countries that do not comply with strict emission standards to avoid the effect of emission relocation and to protect local industry (World Bank, 2020).
- The government can provide tax subsidies and incentives to companies that invest in clean technologies or reduce their emissions. These measures reduce the financial burden and support companies' innovation towards the green economy transition.
- International collaboration through international partnerships on technology transfer and financial support to developing countries is essential to ensure a fair transition and minimize competitive inequalities globally.

Implications on vulnerable communities

The implementation of carbon reduction policies requires not just technological and financial solutions but also broad popular support. The public's acceptance is crucial to the success of these policies because the energy-related costs, lifestyle choices, and work environment can all be directly impacted by the actions required to combat climate change (OECD, 2020). Simultaneously, these policies may have an unfavourable effect on vulnerable communities already impacted by social and economic inequality. Reducing carbon emissions can have a direct impact on consumers by affecting key economic sectors including energy, transportation, and industry. Climate policy policies run the risk of causing a considerable amount of resistance if they are perceived as unaffordable or unjustifiable additional costs for significant citizens. This could have an impact on their effectiveness and implementation (Seto, KC, et. Al., 2016).

Policies that tax carbon emissions or reduce fossil fuel subsidies can lead to higher prices for fuel and electricity, which can be considered a financial burden, especially for a low-income economy.

In regions where local economies rely on high-carbon industries (such as coal mining, oil, and automobiles), the transition to a low-carbon economy may raise concerns about job losses. This could strengthen the resilience of communities dependent on these industries and create social tensions unless re-qualification and economic support programs are implemented.

Acceptance of climate change policies may vary depending on the cultural and political context. In some regions, there is growing skepticism about the reality of climate change and the need for urgent action, which could reduce public support for such action. Political parties can also significantly influence public opinion by supporting or opposing climate action. Vulnerable communities (low-income, rural or marginalized) can be disproportionately affected by carbon reduction measures. Although the objectives of these policies are well-intentioned and are to protect the

environment and reduce the effects of climate change without adequate remedies, they can lead to economic and social inequalities.

Low-income households are more likely to feel the burden of additional costs associated with climate change policies. Introducing a carbon tax or raising fuel prices could have a major impact on households that rely on fossil fuels for heating or transportation. These households typically have a small financial capacity to invest in alternative energy solutions such as solar power systems or electric vehicles. Climate protection is driving the transition to cleaner and more energy-efficient technologies. However, high initial costs may limit access to such technologies in vulnerable communities.

The concept of „just transition” is important for mitigating the negative impact of climate policies on vulnerable communities. This includes the implementation of socio-economic measures to support those affected by economic change, in particular fossil fuel-dependent sectors. These measures may include retraining programmes, grants for access to green technologies, assistance to utility bills and job creation in the green sector.

Communities in poorer rural regions are the vast majority most vulnerable to climate change and may be the most difficult to sustain in the energy transition. These communities can have limited access to efficient public transport and clean energy infrastructure, and climate policies and the lack of locally adapted strategies have a negative effect. To effectively implement carbon reduction measures and gain public support, governments and international organizations must consider both public acceptance, and the impact on vulnerable communities. Here are some possible measures:

- Clear and transparent information on climate change, the costs of inaction, as well as the economic and health benefits of a green economy can help increase public support.
- To mitigate the negative impact on vulnerable communities, governments should introduce social protection measures, such as subsidies for low-income households, aid for energy bills or support for the uptake of energy efficient technologies.
- In regions that rely on polluting industries, the establishment of retraining programs for workers who will be affected by the transition to a green economy needs to be done. Investments in the development of green sectors such as renewable energy, energy efficiency, and recycling also create new jobs.

In order to ensure a fair „transition, it is imperative to implement policies that support not only the ecological transition but also social equity. This concept must be integrated into all climate policies to avoid increasing inequalities and reduce the impact on the most vulnerable members of society

The development and accessibility of clean technologies

Clean technologies, also known as green technologies or eco-technologies, play a key role in the transition to a sustainable economy and in achieving global carbon reduction targets. These technologies include renewable energy sources, energy efficiency solutions, carbon capture and storage methods, and low carbon

industrial and transport processes. However, in order to be effective, it must be economically and technologically accessible, and its widespread implementation depends on economic, political and social factors (Rogelj, et.al 2021).

Accessibility to clean technologies is essential to ensure a fair transition to climate neutrality. However, accessibility can be influenced by several factors:

- High initially cost. One of the main challenges in implementing clean technologies is the high cost; especially for households and companies with limited financial resources (for example, installing solar panels, heat pumps, or electric vehicles requires large initial investments, even if in the long run they generate savings by reducing energy costs).
- Unequal access between regions and sectors. Access to clean technologies is not evenly distributed between regions or economic sectors. In countries or regions with less developed economies, poor infrastructure and lack of investment and financial resources often limit access to modern technology. Traditional high-emission industries may have difficulty integrating these technologies because of the cost of adapting and redesigning their production processes.
- Government subsidies and policies. Government policies have a significant impact on the accessibility of clean technology. Subsidies, subsidies, financial support programs and fiscal incentives are essential to accelerate the transition to low-carbon solutions (such as subsidy programs for solar panel installations or vehicle purchases electrics that help the public and companies make these technologies more accessible).

The development of green technologies has seen a significant acceleration in recent decades due to concerns about climate change and the growing demand for sustainable solutions. Technological innovations have helped to lower costs and improve the performance of many environmentally friendly solutions, making them more affordable and efficient. Among the areas where notable progress has been made are:

i) Renewable energy - Increasing efficiency and reducing production costs for solar panels and wind turbines have turned these technologies into viable options for large-scale power generation.

ii) Electrical vehicles - the electric vehicle industry has advanced significantly, both in terms of battery autonomy and in reducing production costs. Innovations in lithium-ion battery technology have increased the popularity of electric vehicles, and governments are starting to implement policies designed to encourage their acquisition, such as subsidies and the development of charging infrastructure.

iii) *Energy efficiency* - significant advances in energy efficiency technology have been made in various sectors, including construction, transport and industry. Eco-friendly buildings, equipped with advanced insulation and intelligent energy management systems, are becoming increasingly affordable and contribute to lower energy consumption.

iv) *Carbon capture and storage technologies* is a key technology for reducing carbon dioxide emissions in industries hard to decarbonise, such as cement, steel and chemicals.

v) *Circular economy and recycling* - recycling and re-use technologies are crucial in reducing waste and carbon emissions. Innovations in the recycling of plastics, metals and other resources are becoming increasingly relevant in the transition to a circular economy.

While progress in green technologies is evident, there are still many significant challenges that need to be overcome to ensure widespread adoption:

a) *Insufficient infrastructure* - in many areas, the infrastructure required for the large-scale deployment of green technologies is underdeveloped. For example, the network of charging stations for electric vehicles is not sufficiently developed to support a complete transition to electric mobility. In addition, electricity grids in many countries are not ready to manage large volumes of energy from intermittent renewable sources, such as solar and wind power.

b) *Finance and access to capital* - implementing green technologies requires considerable investment, but many companies in developing countries lack the capital to adopt these solutions. Access to low-cost finance is essential for these companies to be able to switch to low-carbon technologies.

c) While some countries have made significant progress in adopting green technologies, others are lagging behind due to factors such as lack of support policies, lack of technical expertise and economic dependence on traditional polluting industries.

d) Some environmentally friendly technologies, such as electric vehicle batteries, depend on rare and valuable materials such as lithium, cobalt and nickel. Access to these resources is limited and unevenly distributed globally, which can lead to supply problems and price increases, thus affecting the accessibility of these technologies.

Policy coordination and challenges in international collaboration International collaboration is essential to the success of climate policy, but there are many challenges that complicate this process:

- states have different priorities depending on their political and economic circumstances. While some countries are taking drastic measures to combat climate change, others are facing internal resistance from polluting industries and economic interests. These divergences often slow and complicate international negotiations.

- in accordance with the Paris Agreement, each country establishes independently determined emission reduction contributions and these commitments are voluntary. Although there are monitoring and reporting mechanisms, there are no direct sanctions for non-compliance with these obligations. This could lead to delays in climate policy implementation.

- developing countries are facing major challenges in accessing the technologies necessary for the transition to a low-carbon economy. We also need financial support to adapt to the effects of climate change. Inequalities in access to the necessary resources could undermine global efforts to combat climate change, especially in the most vulnerable regions (UNFCCC, 2021).

Conclusions. Climate change is a global problem that requires a coordinated and collective response from all countries. Because of the cross-border nature of greenhouse gas emissions and the global effects of climate warming, the actions of a single nation or region are not enough to effectively address the climate crisis. Thus, international cooperation and the harmonisation of climate policies at global level are crucial to achieving the emission reduction targets and limiting global warming to levels agreed by the international community.

The impact of costs and competition on international markets is a significant challenge for the implementation of carbon reduction measures. While the initial costs of the transition may be high, innovation, lower operational costs and access to new markets can offset these expenses through long-term opportunities. With appropriate support measures and international cooperation, it is possible to achieve a fair transition that protects economic competitiveness and mitigates the impact of climate change. Public acceptance and the protection of vulnerable communities are essential elements for the success of carbon reduction policies. Without broad citizen support and adequate measures to protect disadvantaged groups, these policies can lead to increased resilience and social inequalities, thus affecting efforts to combat climate change. It is crucial that governments implement integrated strategies that combine environmental protection with social assistance to ensure a sustainable and fair transition to a low-carbon economy.

Accessibility and progress of green technologies are fundamental to achieving the goals of reducing carbon emissions and combating climate change. Although technological innovations have made these solutions more affordable and effective, a constant commitment from governments is essential, private sector and society to overcome existing challenges and facilitate their widespread adoption.

International collaboration and coordination of global policies are crucial in the fight against climate change. An integrated approach, including both developed and developing countries, it is crucial to ensure a fair transition to a green economy and to achieve climate neutrality targets.

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