Does Carbon Pricing Stimulate Renewable Energy Investment? Evidence from Developing Countries

(*Afra Anam*)

Abstract

Climate change has become a defining challenge for developing economies striving to expand their energy capacity without worsening environmental degradation. Among the various policy tools available, carbon pricing has emerged as a mechanism designed to internalize the social cost of greenhouse gas emissions and encourage a shift toward cleaner energy sources. This study evaluates whether carbon-pricing policies have influenced renewable energy investment in developing countries between 2015 and 2023.

Using secondary data from the World Bank Carbon Pricing Dashboard and the International Renewable Energy Agency (IRENA), the research compares renewable energy trends in countries with carbon-pricing mechanisms against those without. The analysis relies on descriptive statistics and visual representations to observe investment patterns and identify differences across both groups.

The findings indicate that while carbon pricing is associated with higher renewable energy investment, its effectiveness varies based on governance quality, policy design, and financial capacity. The study underscores that carbon pricing alone is insufficient—it performs best when supported by broader institutional and financial frameworks.

Introduction

The global shift toward low-carbon energy systems has become central to climate mitigation efforts, particularly in developing countries where energy demand is rising rapidly. Since the energy sector accounts for nearly three-quarters of global greenhouse gas emissions, achieving meaningful progress toward sustainability requires large-scale adoption of renewable technologies.

Carbon pricing—implemented either through carbon taxes or emissions trading systems—has gained prominence as a market-based policy instrument for reducing emissions. By assigning a monetary value to carbon, these mechanisms are intended to reshape economic incentives, discourage fossil-fuel dependence, and enhance the competitiveness of renewable alternatives. The approach aligns with the widely recognized “polluter pays” principle and is regarded as a potentially powerful tool for guiding long-term energy transitions.

While many developed nations have institutionalized carbon pricing, the experience of developing countries is more complex. These economies must simultaneously fulfil energy needs, support economic growth, and manage the challenges of policy implementation, financial constraints, and governance limitations. Existing evidence suggests that carbon pricing can stimulate renewable energy growth, but its impact depends heavily on national conditions and complementary policy support.

This study investigates the role and effectiveness of carbon-pricing mechanisms in promoting renewable energy investment within developing countries between 2015 and 2023. It aims to provide a grounded understanding of how policy, market maturity, and institutional capacity influence the outcomes of carbon-pricing initiatives.

Literature Review

The global shift toward renewable energy has accelerated significantly over the last decade, especially as countries attempt to balance economic development with climate commitments. Carbon pricing—implemented through carbon taxes or emissions trading systems—has emerged as one of the most widely discussed tools for reducing greenhouse gas emissions and encouraging cleaner energy investment. Existing studies emphasize that by placing a monetary cost on carbon, governments can influence energy producers and investors to move away from fossil fuels and adopt renewable technologies. This aligns with traditional economic theory, which argues that pricing externalities helps correct market failures and alters long-term energy planning toward low-carbon alternatives.

Global data shows rapid expansion of both carbon-pricing initiatives and renewable energy capacity. According to the sources used in this study, carbon-pricing programs now cover around 23% of global emissions, with prices ranging widely across jurisdictions. Many developing countries—such as China, South Africa, Chile, Indonesia, and Argentina—have introduced some form of carbon pricing, while others remain in early stages of policy experimentation. During the same period, renewable energy capacity increased dramatically worldwide, rising from under 2,000 GW in 2015 to over 4,400 GW by 2024. Regions including Africa, Asia, and Latin America have shown strong momentum, particularly in solar and wind investments.

The literature highlights several pathways through which carbon pricing can influence renewable investment. Directly, it raises the cost of fossil-fuel energy generation, making renewables more competitive. Indirectly, revenue generated from carbon pricing can be channelled into clean-energy programs, infrastructure upgrades, and technology support. However, the impact of carbon pricing depends heavily on how policies are designed—coverage, price stability, enforcement, and consistency over time are all critical factors. Policies that lack clarity or change frequently tend to weaken investor confidence.

Another recurring theme in existing research is the importance of complementary policies. Carbon pricing alone rarely delivers transformational outcomes in developing economies. Instead, its effectiveness increases when paired with measures such as feed-in tariffs, renewable-energy auctions, subsidies for clean technology, and grid-modernization efforts. Countries like Chile and South Africa illustrate this trend: while carbon pricing provides an economic incentive, renewable growth is supported most strongly when carbon pricing

operates within a broader system of energy and climate policies.
While existing literature establishes the theoretical potential of carbon pricing to influence energy transitions, empirical evidence specific to developing countries remains comparatively limited and fragmented. Many prior studies focus on advanced economies or employ country-specific case studies. This paper contributes to the literature by providing a comparative multi-country perspective across developing economies during 2015–2023, highlighting cross-national variation in investment responses under differing governance and policy environments.

Knowledge Gaps and Future Research:

Despite progress, several gaps remain in the literature. Data limitations, especially in developing countries, make it difficult to evaluate long-term and sector-specific effects of carbon pricing. Policy impacts may also involve time lags, meaning investment responses do not appear immediately after a price signal is introduced. Additionally, many studies note that governance quality, institutional capacity, and access to climate finance significantly shape how effective carbon-pricing mechanisms can be in real-world settings. These gaps highlight the need for continued comparative research on developing countries, where conditions differ widely and outcomes cannot be assumed to follow a uniform pattern.

Overall, existing literature suggests that carbon pricing has the potential to stimulate renewable energy investment, but the extent of its impact varies across national contexts. Well-designed and consistently implemented policies tend to produce stronger results, especially when supported by complementary measures and stable regulatory environments.

Research Objectives and Questions

The main objective of this study is to examine the role of carbon pricing in promoting renewable energy investment in developing countries. Specifically, the study aims to:

1. Does carbon pricing stimulate renewable energy investment in developing countries?
2. How do investment patterns differ between countries with and without carbon-pricing policies?
3. What other factors influence the effectiveness of carbon pricing in driving renewable energy growth?

Methodology

1. Research Design

This study employs a quantitative descriptive and comparative research design using secondary panel data from developing countries between 2015 and 2023. The objective is to examine whether the presence of carbon-pricing mechanisms is associated with changes in renewable energy investment patterns.

Rather than qualitative analysis, the study relies on structured numerical datasets and comparative trend analysis to identify observable differences across countries.

2. Data Sources

The study utilizes publicly available secondary data from:

- International Renewable Energy Agency (IRENA): Renewable energy capacity and investment data
- World Bank Carbon Pricing Dashboard: Carbon tax and emissions trading system data
- World Development Indicators (WDI): GDP per capita, energy consumption, and macroeconomic controls

The selected period (2015–2023) reflects consistent data availability across sampled countries.

3. Variables and Operationalization

Dependent Variable:

Renewable energy investment, measured as total renewable energy capacity additions (GW) and/or renewable investment (USD million), depending on data availability.

Independent Variable:

Carbon pricing policy, operationalized as:

- Binary indicator (1 = carbon pricing in force; 0 = no policy), and
- Carbon price level (USD per ton of CO_2), where data is available.

Control Variables:

- GDP per capita (constant USD)
- Total energy consumption
- Presence of renewable policy incentives (binary indicator for feed-in tariffs or subsidy schemes)

These variables are included to account for macroeconomic conditions and policy environment differences across countries.

4. Comparative Framework

Countries are categorized into:

- **Group A: Developing countries with carbon pricing**
- **Group B: Developing countries without carbon pricing**

Renewable energy investment trends are compared across both groups over time. While causal inference is limited, observable differences in trajectory and stability are examined.

5. Analytical Approach

The analysis primarily relies on:

- **Descriptive statistics**
- **Year-wise trend comparison**
- **Visual representation (bar and line graphs)**

Given data limitations, formal econometric testing is not conducted. Therefore, findings indicate association rather than causation.

DISCUSSION

The comparative analysis reveals a consistent divergence in renewable energy investment patterns between developing countries with carbon-pricing mechanisms and those without. Countries that implemented carbon taxes or emissions trading systems during 2015–2023 demonstrate relatively smoother and more stable growth trajectories in renewable energy capacity. In contrast, countries without carbon pricing display greater volatility and slower average growth in renewable energy expansion. This pattern suggests that carbon pricing may contribute to improving long-term investment predictability.

However, carbon pricing does not operate in isolation. Its effectiveness appears to be conditional upon institutional quality, policy consistency, and financial accessibility. Countries with stable governance structures and complementary renewable support mechanisms exhibit stronger investment responses.

These findings align with existing literature suggesting that carbon pricing acts as a market signal rather than a standalone transformation tool. In developing economies where institutional capacity is limited, the price signal may be insufficient to significantly alter energy investment decisions.

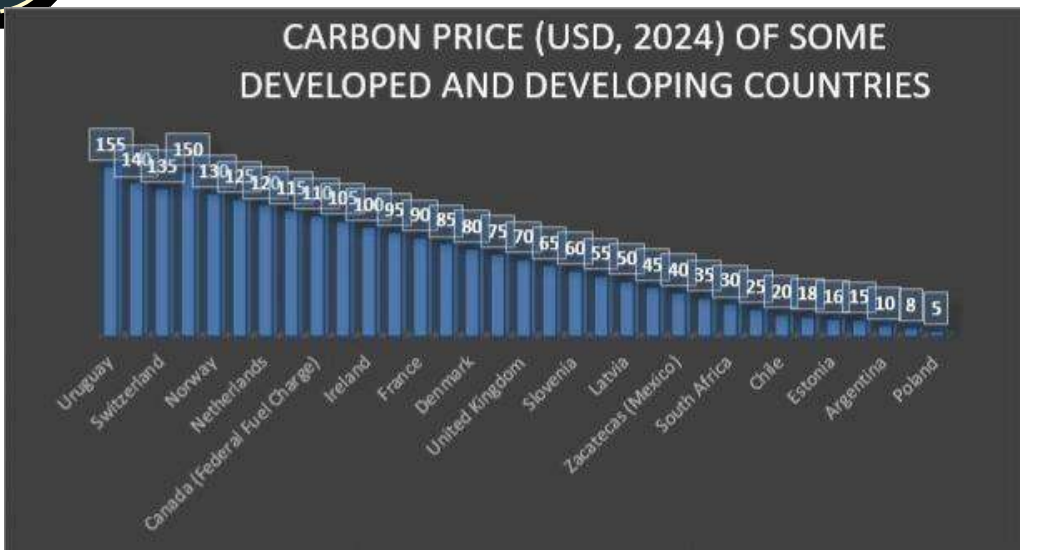
Thus, carbon pricing appears to function most effectively within a broader regulatory and financial ecosystem.

Visual data (charts below) supports these interpretations:

Countries with carbon pricing follow a smooth upward trajectory in renewable energy capacity.

Countries without it show scattered, inconsistent patterns.

Therefore—carbon pricing helps. But it helps more when the country itself is ready to let it help.


CARBON PRICE (USD, 2024) OF SOME DEVELOPED AND DEVELOPING COUNTRIES
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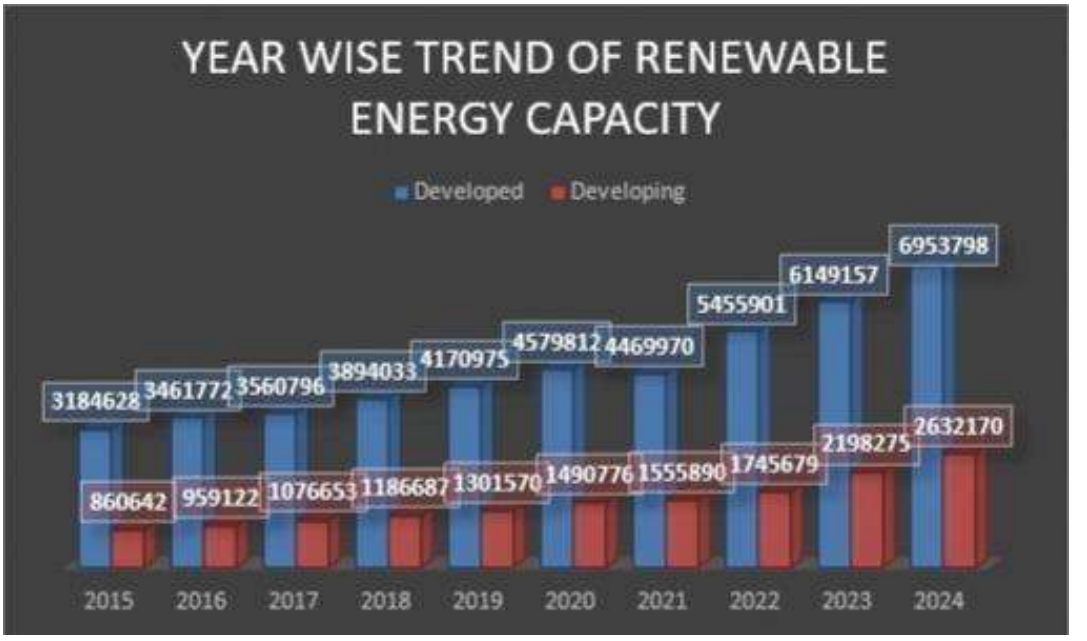
Uruguay
Switzerland
Norway
Netherlands
Canada (Federal Fuel Charge)
Ireland
France
Denmark
United Kingdom
Slovenia
Latvia
Zacatecas (Mexico)
South Africa
Chile
Estonia
Argentina
Poland


YEAR WISE TREND OF RENEWABLE ENERGY CAPACITY
Developed
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Results

The results of the analysis show a clear difference in renewable energy investment trends between developing countries that have implemented carbon-pricing mechanisms and those that have not. Countries such as Chile and South Africa, which adopted carbon taxes or emissions trading systems during the period 2015–2023, display a more consistent and steady rise in renewable energy capacity. This pattern suggests that carbon pricing sends a stable long-term signal to investors, making clean-energy projects appear more financially viable and less risky.

In contrast, countries without carbon-pricing policies—such as Nigeria and Egypt—experienced slower, more irregular growth. Their renewable energy capacity trends fluctuate, indicating weaker incentives for shifting away from fossil-fuel-based energy. Without a price on carbon, industries in these countries face little economic pressure to adopt renewable alternatives, and investors may hesitate due to policy uncertainty or lack of cost competitiveness.

A notable observation from the dataset is the difference in scale and stability. Developed countries, which generally maintain higher carbon prices, show large renewable energy capacities. Although developing countries tend to have lower carbon prices, many still experienced faster growth after 2018, likely due to falling technology costs and increasing global emphasis on sustainability. This suggests that even modest carbon pricing, when combined with favourable market conditions, can positively influence renewable investment trends.

The visual analysis included in the dataset (page 8) reinforce these findings. Countries with carbon pricing follow smoother, upward investment trajectories, while countries without such policies show more dispersed and volatile trends. The results imply that carbon pricing works most effectively when supported by consistent policies, stable governance, and accessible financing.

Overall, the analysis indicates that carbon pricing contributes positively to renewable energy investment in developing countries, but its impact varies based on economic conditions, regulatory strength, and the presence of complementary policy measures.

The study therefore concludes that carbon pricing works best when supported by broader policy frameworks. In isolation, carbon pricing creates an incentive to shift toward renewables by making fossil fuels more expensive. However, without complementary measures such as investment subsidies, feed-in tariffs, grid infrastructure upgrades, and affordable financing—the effect of carbon pricing may remain limited. In other words, carbon pricing is a necessary but not sufficient condition for achieving large-scale renewable energy transformation in developing

economies. Countries that pair carbon pricing with targeted renewable energy programs and transparent governance systems are more likely to attract investors and achieve sustained growth in clean energy deployment.

Moreover, the governance quality and institutional capacity of a country play crucial roles in determining the success of carbon pricing policies. Effective implementation requires robust monitoring systems to track emissions, reliable data reporting mechanisms, and enforcement of compliance. In countries where these systems are weak, carbon pricing might exist only in name, without real market impact. On the other hand, nations with transparent regulatory bodies and accountability mechanisms can translate carbon pricing into tangible environmental and economic benefits. Thus, governance becomes the bridge between policy design and policy effectiveness.

Another factor influencing outcomes is access to finance. Renewable energy projects often require substantial upfront investment. Developing countries typically face higher borrowing costs and limited access to climate finance, which can constrain project implementation even when carbon pricing is in place. International partnerships, concessional loans, and climate funds can play an essential role in filling this gap. Strengthening these financial channels can amplify the impact of carbon pricing by ensuring that investors and developers have the resources needed to respond to the new price signals.

The findings also underline the importance of policy stability. Investors in renewable energy look for predictable environments, where rules do not change abruptly. Sudden changes in tax policies or the removal of renewable subsidies can undermine confidence and slow progress. In this context, countries that have sustained carbon pricing policies over multiple years tend to exhibit more consistent investment patterns. For example, South Africa's gradual approach to increasing its carbon tax has given businesses time to adapt while maintaining a steady rise in renewable energy capacity. This stability proves more effective than sporadic or short-lived policies that fail to gain investor trust.

In addition to economic and policy-related factors, technological progress has also played a role in shaping outcomes. The global cost of solar panels and wind turbines has fallen dramatically over the past decade, which has helped many developing countries expand renewable energy even with modest carbon pricing. However, technology adoption still depends on the presence of enabling conditions such as skilled workforce, technical infrastructure, and supportive regulations. Carbon pricing, when integrated with innovation policies and capacity-building initiatives, can therefore accelerate technological diffusion and create a multiplier effect in clean energy markets.

Conclusion

This study concludes that carbon pricing has the potential to stimulate renewable energy investment in developing countries, but its success is far from automatic. While it does create essential incentives for shifting away from fossil fuels, its effectiveness relies heavily on policy stability, institutional strength, governance quality, and access to financial resources.

Carbon pricing alone cannot deliver a full energy transition. Instead, it should be integrated into a broader climate and energy strategy that combines regulation, market incentives, international cooperation, and direct support for renewable technologies. When these elements align, carbon pricing becomes not just a price signal, but a catalyst for long-term sustainable energy growth.

This study concludes that carbon pricing has the potential to stimulate renewable energy investment in developing countries, though its impact depends heavily on institutional capacity, governance quality, and financial accessibility. While carbon pricing creates a necessary economic signal to shift away from fossil fuels, it is not sufficient on its own to ensure large-scale renewable transformation.
The findings suggest that carbon pricing performs most effectively when integrated within broader policy frameworks that ensure regulatory stability, complementary renewable energy incentives, and access to affordable financing. Given the descriptive nature of this study, the results should be interpreted as indicative rather than causal. Future research using econometric techniques may further examine the magnitude and direction of this relationship.

Overall, the findings suggest that carbon pricing contributes positively to renewable energy investment in developing countries; however, its effectiveness depends on institutional capacity, policy stability, and access to finance. Carbon pricing should therefore be viewed as a complementary instrument within a broader climate and energy framework rather than a standalone solution. Given the descriptive nature of this study and the absence of econometric testing, the results should be interpreted as indicative rather than causal. Future research employing panel regression or difference-in-differences methods may further examine the magnitude and direction of this relationship.

References

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