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Green Energy and Environmental Impact on the Industrial Sector in 33 High-Income Countries

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ABSTRACT

This study analyzes the influence of adequate electricity supply on the industrial sector in developing nations, utilizing panel data from 2000 to 2022. Contrary to original beliefs, the study examines industry output as the dependent variable, with renewable energy as the main explanatory factor. The study incorporated control variables such as CO2 emissions, government expenditure, GDP per capita, labor force participation, and gross capital formation. The investigation included panel Autoregressive Distributed Lag (ARDL) models, unit root tests, and causality tests. In emerging countries, industrial growth is positively impacted by government spending, labor force involvement, CO2 emissions, and GDP per capita. Developed countries demonstrate favorable impacts on industrial growth through gross fixed capital formation, renewable energy, and other factors, as indicated by the long-term outcomes of the ARDL method. Policymakers in developing nations may contemplate raising government spending in pertinent sectors, encouraging worker engagement, and enacting laws to decrease CO2 emissions based on these findings. Developed countries' authorities should prioritize improving gross fixed capital creation, integrating more renewable energy sources, and sustaining factors boosting industry growth.

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1. Introduction

Green growth and higher economic growth in developing countries are both potential outcomes of the overall picture of green energy. In our research assessment, we examine the utilization of green energy. Green energy plans are more beneficial than those in developed countries since they require more complex and unique policy choices. Green energy positively affects developing countries' economies, environments, and societies. Sustainable development and energy policy are intertwined with green growth. Improving environmental management is the main objective of green energy, as it is crucial to halting global warming. This high-level review of renewable energy shows green development and genuine opportunities in developing countries. Using sustainable power sources has been the focal point of our examination. Regardless of its advantages, the efficient power energy plan experiences unmistakable and troublesome approach concerns when standing out from well-off countries. Green energy is advantageous for the economy, society, and

environment. Both economic policy and sustainable development are significantly impacted by it. The primary requirement for green energy is better environmental management, which is necessary to combat climate change. This is especially true for developing fields.

The informal economy's micro- and small companies and a significant portion of the workforce engaged in self-employment define the industrial structure. Any group of businesses that employ a similar business model to make a profit—such as the steel, automobile, or food industries—is often referred to as an industry. Converting natural resources into primary products is the primary sector's usual activity. Other industries utilize the bulk of goods produced in this industry as raw materials. Manufacturing and construction are examples of production industries in the secondary sector of the business that produce finished, useless items.

The shift from conventional to non-conventional energy sources has been ongoing, claim Ntanos et al. (2018)—the drawbacks of conventional energy sources and production and consumption techniques. Employing renewable energy sources is becoming more and more critical. According to research, almost 19% of the world's energy consumption will come from renewable sources by 2020. The plan aims to use them to 50% by 2050. The beneficial relationship between the workforce.

Based on data gathered between 2010 and 2020, Gellert et al. (2022) created projections for the industrial sector using the Markov approach. They asserted that hydropower represented Romania's most recent and cutting-edge renewable energy source. This source will provide 50.266% of the total renewable energy until 2025. The study's value is in its thorough examination of how efficient electricity has affected manufacturing in industrialized and developing nations. The report offers a detailed picture of the elements driving industry expansion by considering various variables, such as renewable energy, carbon dioxide emissions, government spending, and GDP per capita.

The results are much more solid because panel data and sophisticated econometric methods were used, including causality tests and panel ARDL models. Policymakers in wealthy and developing nations can benefit from the study's conclusions, pointing to concrete areas where governmental action could spur industry growth. With its comprehensive examination of the connection between efficient electricity and the manufacturing industry, this study contributes to the current body of knowledge and offers practical consequences for scholars and policymakers.

2. Literature Review

Shahid (2014) study centers around the effect of workforce cooperation on Pakistan's financial development. Using information from the World Bank, State Bank of Pakistan, and Pakistan Department of Measurements, the review lays out a drawn-out interface between workforce investment, financial development, and gross fixed capital creation. Remarkably, the vector blunder revision model demonstrates a huge negative connection between financial development, gross fixed capital creation, and workforce support in the short run.

Ajmair (2014) focused on researching the impact of the modern area on Gross domestic product in Pakistan, utilizing information traversing 61 years (1950-2010) and expanding Dickey-Fuller (ADF) tests to examine time series attributes. The review utilized time series examination and fundamental direct relapse to gauge connections. The results uncovered a positive relationship between all factors in the review and Gross domestic product, except the mining and quarrying area, which displayed a negative connection and yielded an irrelevant outcome in basic direct relapse. Notwithstanding these varieties, the review reasoned that each, to some degree, upheld presumption emphatically added to Gross domestic product. This exploration adds significant bits of knowledge into the mind-boggling elements of the modern area's effect on financial development in Pakistan.

Jain et al. (2015) examined the determinants of gross domestic product parts, zeroing in on assembling, administrations, and industry from an Indian point of view. Using optional information covering the period from 2000-2001 to 2011-2012, obtained from the Monetary Review of India and distributions by the Hold Bank of India, the review applied various relapse investigations. It tried to lay out associations between Gross domestic product parts and macroeconomic development records like import and commodity, unfamiliar direct speculation (FDI), net unfamiliar venture obligation, and net unfamiliar value. The discoveries disclosed huge effects of import, net FII value, and FDI on Gross domestic product parts. Nonetheless, the review did not notice a significant impact of Net FII obligation on Gross domestic product parts. Essential was the unimportance of commodities on gross domestic product parts connected with assembly and industry, while administrations showed a significant effect.

Ali (2015) directed an exhaustive report on the connection between the monetary turn of events and gross fixed capital development in Pakistan, using yearly time series information from 1981 to 2014. The essential goal was to examine the connection between Pakistan's Gross domestic product development and its gross fixed capital result. To guarantee the strength of the information, the analyst utilized the Expanded Dicky-Fuller (ADF) unit root test during the pre-relapse testing stage. The resulting investigation used the Johansen Co-mix and Vector Blunder Revision Model (VECM) utilizing the E-Perspectives econometric program.

Lin et al. (2015) zeroed in on the effect of industrialization on CO2 outflows in Nigeria, lining up with the country's desires for maintainable development and industrialization. The scientists tended to an eminent exploration hole by researching what industrialization-prompted monetary change means for fossil fuel byproducts in non-industrial nations. The essential objective of the exploration was to examine the impact of modern worth added on CO2 discharges in Nigeria, covering the years 1980 to 2011. Iweriebor et al. (2015) dive into the perplexing connection between government spending and modern improvement in Nigeria, utilizing a robust structure to investigate the elements inside this nexus. The review expects to clarify how an essential circulation of public area speculations could reinforce modern creation. Using information from 1980 to 2013 and different econometric strategies, the concentrate tentatively examines the essential effects of vital public area use parts on modern development. In any case, the discoveries reveal that public venture shows no significant transient consequences for modern results. In considerably overstretched periods, government spending appears to have little impact on modern creation, demonstrating a detachment between open uses and the genuine economy. The review proposes that policymakers, to upgrade modern execution in Nigeria in the long haul, should focus on transforming monetary administration processes.

From a worldwide point of view, Nejat et al. (2015) attempt a worldwide concentrate on carbon dioxide discharges from homes, energy utilization, and related guidelines. The review features the critical commitment of the private sector to environmental change alleviation, representing 17% of worldwide CO2 emissions and 27% of worldwide energy utilization. The leading ten nations answerable for 66% of worldwide CO2 emanations are China, the US, India, Russia, Japan, Germany, South Korea, Canada, Iran, and the Assembled Realm. The review underlines the immediate and significant effect of these nations' ozone-depleting substance emanations and family energy use on the worldwide climate. The discoveries highlight the requirement for purposeful endeavors and successful guidelines to address energy utilization and universally decrease ozone-depleting substance outflows.

In a worldwide setting, Geng et al. (2016) noticed the rising ozone-depleting substance (GHG) discharges from modern areas, especially in emerging nations where industrialization has become a point of convergence. Perceiving the shortage of exhaustive exploration on the direction of modern emanations in arising economies, the creators started an exceptional issue to address this examination hole. The examination intended to

understand the current direction of modern emanations and offer encounters for non-industrial nations.

Stupnikova and Sukhadolets (2019) study gives essential bits of knowledge into the effect of the Russian development industry on gross fixed capital arrangement (GFCF) from 2000 to 2016. The exploration planned to figure out the connections among crucial factors, remembering the speculation for fixed resources, the size of the structure business, interindustry adjusting supply, the expansion in GFCF, and the generally monetary ventures. The review utilized relapse investigation and the autoregressive dispersed slacked (ARDL) bound testing approach to assess these associations. Quiet, this exploration tended to a hole in monetary writing by presenting ARDL demonstrating for GFCF examinations in Russia. The discoveries featured non-direct causation between the development area's volume and the drawn-out ascent in GFCF. The review uncovered a cointegrated and fixed relationship, underscoring a favorable climate for fixed speculation. This means that as the development area extended, there was a positive effect on GFCF, exhibiting the area's vital job in Russia's financial turn of events.

Eberhard et al. (2017) investigation dives into the groundbreaking effect of the fourth modern transformation on the work market. The review emphasizes the digitization of work and the development of expectations for new expert skills. It means to expect future work patterns and essential abilities by assessing the impact of digitalization on the work market in countries going through the computerized transformation. Reviewing college teachers and examining educational programs are necessary to survey the status of advanced education establishments for the looming computerized patterns.

Along these lines, Jeff-Anyene et al. (2019) led a review utilizing the Autoregressive Disseminate Slack (ARDL) technique to examine the short- and long-haul elements between government consumption and modern improvement in Nigeria from 1981 to 2016. The disheartening outcomes demonstrate that administration consumption has neither positive long haul nor momentary advantages on Nigeria's modern turn of events. Notwithstanding persistent development in government spending and different measures pointed toward working on modern execution, the review proposes that cautious allotment of assets, particularly for ecological creation like streets, energy, water, and correspondence, is pivotal. Moreover, the review advocates for fair treatment and satisfactory discipline for people ensnared in the misappropriation of public assets.

Trpeski and Cvetanoska (2019) wandered into the efficiency domain in Southeastern Europe and its connection with the gross fixed capital arrangement. Recognizing the significance of capital arrangement for both hypothetical and experimental monetary exercises, the specialists planned to decide what fixed capital consumptions meant for efficiency in the nations of Southeast Europe from 2000 to 2017. The partnership of nations under a magnifying glass included Bosnia and Herzegovina, Macedonia, Montenegro, Romania, Serbia, and Slovenia. Kosovo was rejected because of information constraints. Moreover, the review contrasted these Southeast European nations and Germany and France, both viewed as driving economies in the European Association.

In a connected setting, Mitić et al. (2020) investigated the relationship between gross fixed capital creation, industry, administrations, and CO2 outflows in Balkan states from 1996 to 2017, adding to the field of ecological and financial aspects. The review zeroed in on determining the causative connections between CO2 discharges, industry, administrations, and gross fixed capital creation. A three-step calculation process was utilized, including board tests for unit root, cointegration, and causality examination.

Banelienė (2021) investigated the impact of industry on Gross domestic product development in created nations, dependent upon Research and development venture terms. The review zeroed in on the connection between Research and development ventures, modern design, and Gross domestic product improvement. Affirming speculations, that is what the examination featured, under business-supported Research and development

venture conditions, the development of the business share in gross worth added highly affects Gross domestic product development in advanced industrialized nations with higher Gross domestic product per capita than in those with lower Gross domestic product per capita.

Aslam et al. (2021) led a thorough report digging into the complex interchange of industrialization, gross domestic product per capita, and CO2 outflows inside the Chinese setting. Their exploration investigated the multi-layered effect of exchange receptiveness, populace thickness, industrialization, financial development, and the ecological Kuznets bend (EKC) on China's monetary scene. The review uncovered that China's CO2 outflows were affected by different variables, including modern results, business movement, and populace thickness. A critical finding was the dynamic decrease in CO2 discharges with the expansion in per capita Gross domestic product, featuring its moderating impact. The concentrate likewise distinguished a bidirectional causal connection between industrialization and CO2 outflows. Also, it accentuated the positive relationship between exchange receptiveness design and populace thickness. The transient slack between industrialization, per capita Gross domestic product, and CO2 discharges was explained through fluctuation disintegration drive investigation. The review expects to animate further discussion inside the scholastic local area, especially concerning momentary ramifications.

Ozuzu and Isukul (2021) further investigate the effect of government spending on Nigeria's assembling area. Through relapse investigation, the review presumes that administration capital uses and tax collection positively and significantly affect the modern area. Financial strategy rates emphatically and essentially impact the development of the modern area, while genuine loan fees show no perceivable effect and are adversely impacted. The review underscores that administration strategy is critical in developing Nigeria's modern area, recommending that financial arrangements, especially open ventures, should be coordinated towards working on the nation's framework, particularly in the power area, to diminish production costs. Furthermore, the public authority should zero in on improving security, resolving issues connected with flighty power supplies, and establishing a helpful learning climate. It likewise suggests that the public authority considers its financing cost and money-related strategy rate close to capital speculation to animate modern development.

Sikder et al. (2022) led a careful assessment of the consolidated effect of Gross domestic product development, industrialization, energy use, and urbanization on CO2 discharges in rising nations, utilizing the Board Autoregressive Circulated Slack (ARDL) strategy. Perceiving the rising scene economy as a critical driver of worldwide extension, the review zeroed in on 23 non-industrial nations from 1995 to 2018. The coordinated impacts of energy utilization, industrialization, Gross domestic product development, and urbanization were examined through board ARDL and heterogeneous causality tests. The examination uncovered that a 1% increment in energy use relates to a proportionate long haul ascend in CO2 discharges, with extra effects remembering a 0.17% expansion for financial development, a 0.54% increment in industrialization, and a 2.32% increment in urbanization. The balance focuses in the model was seen to move yearly at a pace of 0.19 percent, showing dynamic changes after some time. The concentrate additionally guaranteed the strength of its discoveries by leading extra tests utilizing Completely Adjusted Normal Least Squares (FMOLS) and Dynamic Customary Least Squares (DOLS) approaches. This careful investigation of examinations contributes significant knowledge to different scholarly and strategic conversations, revealing insight into essential parts of energy, work markets, and monetary elements.

3. Data and Methodology

Utilizing the board ARDL model, the dataset outline dove into the quick and delayed influences on modern improvement concerning gross fixed capital, work, general government, environmentally friendly power utilization, and CO2 emanations across a worldwide example of 33 emerging countries with big-time salaries. The recorded nations

incorporate Kenya, Kyrgyz Republic, Lebanon, Morocco, Nepal, Nicaragua, Nigeria, North Macedonia, Pakistan, Russian Alliance, Senegal, Sri Lanka, Tanzania, Tunisia, Vanuatu, Middle Easterner Repulse, Salvador, Gabor, Ghana, Haiti, Honduran, India, Indonesia, Iran Islamic Rep. The essential point of this section is to clarify the immediate and exact impact of every variable on modern development, crossing the years 2000 to 2022.

Information for this examination is obtained from the World Advancement Pointer, with estimations in U.S. current dollars for factors like Gross domestic product per capita, all-out government spending, and gross fixed capital arrangement. Work units are utilized for different variables, enveloping workforce figures, CO2 discharges estimated in kilotons, and kilowatt-long periods of environmentally friendly power use. The investigation consolidates both the unit root test and the ARDL econometrics model, with the essential objective of laying out the consecutive coordination of the information.

3.1 Model specification

$$Industry(F) = \begin{Bmatrix} Gross\ fixed\ capital \\ General\ Government\ expenditure \\ Labor\ Force \\ Renewable\ Energy\ Consumption \\ GDP\ per\ capita \\ Co2\ emission \end{Bmatrix} \quad (1)$$

It clarified the purported connection between the business sector and the other variables used for analysis. Going from a functional to an econometric format:

$$InIND_{it} = \alpha_o + \alpha_1 InGFCF_{it} + \alpha_2 InGGE_{it} + \alpha_3 InLF_{it} + \alpha_4 InREC_{it} + \alpha_5 InGDP_{it} + \alpha_6 InCO2_{it} + \in_{it} \quad (2)$$

Table 1
Description of Variables

Variable	Description	Measurement	Exp. Sign	Source
IND	Industry output	Value added		WDI
GFCF	Gross fixed capital formation	Current US$	Positive	WDI
GGE	General Government Expenditure	Current US$	Positive	WDI
GDP	GDP per capita	Current US$	Positive	WDI
REC	Renewable energy consumption	Kilo Watt	Positive	WDI
CO2	CO2 emissions	Kilo tones	Positive	WDI
LF	Labor force	Numbers	Positive	WDI

4. Results and Discussion

Table 2, represents the unit root analysis. The first difference does not affect the industrial sector because, at trends smaller than 5% and 1%, the p-values for the industrial sector intercept are 0.75 and 1.00, respectively. At first difference, the industrial sector is likewise immobile. The first difference analysis reveals that carbon dioxide emissions display stationarity. The intercept yields p-values of 0.87 and 0.99, indicating a static nature of the data. The CO2 emissions exhibit stationarity at the first difference, with a p-value below the 5% threshold, precisely at 0.00. When held at its current level, GDP per capita does not move. There is less than a 0.01% chance of error with the proposed intercept p-value of 0.34 and trend v-value of 1.00. At the first difference, the variable representing the general government is stationary. Assuming an intercept value of 1, the proposed p-value is 0.01, and the trend value is 0.98—both of which are less than the significance level of 0.05. As the pattern esteem remains at 1.00, demonstrating 1% of the aggregate, and the planned incentive for the capture is 0.35, the end can be drawn that the gross fixed capital displays stationarity at the main contrast. At its current level, the labor force variable does not change. Less than 0.01, the intercept p-value is 0.48, and the trend v-value is 1.00. There

has been stationarity at the first difference in the usage of renewable energy. One thousand is the p-value for both the intercept and the trend.

Table 2
Unit root test (Im, Pesaran & Shin W test)

Variable	Test for unit root	Include in the test equation	t-Stat.	P- Value	Remarks
Industrial sector output	Level	Intercept	0.69	0.75	I(1)
	Level	Trend and Intercept	4.41	1.00	
	1st difference	Intercept	-11.54	0.00	
	1st difference	Trend and Intercept	-11.53	0.00	
CO2 emissions	Level	Intercept	2.95	0.99	I(1)
	Level	Trend and Intercept	1.13	0.87	
	1st difference	Intercept	-15.25	0.00	
	1st difference	Trend and Intercept	-14.88	0.00	
Renewable energy consumption	Level	Intercept	5.03	1.00	I(1)
	Level	Trend and Intercept	4.58	1.00	
	1st difference	Intercept	-11.55	0.00	
	1stdifference	Trend and Intercept	-16.10	0.00	
GDP per capita	Level	Intercept	-0.39	0.34	I(1)
	Level	Trend and Intercept	6.00	1.00	
	1st difference	Intercept	-10.7	0.00	
	1st difference	Trend and Intercept	-10.65	0.00	
General government final consumption	Level	Intercept	-2.28	0.01	I(0)
Gross fixed capital formation	Level	Intercept	-0.03	0.48	I(1)
	Level	Trend and Intercept	5.21	1.00	
	1st difference	Intercept	-12.46	0.00	
	1st difference	Trend and Intercept	-12.92	0.00	

From the unit root analysis, we found that this study has mixed order of integration. In case of mixed order of integration, we will employ panel ARDL model for the analysis. The results of the panel ARDL model are reported in table 3. An ideal affiliation is obvious between gross fixed capital and modern result, set apart by the positive 0.045 coefficients of the centroid. This optimistic and remarkable result shows that the industrial sector level rises in tandem with gross capital development. Fixed capital contributes to the industrial sector's expansion, diversification, and automation. It also affected the amount of capital needed by the manufacturing sector. With a substantial p-value, the calculated value is 0.00. The general government variable has a favorable effect on the industrial construction sector. Suppose the national government raises money for the construction sector. It establishes the social and legal framework of the economy, provides public goods and services, and preserves market competition. Apart from permitting monetary transfers, it also responds to externalities in tandem and implements specific measures to maintain economic equilibrium. In addition, GDP per capita demonstrates analogous positive outcomes to overall fixed capital. The substantial and affirmative coefficient underscores a noteworthy correlation between GDP per capita and industrial construction. GDP per capita and industrial building are correlated because the GDP increases when construction investment does. One of the most important economic indicators—the gross domestic product—closely correlates with it. Notable is the p-value of 0.00. The development of enterprises exhibits a positive connection with a particularly expanded reception of sustainable power. Moving endowments from petroleum products to feasible energy sources can shorten discharges. Accomplishing more noteworthy uniformity, especially for the world's ruined and weak networks, improving general well-being, and encouraging position creation are among the complex benefits of supportable monetary development. The genuinely critical degree of environmentally friendly power is highlighted by a P-esteem under 0.00.

Table 3
Panel ARDL Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
Gross Fixed Capital	0.045340	0.011254	4.028778	0.0001
Government Expenditure	0.185065	0.044918	4.120083	0.0000
GDP per capita	0.887165	0.070174	12.64234	0.0000
CO2 Emissions	0.192671	0.051336	3.753136	0.0002
Renewable Energy Consumption	0.612826	0.059210	10.35007	0.0000
Labor Force	0.430996	0.072271	5.963606	0.0000
COINTEQ01	-0.159192	0.044966	-3.540301	0.0004
Gross Fixed Capital	0.050096	0.047976	1.044192	0.2969
Government Expenditure	-0.124860	0.051559	-2.421717	0.0158
GDP per capita	1.088359	0.095118	11.44215	0.0000
CO2 Emissions	-0.006728	0.062792	-0.107141	0.9147
Renewable Energy Consumption	0.141753	0.084474	1.678065	0.0940
Labor Force	0.518321	0.555039	0.933846	0.3509
Constant	0.560362	0.158160	3.543007	0.0004
Mean dependent var	0.072512	S.D. dependent var		0.150199
S.E. of regression	0.054645	Akaike info criterion		-3.107878
Sum squared	1.367619	Schwarz criterion		-1.478254
Log-likelihood	1360.404	Hannan-Quinn		-2.478428

The labor force assumed a positive part in the development area. As exchange conditions inclined toward industry, the modern compensation rate expanded to adjust the raised expense of horticultural items against modern results. In general, the information variable examination model results are imperative and positive, with every variable exhibiting an ideal connection with all others. The p-esteem, being under 0.05, highlights its importance. The results indicate a positive connection with the carbon dioxide emissions in the construction sector. The construction process's carbon impact was minimized, and materials were actively sourced to lower CO2 emissions all over the project and portfolio. Machinery planning became more effective. Purchase renewable energy and biofuel-powered equipment that produces no carbon emissions. Compared to the actual value, the p-value of 0.00 is significantly lower.

5. Conclusion

The assessment utilized the ARDL technique to investigate what environmentally friendly power energy means for the product-creating area in big-league salary non-industrial countries. Various free factors, including Gross domestic product per capita, environmentally friendly power business, CO2 discharges, and general government information, were examined comparable to the reliant variable, modern creation. The results uncovered a nuanced connection between item creation and environmentally friendly power energy reception in these economies. The review highlighted the significant effect of a couple of fundamental factors on modern result levels, proposing that reassuring the consolidation of sustainable power can emphatically impact modern creation. By the way, difficulties might emerge in overseeing CO2 emanations and general government measurements. Strategy Mediations: States in wealthy non-industrial nations should ponder ordering approaches that boost and award the joining of sustainable power sources in item creation. This could include monetary motivating forces like endowments and tax reductions. Interest in Environmentally Friendly Power Framework: Reinforcing the foundation for environmentally friendly power creation and appropriation is critical for cultivating more extensive acknowledgment in the ware-delivering area. Cooperative undertakings among states and enterprises are fundamental for putting resources into and creating supportable, sustainable power sources.

Innovation Improvement: Animating headways in efficient power energy creation advancements can increase effectiveness and draw interest from the product delivery area. Offering monetary help for innovative work drives is urgent for advancing advancement. Environmental regulations: Enforcing and strengthening environmental regulations is one strategy to lower CO2 emissions. Establishing stringent, transparent laws and monitoring methods can help achieve this. Labor Force Training: Productivity may be raised by providing training programs to workers in the commodity-producing sector to assist them in embracing green technologies. Upskilling and reskilling initiatives should meet the sector's changing demands. Monitoring and Evaluation: Strict monitoring and evaluation procedures must be put in place to ascertain the long-term consequences of policies that have been implemented. Regular assessments will help identify areas that require improvement and alteration. In conclusion, maximizing the positive impacts of green energy on the commodity-producing industry in high-income developing countries necessitates a methodical, well-coordinated strategy that considers the interplay of several factors.

5.1 Policy Recommendations

The study's results allow us to make some broad policy suggestions for the manufacturing sector that would help it grow and stay in business: reduce dependence on fossil fuels and environmental impacts by promoting renewable energy: incentives, subsidies, and regulatory frameworks should be implemented to encourage the industrial sector to embrace renewable energy sources. Boost manufacturing's productivity, efficiency, and competitiveness through investment in infrastructural development and technology upgrades. In order to promote technical progress and diversification in the industrial sector, it is essential to invest in research and development and cultivate an innovation culture. Boost employee competence by putting money into training and education programs so workers can adjust to new technologies and boost productivity. Put measures in place to encourage eco-friendly procedures, such as minimizing waste, using resources better, and protecting the environment. In order to help the manufacturing sector worldwide, it is essential to encourage international cooperation and the sharing of knowledge to transfer technology, share best practices, and solve shared difficulties. In order to foster the expansion and long-term viability of the manufacturing sector, which in turn will contribute to overall economic growth and prosperity, authorities should adopt the following recommendations.

Authors Contribution
Muhammad Waseem: data curation, literature review, writing – original draft, validation
Sania Batool: conceptualization, methodology, formal analysis, writing – review & editing

Conflict of Interests/Disclosures
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