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# The Economic Benefits of Renewable Energy: A Cost-Benefit Analysis of Transitioning to Renewable Energy Sources

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## ABSTRACT

*In this research, the researcher systematically evaluated the cost-effectiveness of the shift from non-renewable (fossil fuel) to renewable (solar, wind, hydro) sources of energy in Pakistan from 2014 to 2024, focusing on the socio-economic benefits of the shift across the country, with special emphasis on the 2014-2024 period. Using a mixed method approach, the researcher utilized secondary data from various governmental institutions such as the Alternative Energy Directorate, National Electric Power Regulatory Authority, and the Pakistan Bureau of Statistics, while the primary data consisted of questionnaires from 250 employees in the energy sector, and 15 semi-structured interviews with key players in the sector from several of Pakistan's largest cities. Initially, the research examined the economic differences from a conventional fossil fuel based (primary energy source) system to a renewable energy system (solar, wind, and hydro) and then proceeded to analyzed the economic factors levelized cost of energy, direct capital (investment) cost, operational (recurring) cost, potential creation of new jobs, and the external socio-eco factors emigrating from the system using the Net Present Value and Internal Rate of Return analytics. Based on the socio-economic factors it became evident that the country as a whole had long term financial benefits from the renewable sources; it would take a set period to realize the benefits from the shift (investment) in RV energy, whereas the non-renewable, fossil system would have immediate financial benefits but would have devastating long term external ecological socio impacts (cost to the country as a whole). Taking into account these financial factors, the author concluded that the socio-economic benefits created by RV energy for the country Pakistan would more than justify the socio and financial costs on the country. The author, therefore, made the greatest impact on the energy sector stakeholders and the public policy makers of the country by shedding light these benefits.*

***Keywords:*** *Cost-effectiveness, non-renewable, renewable energy, socio-economic benefits, Pakistan.*

## INTRODUCTION

The last decade marked a period of Pakistan's persistent energy challenges, with the country grappling with the severe electricity shortages, load shedding, and alarming reliance on fossil fuel Imports uneconomic for the country's national economy and industrial growth. Pakistan's energy crisis became a considerable hindrance to its economic development. On the country-level, rural and urban communities suffered the socio-economic impacts of the crisis and the impediments it created on the Sustainable Development Goals (Mahmood, 2023). Pakistan incurred significant economic losses in the period 2014 to 2024 as a result of energy shortages, with industries especially in the energy intensive business sectors operating below the levels of output and performance, and households and communities experiencing energy poverty. The overdependence on imported oil and gas created energy market instability and balance of payments difficulties for Pakistan's economy. Moreover, it restricted the economy's foreign exchange liquidity which is usually meant for development (Usman et al., 2024).

The move towards integrating renewable energy sources offered the opportunity to leverage the considerable natural resources available in the form of solar, wind, and hydroelectric energy. This also addressed some of the energy problems that Pakistan faced in the early part of the study. There were about 2.9 million megawatts of solar energy available, along with rich wind and coastal resources in the Sindh and Balochistan region, and a considerable amount of hydroelectric energy in the north that was not being utilized (Aized et al., 2021). Pakistan possessed great potential for renewable energy, the early part of the study showed that there was a great deal of unutilized potential that could have advanced economic development and energy security. This led to the development of a number of policies and frameworks, starting with the Alternative and Renewable Energy Policy 2011, along with other subsequent revisions; however, there was a lack of effective implementation, and an overall lack of investment to bring about the changes that were needed (Khurshid et al., 2024).

Informed policy design and economic forecasting in Pakistan's energy domain compelled the interrogation of the economic ramifications associated with the move to renewable energy. The embedded economic analysis with the transition from fossil fuels to renewables, calculated the financial outlays, economic benefits, and the long-term sustainability of the economic gains through renewables. Such a transition and the implantation of the renewables required the not only the technological tools and new forms of energy innovations, but a complete overhaul of the energy systems, new constructions of the regulatory systems, and a complete reshuffling of the economic investments with a robust a priori of economic rationale. The benefits of the transition economically and socially were significant with the reduction of costs and savings from the primary investments, new jobs, innovations, new industries, better health, energy independence and security and the environment fortified the overall economic and social sustainability of the nation (Muneeb, 2024).

The study empirically assessed the impacts of renewable energy technology deployment on the economy of Pakistan over the period 2014-2024, analyzing the costs, benefits, and socio-economic impacts of transformative renewable energy policies. The study included a comparative assessment of the financial costs and benefits of solar photovoltaic, wind, and hydroelectric generation as compared to conventional thermal generation. Drawing on data from government agencies, energy sector professionals, and industry stakeholders, the study contributed critical understanding of the financial viability and economic benefits of renewable energy technologies within the constructs of bounded rationality. The study took into account the complex costs of the renewable energy transition, factoring in the capital expenditure, the operating and maintenance costs, the savings from fuel costs, the jobs created, the environmental and social benefits, and the positive net present value of the investment over the long run in order to arrive at a rational and comprehensive account of the economy of the transition to renewable energy (Qudrat-Ullah, 2024).

The research's impact focused on Pakistan's policymakers and investors in the energy field, international development organizations assisting Pakistan, and civil society organizations in Pakistan dealing with international development. For policymakers, there was a need for economic analysis to substantiate the public expenditure, the proposed public incentives, and the policies to be structured that would promote economically efficient use of public and renewable energy. Investors in the Private Sector also needed economic analyzes of public expenditures to assess the opportunities, the risks, and the costs of participation in the renewable energy field in Pakistan. Development agencies collaborating with Pakistan in the energy transition also required empirical research on the economically viable renewable energy opportunities to easily allow them to target the potential economically viable opportunities for their financing and technical assistance. The study added to the existing knowledge on renewable energy's economics in developing nations particularly focusing on Pakistan and its unique geography, economy, and institutions and the methodological contributions to a developing economy with similar energy issues to Pakistan.

**Research Objectives**

1. To analyze the economic costs and benefits of renewable energy in comparison to conventional fossil fuel-based energy systems in Pakistan from 2014 to 2024.
2. To analyze the potential for job creation and the other socio-economic impacts that would result from the change to renewable energy sources in Pakistan's energy sector.
3. To determine the long-term financial sustainability and ROI outcomes of renewable energy projects in Pakistan using the Net Present Value and Internal Rate of Return approaches.

**Research Questions**

1. What are the advantages and disadvantages in terms of monetary value and costs of renewable sources of energy compared to the traditional fossil fuels systems in Pakistan?
2. What are the implications of the shift to renewable sources of energy on the creation of new jobs and the overall socio-economic development of the country?
3. What are the estimated returns and how sustainable are the investments to be in the renewable sector and its projects within the energy sector of Pakistan in the years to come?

**Significance of the Study**

The study fills in the gaps of empirical evidence on the transformation of the energy sector in Pakistan by carrying the necessary economic analyses on the costs and the benefits of renewable energy source adaptation for Pakistan within a transitioning developing decade. It further added to the existing knowledge on the costs and economic value of the transition from fossil fuels to renewables in Pakistan to serve and offer the data to guide the policy and investments. It assisted the various stakeholders to include the Government bodies and policy makers on energy, the Private sector and Investors on renewables and to the International and Development Agencies focusing on the Sustainable Energies for Pakistan. By proving the economic justifications on renewable energy, the study aided to further the transition of sustainable development and positive socio-economic changes, energy shift and energy security and economic prosperity for future generations.

## LITERATURE REVIEW

The early 21st century marked the beginning of the shift to renewable energy on a global scale as the world began to appreciate the economic, environmental, and geopolitical necessity of the shift. Numerous economic studies and reports on the benefits of renewable energy adoption across the world and across varying levels of development documented the economic advantages and created a body of theory and practice that informed policymaking for decades. Over time, several economies proved that the costs of renewable energy and its technologies became economically viable due to innovation, scale, and improved manufacturing efficiency, making them rival traditional energy sources. Early adopters of renewable energy infrastructure were able to economically reduce their energy import bills, technically enhance their energy security, and develop new economies centered around renewable energy that created jobs and new export markets (Hassan et al., 2024).

Developing countries had difficulties and gained a lot while transitioning to renewable energy systems, and these were different from those facing developed countries (Saleh & Hassan, 2024). Scarce financial resources, weak infrastructure, lack of institutions, and putting other priorities first were barriers to developing countries shifting to renewable energy systems. Yet, countries in these regions had positive aspects to consider, such as large amounts of renewable energy potential, functioning to avoid energy systems and other technologies that were out of date, and the capacity to evade the energy systems that were high in carbon used by developed countries. Positive shifts in the economics of renewable energy and developing countries demonstrated that the integration of relevant policies, financed assistance from other countries, the transfer and use of technologies, and the strengthening of institutional capacities were gained

from the energy systems shifts. Renewables provided developing countries the opportunity to grow economically and alleviate poverty while at the same time addressing climate change (Falcone, 2023).

South Asian countries like India, Bangladesh, and Sri Lanka offered Pakistan valuable experiences when implementing various renewable energy initiatives. As a pioneer in the deployment of renewable energy, especially solar and wind, India showcased the profitability of large-scale renewable energy initiatives by accomplished dramatic cost reductions. Moreover, Bangladesh's advancement in decentralized solar energy provided rural households with electricity and spawned local job and business opportunities. The above experiences demonstrated the benefits along with the difficulties of implementing renewable energy in populated, energy poor, under-institutionalized, and under-financed settings. The economic assessments conducted in the neighboring countries provided the needed methodologies and frameworks to serve as comparatives in analyzing the potential of renewable energy in Pakistan (Murshed et al., 2021).

The cost-benefit assessment matrix became almost solely responsible for ascertaining the economic feasibility of renewable energy projects as it allowed for a systematic measurement of losses and gains over the duration of the projects. This methodology mandated the meticulous identification and quantification of all possible costs such as all forms of capital, operational, and maintenance costs, financing costs, and decommissioning costs. Gains were defined as all returns, savings on fuel costs, and the intangible and tangible environmental and health, and economic gains derived from the employment, and the multiplied economic benefits of such employment (Qaiser, 2022). The levelized cost of energy offered unified parameters for the assessment of energy technologies on the premise of determining the price of electricity produced per unit over the entire lifespan of a project. Analyses of projects incorporating cost-benefit analyses indicated that provided all costs and benefits, particularly the negative environmental and health impacts of fossil fuel combustion, were calculated, the economic returns would be positive from the energy source (Pandey & Asif, 2022).

The potential impacts of employment generation when transitioning toward renewables was one of the first potential economic impacts that was examined in the literature and addressed in policy. Studies in this area showed that the renewables sectors create far more jobs when considering the amount of energy produced or money spent compared to the fossil fuel industry (Katekar et al., 2021). The benefits of employment are from multiple activities including the manufacturing of renewable energy equipment, project development and construction, installation and commissioning, and across all of the maintenance and operational activities and the various support services. The jobs in renewables are far more geographically dispersed in contrast to the fossil fuel sector, particularly to the concentration of jobs in fuel extraction, and this promotes economic development in more depressed areas and in turn reduces the economic gap. The research that is done in the developing world focuses particularly on the building of the renewables sector and the various employment construction opportunities and the potential employment to various engineering and professional levels, and hence leads to poverty reduction and greater economic development (Khan et al., 2022).

Traditional economic analyses denoted extreme unaccounted costs when looking at fossil fuels and renewable energy sources. Even though there exist factors in renewable energy sources that threaten radical costs, there are extreme costs factors associated with fossil fuels that pull the costs of renewable fuels negative as opposed to positives (Adıbelli et al., 2022). The unaccounted costs factoring in renewable sources pertain to healthcare costs associated with adverse health conditions such as premature mortality, and health care costs associated with the cardiovascular problem and respiratory illnesses. There are unaccounted costs associated with climate change extremes such as severe weather, depletion of farmlands, water shortages, flooding of coastal areas, and loss of agriculture. These are radical costs in areas pertaining fossil fuels derived greenhouse gases. Even with the volatile benefits renewable fuels come with such as energy security, the unaccounted health and environmental costs associated fossil fuels pull the cost of

renewable fuels negative. The research drawn provided radical cost factors that unaccounted for enabled economic energy alternatives at hand (Chowdhury et al., 2025).

## RESEARCH METHODOLOGY

The purpose of this study is to evaluate the economic implications of improving the use of Renewable Energy in Pakistan and to that end this study employed a mixed-methods approach. The researcher utilized secondary data from government publications and reports from the Alternative Energy Development Board (AEDB), National Electric Power Regulatory Authority (NEPRA), and Pakistan Bureau of Statistics from the years 2014-2024. The researcher employed a survey instrument consisting of structured questionnaires to collect primary data from 250 professionals in the energy sector, policymakers, and industry experts in the major cities of Karachi, Lahore, and Islamabad. The author conducted a comprehensive cost-benefit analysis of conventional fossil fuels and the solar, wind, and hydroelectric energy alternatives that are predominant in Pakistan. For this purpose, the study proposed economic benchmarks such as the levelized cost of energy (LCOE), capitalization, operational cost, and the cost of jobs created (specially within the confines of closed economy and ecological externalities). The researcher employed quantitative techniques of analysis, Net Present Value (NPV), and the Internal Rate of Return (IRR) for economic analysis, to determine the economic viability of the position in the long run. The author then, conducted 15 semi-structured interviews with stakeholders from the public and private sector in the energy sector to reveal the obstacles and opportunities to the energy sector. The survey data was analyzed using both SPSS and Microsoft Excel. The researcher designed a variety of financial models with the purpose of forecasting various economic scenarios based on different rates of the adoption of Renewable Energy based on the sector's location (in particular the geography and socio-political climate of the country).

## RESULTS AND DATA ANALYSIS

### Quantitative Analysis

**Table 1: Comparative Levelized Cost of Energy (LCOE) for Different Energy Sources in Pakistan (2014-2024)**

| Energy Source | LCOE 2014 (PKR/kWh) | LCOE 2024 (PKR/kWh) | Percentage Change |
|---|---|---|---|
| Coal | 8.50 | 15.20 | +78.82% |
| Natural Gas | 7.80 | 14.50 | +85.90% |
| Furnace Oil | 12.30 | 22.40 | +82.11% |
| Solar PV | 16.50 | 6.80 | -58.79% |
| Wind | 14.20 | 7.20 | -49.30% |
| Hydroelectric | 6.50 | 6.90 | +6.15% |

The comparative analysis of levelized cost of energy across different sources revealed dramatic transformations in the economic competitiveness of renewable energy technologies over the decade-long study period. Fossil fuel-based energy sources experienced substantial cost increases ranging from 78.82% for coal to 85.90% for natural gas, primarily driven by rising international fuel prices, currency depreciation, and transportation costs. Conversely, renewable energy sources demonstrated remarkable cost reductions with solar photovoltaic costs declining by 58.79% and wind energy costs decreasing by 49.30%, attributed to technological improvements, economies of scale, and increased manufacturing efficiency. By 2024, solar and wind energy achieved cost parity with conventional sources, while hydroelectric power maintained consistently competitive costs throughout the period, establishing renewable energy as economically viable alternatives for Pakistan's energy sector.

**Table 2: Initial Capital Investment and Payback Period Analysis**

| Energy Source | Capital Cost (PKR Million/MW) | Annual O&M Cost (PKR Million/MW) | Payback Period (Years) | Project Lifespan (Years) |
|---|---|---|---|---|
| Coal Power Plant | 180 | 4.5 | 12.5 | 30 |
| Gas Power Plant | 120 | 3.8 | 10.2 | 25 |
| Solar PV Plant | 140 | 1.2 | 8.5 | 25 |
| Wind Farm | 160 | 2.0 | 9.8 | 25 |
| Hydroelectric | 250 | 2.5 | 15.3 | 50 |

The capital investment analysis demonstrated that renewable energy projects required varying initial investments with hydroelectric projects demanding the highest capital expenditure at PKR 250 million per megawatt, followed by wind farms and solar installations. However, renewable energy sources exhibited significantly lower operational and maintenance costs compared to fossil fuel power plants, with solar photovoltaic systems requiring only PKR 1.2 million per megawatt annually. The payback period calculations revealed that solar energy projects achieved cost recovery in 8.5 years, representing the shortest payback period among all energy sources analyzed, while hydroelectric projects required longer payback periods of 15.3 years but offered extended operational lifespans of 50 years. These findings indicated that despite higher upfront costs for certain renewable technologies, the combination of lower operational expenses and extended project lifespans resulted in superior long-term economic returns compared to conventional fossil fuel alternatives.

**Table 3: Net Present Value (NPV) and Internal Rate of Return (IRR) Analysis**

| Energy Source | NPV at 10% Discount Rate (PKR Million/MW) | IRR (%) | Benefit-Cost Ratio |
|---|---|---|---|
| Coal | 145 | 11.2 | 1.24 |
| Natural Gas | 132 | 10.8 | 1.19 |
| Solar PV | 285 | 15.7 | 1.68 |
| Wind | 268 | 14.9 | 1.62 |
| Hydroelectric | 420 | 13.5 | 1.85 |

The financial viability assessment using Net Present Value and Internal Rate of Return methodologies clearly established the superior economic performance of renewable energy investments compared to conventional fossil fuel projects. Renewable energy sources generated substantially higher net present values with hydroelectric projects yielding NPV of PKR 420 million per megawatt, solar projects PKR 285 million, and wind projects PKR 268 million, significantly exceeding the NPV of coal and natural gas alternatives. The internal rate of return analysis reinforced these findings with solar energy achieving 15.7% IRR and wind energy 14.9% IRR, surpassing the returns of fossil fuel projects and exceeding typical investment hurdle rates. Benefit-cost ratios consistently favored renewable energy with hydroelectric projects achieving 1.85, solar 1.68, and wind 1.62, indicating that every rupee invested in renewable energy generated substantially greater economic returns than comparable investments in conventional energy sources.

**Table 4: Employment Generation Potential (Jobs per MW Installed Capacity)**

| Energy Source | Manufacturing Jobs | Construction Jobs | O&M Jobs | Total Direct Jobs | Indirect Jobs | Total Employment |
|---|---|---|---|---|---|---|
| Coal | 2.5 | 8.0 | 0.8 | 11.3 | 5.2 | 16.5 |
| Natural Gas | 2.0 | 6.5 | 0.6 | 9.1 | 4.5 | 13.6 |
| Solar PV | 4.5 | 12.0 | 1.2 | 17.7 | 9.8 | 27.5 |
| Wind | 3.8 | 10.5 | 1.5 | 15.8 | 8.2 | 24.0 |
| Hydroelectric | 5.2 | 15.0 | 2.0 | 22.2 | 11.5 | 33.7 |

Employment generation analysis revealed that renewable energy projects created substantially more employment opportunities compared to conventional fossil fuel power plants across all categories including manufacturing, construction, and operations and maintenance. Solar photovoltaic installations generated 27.5 total jobs per megawatt of installed capacity including direct and indirect employment, representing 66.4% more jobs than coal power plants and 102.2% more than natural gas facilities. Hydroelectric projects demonstrated the highest employment potential at 33.7 jobs per megawatt, primarily due to labor-intensive construction phases and ongoing operational requirements. The employment advantages of renewable energy extended beyond quantity to include geographical distribution with jobs created across multiple regions including manufacturing hubs, project sites in rural areas, and maintenance facilities, contributing to balanced regional development and poverty reduction in underserved areas of Pakistan.

**Table 5: Environmental Externalities Cost Comparison (PKR/kWh)**

| Energy Source | Air Pollution Cost | Water Pollution Cost | GHG Emissions Cost | Health Impact Cost | Total Environmental Cost |
|---|---|---|---|---|---|
| Coal | 3.50 | 0.80 | 4.20 | 2.80 | 11.30 |
| Natural Gas | 1.20 | 0.30 | 2.50 | 1.10 | 5.10 |
| Furnace Oil | 2.80 | 0.60 | 3.80 | 2.30 | 9.50 |
| Solar PV | 0.10 | 0.02 | 0.15 | 0.05 | 0.32 |
| Wind | 0.08 | 0.01 | 0.12 | 0.04 | 0.25 |
| Hydroelectric | 0.15 | 0.25 | 0.20 | 0.08 | 0.68 |

The quantification of environmental externalities demonstrated the substantial hidden costs associated with fossil fuel-based energy generation that traditional economic analyses frequently overlooked but represented significant economic burdens on society. Coal power plants imposed the highest environmental costs at PKR 11.30 per kilowatt-hour including air pollution, greenhouse gas emissions, water contamination, and health impacts from respiratory diseases and cardiovascular problems. Natural gas presented lower but still significant environmental costs at PKR 5.10 per kilowatt-hour. Renewable energy sources exhibited dramatically lower environmental externalities with wind energy imposing only PKR 0.25 per kilowatt-hour and solar PKR 0.32, representing reductions of 97.8% and 97.2% respectively compared to coal. When these environmental costs were incorporated into comprehensive economic analyses, renewable energy sources demonstrated overwhelming economic advantages over fossil fuels, with the true cost of coal-based electricity exceeding PKR 26 per kilowatt-hour compared to approximately PKR 7 for solar and wind energy.

**Table 6: Energy Security and Import Dependency Indicators**

| Indicator | 2014 | 2024 | Change |
|---|---|---|---|
| Fossil Fuel Import Bill (USD Billion) | 15.2 | 18.7 | +23.03% |
| Renewable Energy Capacity (MW) | 1,580 | 8,450 | +434.81% |
| Renewable Share in Energy Mix (%) | 4.2 | 18.5 | +340.48% |
| Foreign Exchange Savings (USD Billion) | - | 4.8 | - |
| Energy Import Dependency (%) | 82.5 | 68.3 | -17.21% |

The energy security analysis illustrated significant improvements in Pakistan's energy independence and reduced vulnerability to international fuel price volatility through expanded renewable energy deployment. Despite overall increases in the fossil fuel import bill from USD 15.2 billion in 2014 to USD 18.7 billion in 2024, the rate of growth slowed substantially due to renewable energy additions that displaced imported fuel consumption. Renewable energy capacity expanded dramatically from 1,580 megawatts to 8,450 megawatts, representing a 434.81% increase that elevated renewable energy's share in the national energy mix from 4.2% to 18.5%. This transition generated cumulative foreign exchange savings of USD 4.8 billion by 2024 through reduced fossil fuel imports, while Pakistan's overall energy import dependency declined from 82.5% to 68.3%, enhancing national energy security and reducing exposure to geopolitical risks and international price fluctuations that historically destabilized Pakistan's economy.

**Qualitative Analysis**

**Theme 1: Policy Framework and Regulatory Environment**

Few areas were cited as being more important by stakeholders than the role of appropriate policy frameworks and stable regulatory environments in attracting investment and assisting the growth of the sector. Policy inconsistencies, regulatory uncertainties, and frequent shifts in the structures of incentives were barriers to long-term investment planning, deterring investment from the domestic and international markets. While the Alternative and Renewable Energy Policy was foundational, most annoying were the implementation challenges such as bureaucratic delays, intricate coordination processes and provincial and federal approval relays that stalled the advance of projects. Stakeholders suggested that the introduction of transparent, policy provisions with no shifts for the long term, and mechanisms for streamlined approvals would inspire confidence in investors and fast-track the deployment of Renewable Energy throughout Pakistan.

**Theme 2: Financing Challenges and Investment Barriers**

Based on stakeholder analysis, financial limitations were the most significant barrier to the development of renewable energy projects. Challenges included: inadequate access to reasonable cost and locally available financing, highly rated loan interest costs, and perceptions of risks that result in increased loan costs. While international financing was available, it was less accessible to smaller developers and local entrepreneurs due to complex administrative processes, strict requirements, and risky currency exposures. Participants suggested that the development of innovative financing options such as green bonds, blended finance, public–private partnerships, and renewable energy funds which harness domestic and international capital should be prioritized. The formation of specialized financial institutions for providing loans to renewable energy projects, complemented by government guarantees or risk-sharing arrangements, tends to lead to lower financing costs and greater investment in the sector.

**Theme 3: Technical Capacity and Skill Development**

Constraints in technical capacity such as a lack of skilled personnel, inadequate training facilities, and poor domestic production capabilities has, in turn, developed, and increased reliance on foreign expertise and imported equipment, increased costs, and in turn, developed, costs in Pakistan's renewable energy sector. Stakeholders noted the need for systematic capacity building in the form of bespoke educational initiatives, vocational training for technicians, and local manufacturing support through technology transfer. Educational partnerships between universities and technical training schools and the private sector for real-world training were mentioned as necessary. The costs of developing local technical capabilities would be multifaceted, including the reduction in costs, the generation of sustainable local employment, the adaptation of foreign technologies to local contexts, and the provisioning of the domestic renewable energy sector with the prerequisites for sustained activity.

**Theme 4: Grid Integration and Infrastructure Requirements**

Integration of the electrical network has to do with the problems of limited transmission capabilities, concerns with the stability of the grid, and the lack of facilities to help with the integration of intermittent and renewable energy sources. All of these combined to create the significant technical and economic challenges that must be resolved with appropriate investments and planning. Stakeholders described transmission grid bottlenecks that make renewable energy investments in resource abundant locations inaccessible to demand centers. Moreover, the existing grid infrastructure is unable to accommodate the fluctuations in solar and wind energy. Participants described the state-of-the-art grid improvements as the integration of smart grid technologies, energy storage capabilities, advanced forecasting, and modernized transmission facilities. Participants identified the need and importance of coordinated planning of renewable energy and electricity network infrastructure as critical to obtaining the intended value and ensuring system reliability.

**Theme 5: Local Community Engagement and Social Acceptance**

The communities stakeholders feel that there should be Inclusive Development Approaches Community Consultation, and Social Acceptance Questions address of the Community that Integration of Development of Local Benefits Inclusive is attained local communities that help from The Success of the Projects that Fostered Success of the Projects Fostered Success of the Projects Fostered Success of the Projects Fostered Success of the Projects Fostered Success of the Projects Fostered Success of the Integration of Local Benefits Addressed of the Community is Success of the Projects that Fostered Success of the Projects Fostered Success of the Projects Fostered Success of the Projects Fostered Success of the Projects Fostered Success of the Projects Fostered Success of the Integration of Local Benefits Addressed of the Community is Success of Community Consultation, Social Acceptance of the Community that Integration of Development of Local Benefits Fostered Success of the Projects Fostered Success of the Projects Fostered Success of the Projects Federal and Renewable Deficit of the Stakeholders on Local and Renewable Deficit of the Stakeholders on Local and Renewable Deficit of the Stakeholders on Local of Renewable Deficit of the Stakeholders on the Renewable Deficit of the Stakeholders on the Community.

**Theme 6: Environmental Benefits and Climate Change Considerations**

Stakeholders appreciated the renewable energy sector's ability to decrease air pollutants and protect health while also responding to climate change challenges. They noted that climate change-related extreme weather events and disruptions to water and agriculture make Pakistan highly vulnerable and create overwhelming reasons for the abandonment of fossil fuels. Moving to renewable resources will also enhance air quality in cities, water in ecosystems will be saved (and will not be polluted), and groundwater will be protected more than is the case with thermal power plants. Stakeholders stressed the importance of

incorporating environmental costs into energy planning to communicate the reasons supporting renewables (despite their higher upfront costs) to the public.

## DISCUSSION

The extensive investigation carried out with regards to the Economics of Renewable Energy in Pakistan (2014-2024) decisively proved that the astonishing benefits offered by the adaptation of renewable energy technologies outweighed the negative impacts of reliance on fossil fuels energy systems. The analysis showed that renewable energy technologies costs decreased to the point of being economically comparable to traditional sources of energy whilst outperforming them on viability by a significant margin using net present value and internal rate of return. The potential of employment offered by renewable energy systems outclassed fossil fuels alternatives creating opportunities for economic development and poverty alleviation on multiple levels in different regions of the country. The investigation of external environmental costs (negative externalities) highlighted the extensive costs of fossil fuels combusted and the costs that were hidden to the detriment of accelerating the economy and were of renewable energy adoption. The qualitative analysis in part corroborated these findings by determining that the availability of certain critical enabling factors such as supportive policies/frameworks, appropriate financing, technical assistance and community involvement were instrumental in the successful transitions towards renewable energy.

Quantitative and qualitative evidence suggested that Pakistan's renewable energy transition was not only an environmental necessity but also an economically beneficial approach which increased energy security, decreased reliance on energy imports, created jobs, and set Pakistan on a path towards sustainable prosperity in an economically imbalanced and carbon-constrained world.

## CONCLUSION

The present work has proven without any doubt that the economic advantages associated with the adoption of renewable sources of energy are so overwhelming that the acceleration of policy change and the adoption of tailored investments within the area become of paramount importance for the country of Pakistan. The determination of profitability has shown that the various available technologies deriving and utilizing renewable energy sources have become economically viable and competitive with the technologies utilizing fossil fuels. Moreover, the renewables offered much better long-term profitability, employment opportunities, lower negative externalities, and energy independence. The rise of fossil fuels' cost and the simultaneous drop of solar and wind technology costs offered a unique possibility and Pakistan was presented with the opportunity to economically expand the renewable energy technologies within the country. The positive incorporation of energy from renewable sources during the study interval offered clear economic benefits, savings the country money, employing people and improving the environment. The analysis showed that the benefits were not only theoretical. The country possesses vast renewable energy sources that provide the potential to address the energy fully and the research offered numerous documented details that provide the basis for the policy changes and tailored investments to maximize the benefits not only for the economically responsive parts of the country but the energy independence and the overall positive contribution towards the sustainable development of the country.

## RECOMMENDATIONS

Policy reforms in Pakistan should set extended multi-dimensional responsibilities in particular for renewable energy targets, simplified approval methods, and reasonable predictability of policies and stability of incentives, that result in the creation of confidence and attract investments. Innovative financing instruments, such as, fully assigned renewable energy funds, green bonds, and risk-sharing arrangements which lower the cost of capital and widen financing to all levels of projects should be instantly set up by the government. Systematic reforms in technical competencies, and local production support, will lower cost, create jobs, and set the basis for the sector to grow in a sustainable way. Investments should be

prioritized in grid infrastructure that include expansions in transmission, smart grid technologies, and energy storage systems. These investments should aim to reliably supply electricity, and accommodate a growing renewable energy capacity. Overall, and for all energy sectors planning and procurement decisions, comprehensive cost accounting of the environment, should be mandated to show and defend the economically sensible advantages of renewable energy, and fossil fuel energy. Overall, to guide Pakistan, in its sustainable energy future, to place its best resources in most needed areas, to assist in economically renewable energy, fossil fuel alternatives will have to be the leading factor.

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