ADVANCE SOCIAL SCIENCE ARCHIVE JOURNAL
Available Online: https://assajournal.com
Vol. 5 No. 02 Apr-Jun 2026.Page#.516-532
Print ISSN: 3006-2497 Online ISSN: 3006-2500
Platform & Workflow by: Open Journal Systems
https://doi.org/10.5281/zenodo.20025519

Renewable Energy Policies and National Energy Security in Pakistan: An Empirical Analysis of Policy Effectiveness and Public Adoption

Hadia Jathol (Correspondent Author)
MS Scholar, Department of Politics & International Relations, GC Women University Sialkot, Pakistan
javaidhadia906@gmail.com

Abstract
This study evaluates Pakistan's renewable energy policies against international best practices, assesses socioeconomic and environmental impacts, and examines international cooperation, notably the China-Pakistan Economic Corridor. Despite abundant solar and wind potential, Pakistan faces severe energy insecurity due to fossil fuel dependence. The Alternative and Renewable Energy Policy targets a higher renewable share, yet implementation remains ineffective due to institutional fragmentation and weak public engagement. Using a mixed-methods approach in Punjab province, data from 410 participants (222 male, 188 female) via a Likert-scale questionnaire revealed high awareness of renewable energy but low adoption rates. The data were analyzed with the help of descriptive and inferential statistics. Key barriers include poor policy awareness, inaccessible government support, and high upfront costs. Nevertheless, public support for renewable investment is strong. Recommendations include simplifying net metering, establishing subsidized financing, and strengthening public-private partnerships through international cooperation to enable an inclusive and sustainable energy transition.

Keywords: *Pakistan, Policy, Renewable Energy, Punjab, Economy, Awareness***.**

Introduction

The world is shifting its paradigm from non-renewable sources to renewable sources of energy, which is essential for lowering greenhouse gases and mitigating climate change. Most nations are employing renewable sources of energy, such as solar, wind, and hydroelectric power. According to research, it has been reported that 29 percent of total electrical energy production in the world comes from renewable energy. Furthermore, it is predicted that this amount will be doubled in the coming years as many nations are setting ambitious goals (IRENA's 2020). This is the way to sustainability. However, when Pakistan moves forward with renewable energy, there are various barriers.

Getting the required finances is definitely not going to be an easy feat. Getting the required technology is going to prove to be equally difficult. It is important for Pakistan to resolve the issue of energy deficiency. The way forward here is to import even more fossil fuels. This will not only hurt the environment but also the exchequer. With more than 220 million people residing in Pakistan, meeting the energy needs is certainly no easy feat. Currently, Pakistan relies on imports of oil, gas, and coal for well over 60 percent of its energy needs. Unless it finds greener options, it will continue to rely on these sources of energy, which have been cited to cause problems associated with environmental degradation, energy security, and economic crises.

The importation of fuel cannot be sustained, and there is an urgent need for the country to explore other sources of energy in order to achieve a bright energy future (World Bank, 2021). The government of Pakistan proposes certain policies, among which is the Alternative and Renewable Energy Policy (AREP), which endeavors to enhance the proportion of renewable

energy up to 30 percent within 2030 (Government of Pakistan, 2019). Projects under the CPEC initiative will mainly focus on the production of renewable energy, including solar and wind energy. If strict actions are not taken, it would be hard for the country to reach its target on renewable energy use. Policy enforcement may become inconsistent. It is astonishing to note that even now Pakistan does not have specific policies promoting renewable energy use; yet they seem to be doing well.

Some of the most difficult things that make renewable energy projects difficult are high fossil fuel dependence, lack of well-organized institutional structures, and a lack of public understanding. For instance, AREP 2019 has received criticism due to poor organization and criteria for funding and the project implementation process (Al Yousif, 2020). Poor planning in AREP 2019 will pose great challenges to Pakistan's effort in developing better ways of financing the project or closing it down after completion. Moreover, socio-economic and environmental impacts of renewable energy projects have never been fully investigated in Pakistan. Even though positive effects such as employment creation and reduction in carbon emissions are anticipated, the impact of renewable energy projects in Pakistani society and environment has never been thoroughly analyzed.

Literature Review

Raza et al. (2019), a review of renewable energy policies in Pakistan has shown a certain range of noise and challenges. Important policies were analyzed, for example, as the Alternative and Renewable Energy Policy (AREP) 2019 and their consequences effects on renewable energy development. The states that while there have been modest achievements in Pakistan, much remains. Thus, the policy inconsistencies, non-existence of enforcement mechanisms, and insufficient funding as some of the challenges. Absence of long-term vision according to the authors on the renewable energy development quite cripples the existing policies. Furthermore, implementation bottlenecks are created by the lack of coordination between federal and provincial governments for that matter. To establish a long-term renewable energy vision with clear targets and timelines; among them suggest improvement in coordination between federal and provincial governments and increasing funding for renewable energy projects.

Khan and Pervaiz (2013) perform a technological review of renewable energy sources in Pakistan including solar, wind and hydropower technologies. with the aim power sources of these technologies to solve the energy crisis in Pakistan and how technology transfer and innovation would help the progress of a renewable energy movement. These advancements should include awareness of the technological barriers, such as: lack of access to advanced technologies and limited technical expertise, high cost of these renewable technologies, lack of local manufacturing capabilities; and absence in R&D investment, all of these limit innovations in renewable energy. promote technology transfer and invest in local manufacturing capabilities to reduce costs. For increasing R&D funding to encourage innovation and develop indigenous renewable energy technologies.

Malik and Mahmood (2015) investigate the current conditions and tendencies regarding renewable energy in Pakistan, portraying on-the-ground developments such as solar, wind, and hydropower projects and showcasing the role of government policies in such progressions. Such challenges would include the lack of public awareness, meager funding, and bureaucracy. The absence of a clear framework of regulation and incentives for renewable energy adoption slowed down progress. Awareness raising for the public and financial incentives has been put in place to increase the use of renewable energy. Streamlining all the bureaucratic processes will pave the way for executing renewable energy projects easily.

Arif et al. (2017) explore Pakistan's renewable energy industry has numerous potentialities and hurdles. The harnessing of solar and wind energy can result in supplying energy demands for the country while reducing carbon emissions. Include key challenges like absence of technical know-how, high initial costs, and poor policy support. Non-provision of a long-term energy strategy has hampered the growth of renewable energies, creating a long-term energy strategy that is targeted, has clear aims, and fixed timelines. Provision of technical training and financing support to mitigate barriers to renewable energy uptake.

Zaidi and Mirza (2016) analyze the effect of renewable and non-renewable energy consumption on the economic growth of Pakistan. The consumption of renewable energy was found to have a positive impact on the economic growth and thus recommends an increase in proportionate share of renewable energy in the energy mix. The identification of challenges such as no investment, obsolescence of the existing infrastructure, and inadequate policy support. High cost of renewable energy technologies is the primary challenge to its adoption. Invest more in renewable energy infrastructure and put financial incentives in place to offset the cost of renewable energy technologies. Develop a clear policy framework geared towards supporting the renewable energy initiative.

Akhtar and Sharma (2018) have been investigating all facets with strengths and weaknesses of renewable energy policies in Pakistan. They assess into the potential of solar and wind energy in alleviating energy crisis and base load shortage for the development of the Indian economy. Lack of enforcement mechanisms, insufficient bureaucratic and funding hurdles, are mentions of the weaknesses here. Not having a long-term vision for renewable energy development has affected the existing policy framework. Development of a long-term vision for renewable energy development with sharply defined targets and timelines. Improve governance and increase funds towards renewable energy projects.

Qureshi and Rasli (2015) analyzed energy crisis in Pakistan and how renewables could turn it around. The authors identify the extensions of solar, wind, and hydropower for energy demand within the country. Challenges such as lack of investment, poor infrastructure, and deficient policy support have been identified. With this, the authors also lament that the abstract absence of a clear pricing mechanism for renewable energy discourages investment, the establishment of an explicit pricing mechanism and increases investment in renewable energy infrastructures. Provide financial incentives to attract private sector participation.

Ahmed and Azam (2016) discussed the renewable energy opportunities and challenges faced by the country of Pakistan. The opportunity for the development of solar energy and wind energy for meeting the energy requirements, besides controlling carbon emissions, has been highlighted. Lack of infrastructure, lack of technical know-how, and high investment costs are a few of the challenges faced by the country. The lack of institutional support, the absence of a long-term energy policy, has also resulted in the non-development of renewable energy resources. According to the authors, it is important to develop a long-term energy policy with specific goals, objectives, technical, and financial support for removing the barriers to the development of renewable energy resources.

Conceptual Framework

Renewable Energy Development and Sustainable Outcomes in Punjab

INDEPENDENT VARIABLES		DEPENDENT VARIABLES
• Government Policies (AREP 2019, Net Metering) • Institutional Support (AEDB, NEPRA, DISCOs) • Policy Implementation (Approval Processes, Tariff Mechanisms) • Financial Mechanisms (Subsidies, Green Financing) • International Cooperation (CPEC, Technology Transfer)		• Renewable Energy Adoption (Household Solar, Net Metering) • Energy Security (Reduced Load Shedding, Grid Stability) • SDG Achievement (SDG 7, SDG 8, SDG 13) • Socio-Economic Benefits (Job Creation, Poverty Reduction) • • Environmental Sustainability (Carbon Reduction, Climate Resilience)

MODERATING VARIABLES

Public Awareness	**Governance Coordination**	**Infrastructure Readiness**
Socio-Cultural Factors	**Economic Condition**	

Hypotheses

H_1: Government policies have a positive Relationship on renewable energy adoption in Punjab, Pakistan.

H_2: Institutional support helps in the accessibility of renewable energy technologies in Punjab.

H_3: Good policy implementation helps in strengthening the relationship between government policies and renewable energy.

H_4: Financial mechanisms provide opportunities to facilitate investment in renewable energy.

H_5: Public awareness helps in moderating the relationship between government policies and renewable energy adoption.

H_6: International cooperation has a positive influence on renewable energy in Punjab.

H_7: Renewable energy adoption helps in achieving energy security and sustainable development

Material and Methods

The research was a mixed-methods approach by developing exploratory, descriptive and analytical was used to generalize the results. The population in this research includes people in the province of Punjab in Pakistan; these people include students, employed people, self-employed people, and unemployed people, focusing on people aged 18-60 years from both cities and villages in order to know their knowledge and experiences regarding initiatives in renewable energy schemes, government policies, and sustainable development schemes. The target population includes people in the province of Punjab in Pakistan; there is no restriction in terms of cities and districts in selecting people in this research. The study's minimum sample size, as determined by the Cochran Bach Formula, was 384 with a 95% confidence level; nonetheless. The target population includes people living in the Punjab province of Pakistan and ranging in age from 18 to 60 years. This includes students, employed professionals, self-employed people, and unemployed people who are directly or indirectly impacted by government policies regarding renewable energy and sustainable development. Convenience sampling is a non-probability sampling method used in data collection from respondents regarding the subject of this investigation. This method is considered suitable due to time constraints and a large

population spread across a wide area of the province of Punjab. A total of 410 people in the range of 18 to 60 years of age were included in the survey from different regions of the province of Punjab.

To collect data, a set of questions were given in the form of a questionnaire consisting of various statements related to awareness, perceptions, and attitudes regarding renewable energy and SDGs. Considering the nature of the questions in the questionnaire, a Likert scale was used in which the values were as follows: SA - Strongly Agree - 5; A - Agree - 4; N - Neutral - 3; DA - Disagree - 2; and SDA - Strongly Disagree - 1. There was a total of 22 questions in the questionnaire related to demographic information, awareness of SDGs and renewable energy, policy information and accessibility, perceptions and attitudes, and barriers and challenges.

The reliability of a research tool is crucial for improving the quality of the study. The same is true for validity, which is crucial when choosing one of the four categories of research tools: construct, criteria, predictive, and content. Expert opinion typically determines both face validity and content validity. The initial version of the instrument was created with the study's requirements in mind. In the second stage, the questionnaire's items were combined and a plain form was created. The committee, which included the following specialists, the face and content validity were got checked by a committee of experts consisting:

- Head of the department of Politics and International Relations, GC Women University Sialkot
- Assistant Professor, Department of Politics and International Relations
- Assistant Professor Department of English

A team of specialists from Government College Women University Sialkot's English Department verified the language of these instruments.

Table 1

Case processing summary

	N	**%**
Cases valid	410	100.0
Excluded	0	.0
Total	410	100.0

Table 2

Reliability statistics

Cronbach's Alpha	**No of items**
.701	16

Two techniques were employed to examine the questionnaires of the desired sample size. Descriptive statistics were computed for individual statements in the questionnaires, which include frequencies, mean, and standard deviations. Additionally, arithmetic mean and standard deviation were computed for the intended sample size by examining the questionnaires of the respondents to assess the level of Punjab's renewable energy awareness, adoption, and perception.

The minimum level of awareness, which was assessed in this analysis, was fixed at "3." Awareness level of individual respondents with regard to renewable energy was found to be low if their mean was below "3." On the other hand, individual respondents' scores were computed and ordered to determine their arithmetic mean and standard deviation in the questionnaire-wise analysis. For Yes/No type questions, frequencies and percentage were analyzed.

With a focus on governmental policies and practices on renewable energies in Punjab, Pakistan, the questionnaire-wise analysis of the respondents to determine the levels of awareness, adoption, and perception of Punjab on the topic of renewable energies.

Results and Discussion

Table 3

Gender

	F	%	Mean	SD
Male	222	54.1	1.46	.499
Female	188	45.9		
Total	410	100.0		

From Table 3, the number of male respondents is 222, accounting for 54.1%, while the number of female respondents is 188, accounting for 45.9%. The mean score is 1.46, and the standard deviation is 0.499, where Male = 1 and Female = 2. The results indicate that the mean is closer to 1 because there is a slight majority of males compared to females. The balanced representation of both genders is a clear indication that the results obtained are generalizable, as both male and female perspectives are adequately represented. The slight majority of males compared to females is only 8.2 percentage points, and this is a clear indication that there is no significant gender-based bias that may affect the results obtained, and this means that meaningful insights can be obtained across gender lines regarding attitudes towards the adoption of renewable energy, awareness of policies, and other variables.

Table 4

Education Level

	F	%	Mean	SD
Undergraduate	121	29.5	1.89	.687
Graduate	212	51.7		
Post Graduate	77	18.8		
Total	410	100.0		

As presented in Table 4, Majority of the respondents had attained Graduate level education (51.7%), while 29.5% were Undergraduates, and the remaining 18.8% were Post Graduates. On a scale of 1 to 3 where 1 represented an undergraduate, 2 a graduate, and 3 a post-graduate education, the mean value was 1.89, putting an average respondent between Undergraduate and Graduate levels of education, with a standard deviation of 0.687. Together, 81.2% had attained a Graduate level of education or lower, whereas just 18.8% had post-Graduate level education. A relatively higher level of education among the respondents (majority having attained at least a Bachelor's degree) is suitable for a renewable energy study.

Table 5

Region

	F	%	Mean	SD
Punjab	410	100.0	1.00	.000
Total	410	100.0		

As depicted in Table 5, The average value for all 410 respondents is 1.00, and the standard deviation is 0.000; thus, there are no differences in perception between regions since all respondents were from the region of Punjab. This means that the results obtained in this research are applicable only to Punjab, since there might be significant differences among other provinces regarding perceptions on renewable energy adoption and the problems faced while adopting such technologies. In this regard, further research needs to cover the residents of other regions like Sindh, Khyber Pakhtunkhwa, Baluchistan, and others.

Table 6
Place of Residence

	F	%	Mean	SD
Rural	149	36.3	1.64	.482
Urban	261	63.7		
Total	410	100.0		

From Table 6, As the sample is mainly urban (63.7%), with just 36.3% being rural, the average score is 1.64 on the scale of 1 for Rural to 2 for Urban (with SD = 0.482). The excess of urban residents by 27.4% means that the results would mainly be biased by the opinions of the urban population due to their higher level of grid accessibility, awareness, and financial capabilities.

Table 7
Age

	F	%	Mean	SD
18-22 years	111	27.1	1.84	.656
23-27 years	266	64.9		
28-32 years	19	4.6		
32-Above	14	3.4		
Total	410	100.0		

As can be seen from Table 7, The sample heavily consists of young people, as 92% of them are less than or equal to 27 years old, with an average age category of 1.84 and standard deviation of 0.656; their age groups range mostly from 23-27 and 18-22 years, whereas only 8% are more than 28 years old. Therefore, the conclusions of this study can be applied to the youth population of Punjab only.

Table 8
Occupation

	F	%	Mean	SD
Academic/ Researcher	56	13.7	2.36	.809
Private Sector Representative	183	44.6		
Student	140	34.1		
Legal Expert	31	7.6		
Total	410	100.0		

As presented in Table 8, The sample is heavily concentrated on Private Sector Representatives (44.6%) and Students (34.1%). The other sub-groups include 13.7% Academics/Researchers and only 7.6% Legal Professionals. Such an unequal distribution means that the results of this study may be skewed to a market-minded generation and those who care about environmental issues, but not about legal and administrative matters.

Table 9
Familiar with the SDGs

	F	%	Mean	SD
Yes	410	100.0	1.00	.000
No	0	0.00		
Total	410	100.0		

As shown in Table 9, The awareness of the SDGs is 100%, as all 410 respondents (100%) knew about the SDGs, resulting in a consistent average score of 1.00 with a standard deviation of 0.000. Such consistency is associated with the well-educated participants (81.2% had at least Graduate degrees) and a large number of participants representing the private sector, students, and

academics. Although the presence of the awareness will help us to conclude that our respondents have enough knowledge about sustainable development issues, we may identify it as a limitation since it will prevent the assessment of how the awareness influences views on renewables' adoption in any way.

Table 10

Concept of "RE"

	F	%	Mean	SD
Yes	410	100.0	1.44	.497
No	0	0.00		
Total	410	100.0		

As shown in Table 10, Awareness of renewable energy was 100% across all 410 participants, resulting in an identical mean score of 1.00 and standard deviation of 0.000—this is a given for the highly educated sample, containing many Private Sector Representatives and Students, as well as a relatively young group (92% under the age of 27). Total awareness of this concept allows one to assume that the respondent knows enough to respond correctly to other questions, yet no variance within the data prevents us from studying the effect of awareness on attitudes or adoption. It should be noted that despite this awareness, only 56.1% adopted the concept.

Table 11

Use any form of renewable energy

	F	%	Mean	SD	
Yes	230	56.1	1.79	.411	
No	180	43.9			
Total	410	100.0			

Table 11 shows Notwithstanding the 100 percent awareness about renewable energy, merely 56.1 percent of households have adopted these technologies (mean = 1.44, SD = 0.497). This rate of 43.9 percent non-adopters reflects the key challenges as reported by respondents; 68.5 percent agreed that the high price involved is a challenge, 67.3 percent felt that government support is not within reach, while 30.7 percent pointed out cost or financing as being the greatest challenge. This is surprising in view of the fact that 88.1 percent of respondents strongly favored investment in renewable energy.

Table 12

Family employed in the renewable energy sector

	F	%	Mean	SD
Yes	88	21.5	1.31	.463
No	322	78.5		
Total	410	100.0		

As presented in able 12, A substantial majority (78.5%) did not have any kinship ties or community relations working in the field of renewable energy (mean = 1.79, SD = 0.411). The lack of direct interaction with professionals in this field can be seen as a contributing factor to the awareness-implementation gap (100% awareness, yet only 56.1% implementation), which coincides with poor knowledge of policies (39.0%) and poor participation in awareness meetings (19.8%).

Table 13

Fossil fuels (oil, gas) as major threat to national energy security

	F	%	Mean	SD
Yes	283	69.0	1.61	.488
No	127	31.0		
Total	410	100.0		

From the data presented in Table 13, Almost seventy percent of the respondents (69.0%) perceived Pakistan's reliance on fuel imports as a significant threat to energy security (mean 1.31, SD 0.463), which is in agreement with 88.1% agreeing for investing in renewable energy with financial constraints being considered as significant barriers. Although the majority perceive that reliance on fuel imports is a threat and they are advocating for renewable energy sources, still thirty-one percent did not perceive this as a threat.

Table 14

Government RE policies or initiative

	F	%	Mean	SD
Yes	160	39.0	1.18	.391
No	250	61.0		
Total	410	100.0		

Moreover, able 14 indicates Majority of respondents (61.0%) were not aware of the government's policies such as AREP 2019 and net metering, while 39.0% were aware (M = 1.61, SD = 0.488). Such a huge difference in policy awareness despite 100% awareness regarding renewable energy implies that people cannot benefit from financial and net metering incentives, which is consistent with previous studies showing that 67.3% find government support unattainable, 80.2% did not attend any awareness seminars, 68.5% feel that lack of awareness is a big barrier, and 26.1% consider inefficient policy implementation as the biggest obstacle.

Table 15

Anyone applied for a government scheme for RE

	F	%	Mean	SD
Yes	77	18.8	1.67	.470
No	333	81.2		
Total	410	100.0		

The results presented in Table 15 indicate that a huge percentage of 81.2% did not have any idea on how to apply for government funding or loan programs for renewable energy projects (M = 1.81; SD = 0.389), while 18.8% knew how to do so. These results indicate that the lack of utilization of renewable energy financing is consistent with previous studies that show that 61.0% have no knowledge about government policies, 67.3% have difficulty accessing such financial sources, 68.5% strongly agree that cost is a key barrier, and 30.7% consider financial issues as the greatest barrier.

Table 16

Government support for renewable energy

	F	%	Mean	SD
Yes	134	32.7	1.80	.399
No	276	67.3		
Total	410	100.0		

The results presented in Table 16 indicate that more than two-thirds (67.3%) feel that governmental support to the renewable energy industry is out of reach (mean = 1.67, SD = 0.470). These results corroborate previous findings that indicated that 61.0% of the respondents

are unaware of any government policies, 81.2% never made use of any government schemes, and 80.2% never participated in any awareness seminars. It becomes apparent that there is a significant mismatch between policy provision and its accessibility.

Table 17

Participated in any Government or NGO-led awareness session

	F	%	Mean	SD
Yes	81	19.8	3.02	.939
No	329	80.2		
Total	410	100.0		

From Table 17, An overwhelming majority (80.2%) had never attended any awareness campaign organized by the government or NGOs regarding renewable energy (mean = 1.80, SD = 0.399). This is due to the recurring trend from the data where 61.0% are unaware of the existing policies, 81.2% had never applied for any of the schemes, and 68.5% view public awareness as a significant barrier. This clearly demonstrates why there is a lack of knowledge concerning the government initiatives (67.3% view these as non-accessible) and scheme application rates.

Table 18

Prefer to get my electricity from renewable sources

	F	%	Mean	SD
Strongly Disagree	47	11.5	3.02	.939
Disagree	36	8.8		
Neutral	190	46.3		
Agree	137	33.4		
Strongly agree	0.00	0.00		
Total	410	100.0		

The respondents displayed limited readiness to incur higher costs for renewable energy (mean 3.02 out of 5, SD 0.939), with 46.3% being neutral, 33.4% agreeing, 20.3% disagreeing, and zero percent strongly agreeing. This shows that although there is overall support, price sensitivity is a crucial issue.

Table 19

Limited public awareness are the biggest hurdles in Pakistan

	F	%	Mean	SD
Strongly Disagree	30	7.3	4.16	1.327
Disagree	27	6.6		
Neutral	72	17.6		
Agree	0	0.00		
Strongly agree	281	68.5		
Total	410	100.0		

As depicted in Table 19, there is a strong agreement (Mean = 4.16, SD = 1.327) that lack of awareness and initial investment are the major challenges hindering the adoption of renewable energy in Pakistan with the percentage agreement amounting to 68.5%. The current observation corroborates with the earlier results which have indicated 100% general awareness, but very little awareness in terms of policies (39.0%), awareness sessions (19.8%), accessibility of government incentives (67.3%), and involvement in financial schemes (81.2% have never applied).

Table 20

Government policies for the renewable energy

	F	%	Mean	SD
Strongly Disagree	24	5.9	3.46	1.047
Disagree	47	11.5		
Neutral	108	26.3		
Agree	177	43.2		
Strongly agree	54	13.2		
Total	410	100.0		

There is a strong level of agreement from respondents (mean 3.46, SD 1.047) regarding the poor implementation and promotion of government renewable energy policies despite the fact that they are well-conceived, with 56.4 percent in agreement and just 17.4 percent disagreeing. Indeed, this is reflected in previous results, where 39 percent were aware of policies, 67.3 percent reported difficulty in accessing support, and 80.2 percent never attended awareness programs.

Table 21

Get approval for a home solar system (Net Metering) is too complex

	F	%	Mean	SD
Strongly Disagree	29	7.1	3.20	.904
Disagree	47	11.5		
Neutral	146	35.6		
Agree	188	45.9		
Strongly agree	0	0.00		
Total	410	100.0		

Table 21 demonstrates that Almost half (45.9%) of the respondents felt that the procedure for approving the installation of net meters was complicated and time-consuming (mean = 3.20; SD = 0.904), without any respondent strongly agreeing with this statement, showing that there is some bureaucratic burden but not excessively high. This corresponds to previous research showing that almost two-thirds (67.3%) of the population felt that government assistance was unavailable.

Table 22

Prioritize investing in renewable energy infrastructure over new fossil fuel projects

	F	%	Mean	SD
Strongly Disagree	22	5.4	4.47	1.013
Disagree	0	0.00		
Neutral	27	6.6		
Agree	77	18.8		
Strongly agree	284	69.3		
Total	410	100.0		

The results displayed in Table 22 indicate a massive endorsement of investing in renewable energy infrastructure compared to fossil fuels (mean 4.47, SD 1.013), where 69.3% of the participants strongly agreed while an additional 18.8% agreed, amounting to 88.1% agreement overall. The number of participants who strongly disagreed was 5.4%, while no one selected "Disagree". Such unanimity is consistent with previous findings indicating that 69.0% of the participants perceive importing fossil fuels as a threat to energy security, while 68.5% regard lack

of awareness and cost as key barriers. All respondents are aware of renewable energy technologies.

Table 23

Public-private partnerships boost development

	F	%	Mean	SD
Strongly Disagree	23	5.6	4.08	1.274
Disagree	24	5.9		
Neutral	107	26.1		
Agree	0	0.00		
Strongly agree	256	62.4		
Total	410	100.0		

As Table 23 depicts, there is wide and polarized agreement in favor of public-private partnership initiatives, such as those related to CPEC, as facilitators in the adoption of renewables (average rating of 4.08 on the 5-point scale; standard deviation: 1.274). Specifically, the proportion of respondents who "Strongly agree" with this notion stands at 62.4%, while no one has merely "Agreed;" 26.1% are neutral, whereas only 11.5% disagree.

Table 24

Biggest challenge

	F	%	Mean	SD
Lack of government policy implementation	107	26.1	2.43	1.135
High initial cost and financing issues	126	30.7		
Unreliable grid infrastructure	71	17.3		
Lack of public awareness and technical skills	106	25.9		
Total	410	100.0		

As seen in Table 24, the highest factor responsible for inhibiting the use of renewable energy in Pakistan is high initial cost/financing issues (30.7%), closely followed by lack of implementation of government policy (26.1%), lack of awareness/skills (25.9%) whereas unreliability of the infrastructure grid is the fourth highest factor (17.3%). Half of the respondents have either identified financial issues (23.1%) or lack of implementation of policy (33.7%) as the highest challenge to renewable energy. This is evidenced by a mean value of 2.43 with SD of 1.135 with an almost equal distribution among the top three factors. It must be noted that these responses closely mirror previous survey data: 68.5% strongly agree that awareness and high costs are significant barriers to using renewable energy (Table 20), 67.3% believe government support is difficult to access (Table 17), and 56.4% those policies are poorly implemented (Table 21).

Table 25

One-Sample Statistics

	N	Mean	SD	S. Error Mean
REAAPP	410	1.3201	.22617	.01117
GPAS	410	1.5488	.32339	.01597
PPORET	410	3.6390	.67862	.03351
GPAC	410	3.5504	.78306	.03867

Table 26

One-Sample Test

	Test Value = 3					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
REAAPP	-150.396	409	.000	-1.67988	-1.7018	-1.6579
GPAS	-90.865	409	.000	-1.45122	-1.4826	-1.4198
PPORET	19.067	409	.000	.63902	.5731	.7049
GPAC	14.232	409	.000	.55041	.4744	.6264

A one-sample t-test was performed to compare each composite variable against a test score of 3 (a neutral response on a 5-point Likert scale or the midpoint of binary coded variables). There were statistically significant differences found for all four variables (all $p < .001$); REAAPP (Section B: Awareness and Personal Practice) = 1.32 (t (409) = -150.40); GPAS (Section C: Government Policies and Support) = 1.55 (t (409) = -90.87); PPORET (Section D: Public Perspective) = 3.64 (t (409) = 19.07); GPAC (Section E: Government Practices and Challenges) = 3.55 (t (409) = 14.23). That means people lack awareness and personal adoption of renewable energy based on the overwhelming number of respondents below the neutral marker of a mean of 3. People were also unfamiliar with and unable to access government renewable energy initiatives based on the overwhelming number of respondents below the neutral marker again of a mean of 3.

However, a moderately positive public perception of the transition to renewable energy is suggested based on the significant number of people above the neutral marker of 3 for both PPORET and GPAC variables; while supporting stronger government intervention and cooperation with the private sector, respondents tend to agree on the existence of procedural barriers to greater adoption of renewable energy (e.g., complicated approval process for net metering). Overall, awareness and access to government policy are significantly low; however, both public perception and public support of changing public policy towards more renewable energy options is cautiously positive.

Conclusion

The transition to renewable energy sources in Pakistan does not suffer from technical or financial feasibility issues, but is rather constrained by institutional, political, and socio-economic impediments, despite the existence of high levels of public awareness and enthusiasm, which act as good building blocks. In order for this change to take place, the government has to streamline the bureaucratic processes, particularly net-metering approval processes, ensure that assistance programs become easier to access, increase public education efforts, and incentivize transparent public-private collaboration initiatives. At the same time, energy justice should be promoted in all decision-making processes.

Recommendations

Address awareness-adoption gap through initiating a Niche-to-Mainstream campaign which involves documenting and replicating successful off-grid solar and micro-hydel projects, shifting awareness campaigns to be more educational in nature, and harnessing community leaders, religious organizations, and schools in spreading such practical knowledge.

Improve policy communication by establishing a Renewable Energy Policy Outreach Unit within the ambit of AEDB, independent of any fossil-fuel interest, which would undertake to distribute simplified policy information (infographics, videos, SMS, and radio/television broadcasts in indigenous languages), as well as an overarching Renewable Energy Coordination Council.

Facilitate financing by setting up a Renewable Energy Financing Facility which provides concessional loans (through banks and micro-finance institutions) with easy application processes, minimal collateral, and flexible repayment conditions, along with promotion of pay-as-you-go, leasing options, and community-owned solar projects, particularly targeting subsidies towards rural, poor, and women-headed households with CPEC funds.

Address institutional challenges through the establishment of a legally binding one-stop center for approvals with set timelines, an online portal for monitoring project progress and standardized reports, and standardized and investible Power Purchase Agreements, alongside the establishment of an overarching Renewable Energy Coordination Council.

Develop two-way flow modernized grid by investing in smart grid technologies and energy storage, along with establishing a predictable market by conducting auctions for renewable energy projects and requiring DISCOs to upgrade their infrastructure via net metering processing time mandates.

Implement energy justice in practice by ensuring that communities hosting energy systems benefit from them, including through ownership of projects, shared revenues, rate reductions, participation through FPIC process and grievance mechanisms; while also taking into consideration the needs of women, minorities and pastoralist communities during planning process and workforce programs.

Enhance the innovation system by setting up a fund for renewable energy research and innovation, an entrepreneur's incubator, green banking practices/lending departments as well as offering incentives for local production of solar cells and inverters, while simultaneously countering fossil fuel narrative with evidence-based communications strategy.

Use the power of public-private partnerships in developing renewables by redirecting CPEC towards renewable energy sources and technology transfer, involving World Bank, ADB and South-South cooperation partners in projects, and doing all PPPs in a transparent manner.

References

Ahmed, M., & Azam, M. (2016). Renewable energy in Pakistan: Opportunities and challenges. *Renewable and Sustainable Energy Reviews, 64*, 1–10.

Ahmed, N. (2022). *Digital governance for the energy sector: Lessons for Pakistan*. Pakistan Institute of Development Economics. https://www.pide.org.pk/research/digital-governance-for-the-energy-sector-lessons-for-pakistan/

Akhtar, R., & Sarmah, A. K. (2018). Renewable energy in Pakistan: Policy strengths, weaknesses, and the way forward. *Energy Strategy Reviews, 22*, 1–10.

Al Yousif, M. A. (2020). Renewable energy challenges and opportunities in the Kingdom of Saudi Arabia. *International Journal of Economics and Finance*, *12*(9), 1.

Ali, S., & Badshah, L. (2021). Social license to operate: A study of community acceptance of wind energy projects in Jhimpir, Pakistan. *Energy Research & Social Science, 71*, 101834. https://doi.org/10.1016/j.erss.2020.101834

Arif, W., Dilshad, R. M., & Khan, H. M. A. (2026). Solar-Powered Supercapacitor Systems for Sustainable Energy Storage. *Research Consortium Archive*, *4*(2), 222-231.

Alternative Energy Development Board. (2006). *Policy for development of renewable energy for power generation*. Government of Pakistan.

Asif, M. (2009). Sustainable energy options for Pakistan: Opportunities and challenges. *Energy Policy, 37*(1), 55–62. https://doi.org/10.1016/j.enpol.2008.08.019

Bergek, A., Jacobsson, S., Carlsson, B., Lindmark, S., & Rickne, A. (2008). Analyzing the functional dynamics of technological innovation systems: A scheme of analysis. *Research Policy, 37*(3), 407–429. https://doi.org/10.1016/j.respol.2007.12.003

Bhutto, A. W., Bazmi, A. A., & Zahedi, G. (2012). Sustainable energy options for Pakistan. *Renewable and Sustainable Energy Reviews, 16*(6), 3347–3362.
Cheema, A. R., & Malik, M. N. (2021). Data for development: Challenges of SDG localization and monitoring in Pakistan. *Sustainable Development, 29*(5), 851-860.
China-Pakistan Economic Corridor (CPEC). (2022). *Energy projects under CPEC*. CPEC Authority. https://cpec.gov.pk/energy
Geels, F. W. (2002). Technological transitions as evolutionary reconfiguration processes: A multi-level perspective and a case-study. *Research Policy, 31*(8-9), 1257–1274.
Geels, F. W. (2011). The multi-level perspective on sustainability transitions: Responses to seven criticisms. *Environmental Innovation and Societal Transitions, 1*(1), 24–40. https://doi.org/10.1016/j.eist.2011.02.002
Government of Pakistan. (2019). *Alternative and renewable energy policy (AREP) 2019*. Ministry of Energy (Power Division). https://www.aedb.org/
Hassan, A. (2022). Provincial energy governance in Pakistan's federal system. *Journal of Energy & Development, 45*(2), 89–104.
Hassan, A., & Qamar, S. (2021). *Energy governance in Pakistan: A post-18th amendment analysis*. Institute of Regional Studies.
Howlett, M. (2019). *Designing public policies: Principles and instruments* (2nd ed.). Routledge.
Hussain, A. (2022). *The impact of currency devaluation on Pakistan's power sector*. Institute of Policy Studies. https://www.ips.org.pk/
Hussain, I. (2023). *Macroeconomic vulnerabilities and the power sector* [Conference presentation]. Sustainable Development Policy Institute (SDPI) Conference, Islamabad, Pakistan.
International Monetary Fund. (2023). *Pakistan: 2023 Article IV consultation—Press release; Staff report; and Statement by the Executive Director for Pakistan* (IMF Country Report No. 2023/001).
International Renewable Energy Agency. (2020). *Decentralized renewable energy: Opportunities for energy access and sustainable development*.
IRNA. (2020). *Renewable energy prospects for Pakistan*. International Renewable Energy Agency.
IRNA. (2021). *Renewable energy and jobs: Annual review 2021*. International Renewable Energy Agency.
Jann, W., & Wegrich, K. (2007). Theories of the policy cycle. In F. Fischer, G. J. Miller, & M. S. Sidney (Eds.), *Handbook of public policy analysis: Theory, politics, and methods* (pp. 43-62). CRC Press.
Jenkins, K., McCauley, D., Heffron, R., Stephan, H., & Rehner, R. (2016). Energy justice: A conceptual review. *Energy Research & Social Science, 11*, 174–182.
Khan, H. (2021). *Institutional challenges in Pakistan's renewable energy sector* (SDPI Working Paper No. W-251). Sustainable Development Policy Institute.
Khan, H. A., & Ahmed, I. (2017). Renewable energy transition in Pakistan: A policy analysis. *Energy for Sustainable Development*, 38, 70-76.
Khan, H. A., & Pervaiz, S. (2015). Technological review of solar photovoltaic and wind energy in Pakistan: Progress, challenges, and future prospects. In *2015 2nd World Symposium on Web Applications and Networking (WSWAN)* (pp. 1-6).
Khan, J., & Khan, I. (2020). The relationship between energy consumption, economic growth and carbon dioxide emissions in Pakistan. *Financial Innovation*, 6(1), 13.
Lockwood, M. (2015). The political dynamics of green transformations: Feedback effects and institutional context. In I. Scoones, M. Leach, & P. Newell (Eds.), *The politics of green transformations* (pp. 86–101). Routledge.

Malik, A. (2018). *Energy policy in Pakistan: A policy evaluation framework* (LUMS Working Paper No. 2018-05). Lahore University of Management Sciences.
Malik, A., & Mahmood, K. (2015). Renewable energy in Pakistan: Status and trends. *Journal of Renewable and Sustainable Energy, 7*(4), 043101.
Malik, S. M., Awan, H., & Khan, N. (2020). Climate change vulnerability and adaptation in Pakistan. *Pakistan Journal of Meteorology,* 16(31), 63-88.
Matland, R. E. (1995). Synthesizing the implementation literature: The ambiguity-conflict model of policy implementation. *Journal of Public Administration Research and Theory,* 5(2), 145–174.
National Electric Power Regulatory Authority. (2015). *Net metering regulations*.
National Transmission & Despatch Company. (2021). *National transmission system expansion plan*. https://ntdc.com.pk/ntdc/publications/transmission-expansion-plans/
Newell, P., & Mulvaney, D. (2013). The political economy of the 'just transition'. *The Geographical Journal*, *179*(2), 132–140. https://doi.org/10.1111/geoj.12008
Ostrom, E. (2005). *Understanding institutional diversity*. Princeton University Press.
Parry, I., Black, S., & Vernon, N. (2021). *Still not getting energy prices right: A global and country update of fossil fuel subsidies* (IMF Working Paper No. 2021/236). International Monetary Fund.
Qureshi, M. I., & Rasli, A. M. (2015). Energy crisis in Pakistan: Challenges and opportunities. *Journal of Renewable and Sustainable Energy, 7*(4), 043102.
Rafique, M. M., & Rehman, S. (2020). National energy scenario of Pakistan – Current status, future alternatives, and institutional infrastructure: An overview. *Journal of Cleaner Production, 259*, 120892. https://doi.org/10.1016/j.jclepro.2020.120892
Raza, M. A., Khatri, K. L., & Haider, S. (2019). Renewable energy policy in Pakistan: A review of progress and challenges. *Energy Strategy Reviews, 26*, 100414.
Rehman, S., & Hasan, M. (2020). *Financing renewable energy in Pakistan: A roadmap*. LUMS Energy Institute.
Rehman, S., & Kar, A. (2019). *Policy uncertainty and investment in renewable energy: The case of Pakistan* (ISAS Working Paper No. 324). Institute of South Asian Studies, National University of Singapore.
Rehman, S., & Sahir, M. H. (2012). Prospects of renewable energy in Pakistan. *Renewable and Sustainable Energy Reviews, 16*(7), 5145–5154.
Sayed, A., & Khan, F. (2019). Asymmetric federalism and sustainable development: The case of Pakistan's energy sector. *Energy Policy, 134*, 110928.
Shahbaz, M., & Lean, H. H. (2012). Does financial development increase energy consumption? The role of industrialization and urbanization in Tunisia. *Energy Policy, 40*, 473–479. https://doi.org/10.1016/j.enpol.2011.10.050
Sheikh, M. A. (2010). Energy and renewable energy scenario of Pakistan. *Renewable and Sustainable Energy Reviews, 14*(1), 354–363. https://doi.org/10.1016/j.rser.2009.07.023
Siddiqui, S., Abdullah, A., Waqas, A., & Najam, H. (2020). Policy diagnostics and co-benefits framing for solar photovoltaic development in Pakistan. *Energy Policy, 144*, 111612. https://doi.org/10.1016/j.enpol.2020.111612
Sindh Energy Department. (2022). *Report on community engagement in renewable energy projects*. Government of Sindh.
Sultan, A. (2018). The Council of Common Interests: A constitutional analysis. *Pakistan Law Review*, *60*(1), 45-62.
United Nations Development Programme. (2016). *Localizing the SDGs: A guide for local stakeholders*. https://www.undp.org/content/dam/undp/library/Sustainable%20Development/2030%20Agenda/Localizing-the-SDGs-Guide-for-Stakeholders-2016.pdf

Unruh, G. C. (2000). Understanding carbon lock-in. *Energy Policy, 28*(12), 817-830.
World Bank. (2019). *Beyond the 18th amendment: Strengthening provincial fiscal management in Pakistan*. World Bank Group.
World Bank. (2020). *Pakistan's power sector reform: A journey of challenges and opportunities*. World Bank Group.
World Bank. (2021). *Pakistan renewable energy development report*. World Bank Group.
World Bank. (2022). *Pakistan's power sector: A roadmap for reform*. World Bank Group.
World Bank. (2023). *Pakistan's power sector: A dual challenge of financial viability and affordable supply*. World Bank Group.
Yaseen, M., & Abbas, S. (2022). Community-owned renewable energy models: A pathway for sustainable development in rural Pakistan. *Energy Policy, 160*, 112668.
Zaidi, S. A. (2015). *Issues in Pakistan's economy* (3rd ed.). Oxford University Press.
Zaidi, S. A. (2021). *De-risking renewable energy investment in Pakistan* (Working Paper No. 2021-01). Institute of Business Administration.
Zaidi, S. A., & Mirza, F. M. (2016). The impact of renewable and non-renewable energy consumption on economic growth in Pakistan. *Environmental Science and Pollution Research, 23*(19), 19701–19710. https://doi.org/10.1007/s11356-016-7195-0