Navigating Barriers: A Stakeholder Analysis of China-Pakistan Economic Corridor (CPEC) Energy Projects Implementation

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ABSTRACT

This study delves into the multifaceted challenges obstructing the successful execution of China Pakistan Economic Corridor (CPEC) Energy projects, integral to the broader framework of the Belt and Road Initiative. By canvassing insights from a diverse array of stakeholders encompassing Government Officials, Academicians, Businesspersons, and others, this research meticulously scrutinizes the social, economic, environmental, technical, and policy impediments entrenched within the CPEC landscape. Unlike previous research, this study adopts a holistic approach, consolidating prevalent barriers within a singular scholarly approach. Through in-depth interviews conducted with professionals hailing from both Pakistan and China, critical hindrances emerge, notably including systemic issues such as corruption, nepotism, and institutional inefficiencies within the Pakistani governmental apparatus. These findings augment existing knowledge by shedding light on persisting challenges, prominently featuring deficiencies in Infrastructure Challenges, Policy Reforms, and Governance. By unraveling the intricacies of these identified barriers, the research furnishes a comprehensive comprehension of the underlying rationales influencing stakeholders' decisions. Through this nuanced exploration, the study seeks to offer insights pivotal for navigating the complex terrain of CPEC implementation, thereby fostering informed strategies to surmount these formidable obstacles and advance the overarching objectives of regional economic integration and development.

1. INTRODUCTION

Under the patronage of the Belt and Road Initiative (BRI), China and Pakistan entered into an agreement namely China-Pakistan Economic Corridor (CPEC). China-Pakistan Economic Corridor is a multidimensional integrated roadmap enabling global connectivity among regions. Under the CPEC, China committed to invest approximately $46 billion in all these projects for 15 Years. The long-term collaboration pledge included several macro and micro-level projects related to communication and transport infrastructure, industrial cooperation, and energy security. Among these projects, the energy-related projects are of utmost importance as Pakistan is under severe energy stress for the last two decades. The long-lasting energy crisis has affected industrial as well as domestic day-to-day operations. The reason for the crisis mainly includes reliance on imported fossil fuel for energy generation and poor distribution systems. These issues resulted in a shortage of supply, expensive tariffs, and line losses.

It has been anticipated that the energy projects under CPEC will add up to 10,000 MW in upcoming years. Most of the energy-related projects are based on renewable and indigenous energy resources. The addition of MWs will not only shift the reliance from fossil fuel to hydro generation but also ensure the uninterrupted energy supply necessary for industrial growth. It has been estimated that CPEC efforts will increase energy growth from 4.9% to 12.3% during 2016–2035[1]. Moreover, CPEC includes some cutting-edge technologies like the Photovoltaic Energy Distribution Systems [2] and wind power generation [3]. There could be health impacts too due to the use of coal fired power plants, which are also part of CPEC. [4].

In the past few years, it has been observed that the pace of overall CPEC energy projects is slow [5]. Several studies tried to identify challenges that resulted in a slower pace of CPEC. Some studies revealed political issues, while some studies focused on economic barriers. Several studies also identified social issues that influenced the operational speed of the CPEC projects. In this context, this study attempts to identify all the challenges including, social, cultural, economic, and political barriers that are hurdled in the

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achievement of CPEC goals. Keeping in view the importance of energy, this research exclusively focused on challenges faced by energy projects, which have been unexplored in previous studies. This study aims to examine the social, environmental, economic, technical, and policy-related challenges associated with CPEC energy projects, as identified through interviews with knowledgeable key stakeholders.

Based on identified challenges, this research also provides a way forward for the smooth and swift implementation of CPEC energy projects. For this purpose, one of the qualitative research methodologies, such as, thematic analysis has been employed.

In the past few years, several studies have been performed to get social, regional, and technical insights into CPEC projects. Abid, M., & Ashfaq, identified several internal and external challenges in the context of demographic and geographic location. The internal challenges include energy crisis, security, infrastructure, and political disharmony whereas external challenges include concerns of neighboring countries which include India, Iran, and Afghanistan [6]. In the context of internal challenges, the study identified security issues, terrorism, and lack of consensus among political parties [7]. Another study proposed a "Golden Ring Energy Corridor" (GREC), which would connect China, Iran, Pakistan, Turkey and Russia to enable energy trade through pipeline, land, and sea routes [8]. The author of the study investigates the administrative challenges confronting cross-cultural adjustment among Chinese and Pakistani employees working on CPEC projects. The issues included language proficiency, social networks, and cultural differences which are the main contributors to the successful completion of CPEC projects [9]. Apart from the overall challenges to CPEC, several challenges have been identified by researchers which are exclusively related to CPEC energy projects.

It has been identified that several administrative issues which can affect the pace of energy projects. These issues include severe weather conditions in hilly areas of Pakistan, where 4 major energy projects are underway. The study also highlighted recent regime change and resulting political instability as hurdles in the swift completion of some early harvest energy projects. This issue has also been highlighted by Urban Development Challenges under the China-Pakistan Economic Corridor (CPEC), pointing to inconsistent political commitments and limited institutional capacity [10].

One of the studies examined the possible environmental impacts of infrastructural developments of CPEC Projects. Findings show that the coal-fired power plants due to their CO_2 contributions and smog may affect the overall environment [11].

In one study, the authors discussed the importance of hybrid energy projects along the CPEC Economic Zones. Moreover, the study also analytically suggested different sites for hybrid energy projects based on the location concerning industrial needs and the most feasible available energy resource [12]. However, this may be a great challenge due to existing socio-political differences among provinces in Pakistan. A study emphasized that CPEC projects may face challenges due to a shortage of qualified personnel, stemming from factors such as outdated equipment, limited industry connectivity, insufficient skills, and unemployment [13]. It was identified financial constraints as a significant barrier for CPEC energy that is capital-intensive, moreover, banks are hesitant to lend to these large renewable projects, making it difficult for investors to achieve the goals of energy projects [14].

Hence, the previous studies have identified various challenges facing CPEC as a whole, including political, economic, and social issues. However, there is a gap in research specifically examining the barriers faced by CPEC energy projects, which are critical for addressing Pakistan's long-standing energy crisis.

This study aims to fill that gap by focusing exclusively on the challenges confronting CPEC energy initiatives. The research employs qualitative methodology, namely thematic analysis of interviews with key stakeholders, to identify the social, economic, environmental, technical, and policy-related obstacles. This granular perspective on CPEC energy projects is significant because Pakistan's economic development and industrial growth depend heavily on resolving energy shortages.

While some prior studies have flagged administrative problems or environmental impacts of CPEC energy projects, this study will provide a comprehensive, multi-faceted understanding of the barriers based on insights from experts directly involved in the projects. Delineating these challenges clearly is an essential step toward recommending solutions and smoothing the way forward for successful implementation of CPEC energy investments. Given China's $46 billion commitment over 15 years, it is crucial that the energy component of CPEC receives focused analysis to ensure the objectives are achieved. This study's specific examination of CPEC energy initiatives will generate targeted knowledge to inform policies and strategies for expediting this pivotal aspect of CPEC.

2. CPEC ENERGY PROJECTS: CURRENT STATUS

Under the CPEC several energy projects are undertaken to strengthen the electricity infrastructure and ensure energy security. These energy projects include the uplifting of transmission networks along with enhancement in electricity generation based on renewable and non-renewable energy resources. Over all US $ 16.18 Billion has been dedicated to these projects [15]. The details of CPEC energy projects are provided in Table 1 [16].

Table 1. Details of CPEC Energy Projects

Completed Projects	MWs	Estimated Cost (US $ Million)	**Under Construction Project**	MWs	Estimated Cost (US $ Million)
HUBCO Thar Coal Power Project (Thar Energy)	330	497.7	Thar Coal Block-I 7.8 mtpa & Power Plant	1320	1912.12
Sahiwal Coal-fired Power Plant	1320	1912.2	HUBCO ThalNova Thar Coal Power Project	330	497.7
Coal-fired Power Plant at Port Qasim Karachi	1320	1912.2	Suki Kinari Hydropower Project, KP	870	2000
China Hub Coal Power Project, Hub Balochistan	1320	1912.2	Coal-Fired Power Project at Gwadar	300	54.2
Engro Thar Coal Power Project	660	995.4	**Under Consideration Projects**		
Quaid-e-Azam Solar Park (Bahawalpur)	600	520	Kohala Hydropower Project, AJK	1124	2400
Hydro China Dawood Wind Farm, Gharo, Thatta	50	112.65	Azad Pattan Hydropower Project, AJK/Punjab	700.7	1600
UEP Wind Farm, Jhimpir, Thatta	100	250	Thar Mine Mouth Oracle Power Plant & Surface mine	1320	1912
Sachal Wind Farm, Jhimpir, Thatta	50	134	Cacho Wind Power Project	50	150
Three Gorges Second and Third Wind Power Project	100	150	Western Energy (Pvt.) Ltd. Wind Power Project	50	150
Karot Hydropower Project, AJK/Punjab	720	1720	**Transmission**		
Total	6570	10116.35	Matiari to Lahore ±660 KV HVDC Transmission Line Project	6064.7	1658.34

Source: https://cpec.gov.pk/energy

As shown in Table 1, among 21 energy projects, 11 energy projects with an overall installed capacity of 6570 MW have been completed in the last five years. It may be observed that all the projects are based on indigenous energy resources i.e. coal (75%), hydro (10%), wind (4.5%), and solar (9%). As shown in Table 1, four energy projects of 2820 MW are under construction which are to be completed by 2024. These energy projects are also based on indigenous fuel resources including coal (69%) and Hydro (30%). As per CPEC energy plans several other energy projects of 3244 MW are under consideration including hydro (56%), coal (40%), and wind (3%) based energy resources. To efficiently manage the distribution of generated electricity at the consumer end a high-voltage transmission line of 878 Km is also in the progress stage. It has been observed that in upcoming years the addition of energy to the national grid under CPEC will result in an efficient energy mix, which will not only lessen the dependence on electricity generation from imported conventional fuels but also ensure energy security in terms of availability, affordability, environmentally friendly clean energy.

3. RESEARCH METHODOLOGY

Thematic analysis was used to conduct this study. Thematic analysis is one of the tools utilized for the analysis of data within qualitative research [17]. It focuses on identifying, analyzing, and interpreting underlying trends of qualitative data.

The thematic analysis consists of three main components: theme, prevalence, and power.

Theme: A theme represents something significant in the data that relates to the research question and carries a certain level of intended reaction or importance within the data collection. Ideally, the theme should appear in multiple instances across the data, but the number of occurrences does not necessarily determine its importance. Since thematic analysis is subjective, there is no definitive answer to how much evidence of a theme is required in the data for it to be considered a theme.

Prevalence: Prevalence is measured at the level of the individual data items. It can be determined by counting how many times a theme appears throughout the entire data set or by considering the number of different speakers who articulate the theme. Determining prevalence raises complex

questions about the boundaries of a "pattern" within an extended sequence of discourse.

It is important to note that there is no fixed method for determining prevalence in thematic analysis. The flexibility of this approach allows researchers to identify themes and assess their prevalence in various ways.

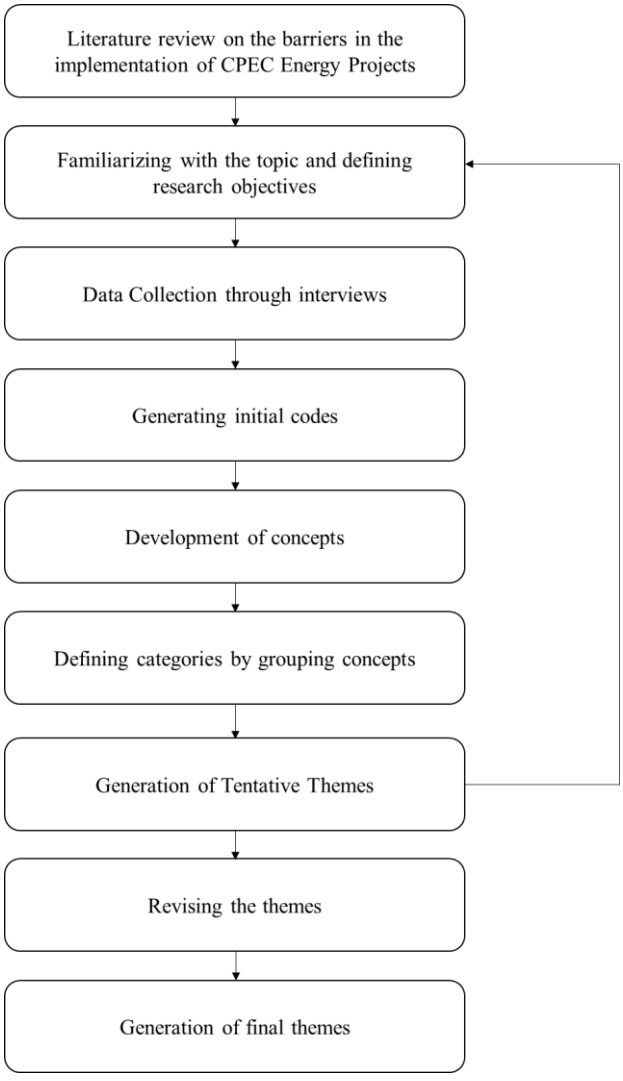

Fig. 1. Thematic Analysis Research Framework.

Power: Power refers to the researcher's confidence in identifying fewer common themes. It involves the researcher's certainty in recognizing and interpreting themes that may have lower prevalence compared to others.

Researchers who utilize professional tools for qualitative data processing find them valuable for generating analytical results, expanding their ability to organize and comprehend information. These specialized software programs assist in managing large amounts of data and facilitate traditional analytical tasks, although they cannot surpass the cognitive capabilities of researchers. While software programs such as ATLAS.ti, NVivo, CAQDAS, and QDA Miner offer advantages in handling extensive data, the selection of software should prioritize user-friendly interfaces and the ability to align with the researcher's mental approach. Based on these considerations, QDA Miner was chosen for its alignment with the research objectives and potential for diverse operations.

The data analysis process was carried out using QDA Miner software. The initial phase involved generating preliminary codes with the software, followed by further analysis to identify the barriers. As noted by PROVALIS Research (2018), QDA Miner has been extensively utilized and cited in numerous research studies across various fields, including political science, public policy, sociology, communication and media studies, management science and market research, education and psychology, health, medicine, life sciences, and library and information sciences, among others [17].

Instances: Instances refer to how frequently themes need to occur for research purposes. It involves observing and noting the frequency of theme occurrences within the data to gain insights for the research.

The purpose of employing thematic analysis is to gain insights into the level of awareness and expertise surrounding the issue under study. Specifically, the aim is to understand the viewpoints of various stakeholders regarding the challenges associated with implementing CPEC.

These stakeholders represent diverse professional backgrounds, including academia, government officials, policymakers, the energy sector, private businesses, public institutions, and legal firms. The research framework for thematic analysis is illustrated in Figure 1.

Table 2. Details of the number of respondents to the survey [17]

	Private Sector	Public Sector	Policy Institutions	Academic Sector	Legal Firms	Energy Organizations	Total
Stakeholders initially contacted	10	12	5	12	7	11	57
Interviews conducted indirectly	-	2	-	-	-	-	-
Participants in the first survey	4	6	3	5	2	2	22
Participants in the second survey	3	4	2	5	2	1	17

Table 3. Details of Denotation Stakeholder's Category [17]

Stakeholder Category	Abbreviation Used
Private Sector	**B**
Public Sector	**G**
Policy Institutions	**P**
Academic Sector	**A**
Law Firms	**L**
Energy Organizations	**E**

**** Data collection***

This is qualitative research and hence well-informed participants on the subject of CPEC were selected carefully. A mixed method has been employed for stakeholder selection. First, purposive stratified sampling is used followed by the snowball sampling technique. Purposive stratified sampling involves deliberately choosing participants from specific subgroups within a population to ensure representation and gather focused insights for research. In contrast, the snowball sampling technique relies on referrals from initial participants to recruit others, creating a network-driven sampling approach.

The interviews were conducted with stakeholders based on a semi-structured questionnaire using both inductive and deductive approaches. For this research, the themes were obtained directly from literature review, stakeholder interviews, and indirectly by considering interviews of the high-level officials' opinions from television channels and media talks and newspapers.

The process of conducting interviews for data collection involves defining a sample universe and selecting knowledgeable participants who are well-informed about the chosen topic. Unlike survey studies, qualitative research aims to capture a diverse range of views and opinions. Therefore, stakeholders from various professions, including academia, government officials, policymakers, the energy sector, private sector (business), public sector, and law firms, are considered as potential interviewees. These stakeholders provide different perspectives on the issue at hand, contributing to a comprehensive understanding of the topic. To ensure a wide spectrum of views, systematic dialogues are conducted, facilitating discussions on dynamic issues in the ecosystem. This approach increases awareness of stakeholders' own opinions and points of view while recognizing the diversity of views and interests involved. The details of the number of respondents to the survey are provided in Table 2.

Upon collecting pertinent data from the stakeholders, the information was categorized. Each category was established by assigning a letter to identify the organization or sector to which the stakeholder belonged, followed by a number indicating the interview sequence (e.g., A1, A2, B1, B2, etc.). The allocation of letters to the stakeholders' organizations/sectors can be found in Table 3.

Determining the sample size for a qualitative project is influenced by both theoretical and practical factors. To plan and allocate resources effectively, an initial sample size estimation is necessary at the design stage. However, flexibility is maintained by specifying a range of sample sizes rather than a fixed number. For interview-based research, a small sample size is often preferred to ensure localized voices and enable in-depth analysis of individual cases. Recommendations suggest a range of 3 to 16 participants for Interpretation Phenomenological Analysis, with the specific number varying based on the scope of the study. This approach allows for the development of case-specific generalizations while maintaining the uniqueness of individual experiences. Power analysis, based on negative binomial probability distribution and random sampling, can be employed to determine the number of participants needed to achieve a desired level of confidence. In this study, using R programming and considering a theme prevalence of 0.1 and 2 instances, the minimum required number of participants was found to be 14, with an associated power of 80%. However, to enhance the results, a total of 22 stakeholders were interviewed. Additionally, the research also incorporated information from interviews conducted by influential individuals through television channels and media as an indirect secondary source

4. RESULTS AND DISCUSSIONS

The following pre-identified themes were derived from the literature review through data analysis in QDA Miner:

1. Power Policy Reforms (Weak Governance, Delays in Policy Execution).
2. Infrastructure Challenges (Ineffective Congestion Control, Energy Losses, Power Theft).
3. Domestic Challenges (Energy Stability, Provincial Tensions, Delays in Project Completion).
4. Environmental Challenges (Pakistan's Commitment to the Paris Climate Agreement).

Hence, the questionnaire was designed in such a way so that the relevant questions related to the pre-identified themes could be asked, as well as there were open-ended questions to let the interviewees express themselves freely. This method allowed new themes to be identified as well. The questionnaire can be found in the Appendix.

The participants in the interview documented their answers regarding these topics. Additionally, new themes emerged during the interviews, uncovering barriers that had not been extensively discussed in previous research. A selection of stakeholder responses related to these themes can be found in Table 4 (refer to the appendix). To maintain confidentiality, the stakeholders' real names were substituted with a letter indicating their professional

category and a number indicating the interview sequence. Importantly, the subsequent stages of thematic analysis were conducted collaboratively using the software. The software generated initial codes, developed concepts, and the aforementioned table aided in the classification of the 'themes' (or new barriers). Furthermore, new factors were identified towards the conclusion of the first interview.

The software extracted those themes from the blocks of speech/text of the interviewees, checked the frequency of occurrence of each theme, counted the number of times each theme was repeated in each case (interviewee), and categorized sub-themes under their respective categories, which can be seen in figure 2. Figure 2 shows how the software bound themes in their respective categories, by calculating the percentage of their occurrence in each instance.

	Count	% Codes	Cases	% Cases
Environmental Concerns				
Impact of Coal fired power plants	20	10.9%	17	85.0%
Pakistan INDC to Paris Agreement	20	10.9%	16	80.0%
Infrastructure Management				
Congestion	5	2.7%	4	20.0%
Electricity Theft	15	8.2%	15	75.0%
Energy Shortage	2	1.1%	2	10.0%
Line Losses	22	12.0%	18	90.0%
Internal Conflict				
Energy Security	5	2.7%	5	25.0%
Provincial Conflicts	12	6.6%	10	50.0%
Terrorism	9	4.9%	9	45.0%
Other Concerns				
Corruption	2	1.1%	2	10.0%
Incompetent people	2	1.1%	2	10.0%
Nepotism	1	0.5%	1	5.0%
Power Policy Reforms				
Delay in implementation	21	11.5%	18	90.0%
Poor Governance	25	13.7%	17	85.0%

Fig. 2. Applying QDA Miner, Code Tree indicates the frequency of these factors in each instance [17].

The information on word counts, percentages of words, and the frequency of these aspects in each instance, more accurately depicted in Figure 2, was extracted from Table 4 (appendix). QDA Miner cannot study relationships between the codes, nor is it possible to code a portion of text outside of the predefined category. Before connecting the text fragment with the stated categories, researchers are expected to determine the categories (themes). Additionally, this software's analysis and results do not produce any tangible outcomes. For instance, the proportion of cases, word count, and frequency of topics in this research do not always produce findings that can be used to determine what the main obstacle is to the implementation of CPEC Energy projects in Pakistan. Therefore, a more profound approach was adopted to reach a more reliable conclusion. The results yielded by the software were further refined by the conventional research methods to find conclusive results.

The software facilitated the development of an initial model or a set of categorized barriers. Subsequently, the researchers refined this model by seeking input from participants to identify the most prevalent and influential barrier. In the final step, the researchers validated the refined model by revisiting the same group of participants and requesting them to rate each research finding on a scale of 1 to 10, indicating its impact level. Notably, all participants expressed positive views regarding the overall impact of CPEC Energy projects on Pakistan's economy and security. One of the questions was a sensitive one. When asked if CPEC was a component of China's debt trap, the majority of the stakeholders appeared to disagree with this notion as well, as depicted in figure 3

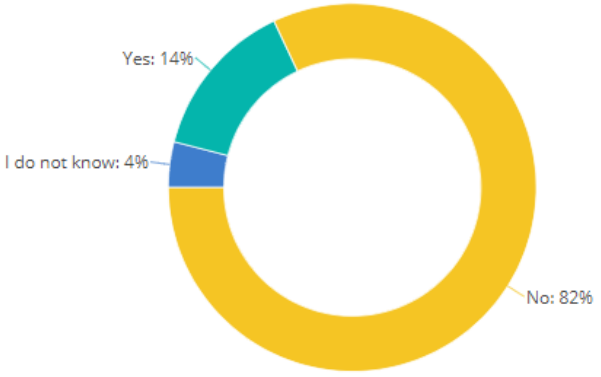

Fig. 3. Stakeholders' views on CPEC as a component of the Chinese debt trap.

In the subsequent phase, a critical assessment of the identified themes was undertaken to determine the primary obstacles and barriers hindering the implementation of CPEC Energy projects. To achieve this, participants were individually requested to prioritize and select the most significant and widespread barrier from a comprehensive list of factors. The ensuing results are presented below.

Clearly, out of the 22 stakeholders, 8 identified "poor infrastructure and financial issues" in Pakistan as the main barriers to the successful implementation of CPEC energy projects. Additionally, 7 participants rated "Poor Governance" in Pakistan as the most significant barrier. Furthermore, 3 stakeholders believed that "Domestic Challenges and Energy security" posed the most considerable hindrance to the implementation of CPEC Energy. The graphical representation of the number of respondents who selected each issue as the largest obstacle to the implementation of CPEC energy projects is shown in Figure 5 projects, 2 of them declared that there is no significant barrier to the implementation of CPEC Energy projects. The remaining two stakeholders rated “lack of competent people at important positions” and “Corruption and Nepotism” as the biggest hurdles in the implementation of CPEC Energy projects, a piece. However, none of them considered “Enviornmental Issues and Pakistan INDC Targets” as a barrier to the implementation of CPEC Energy projects.

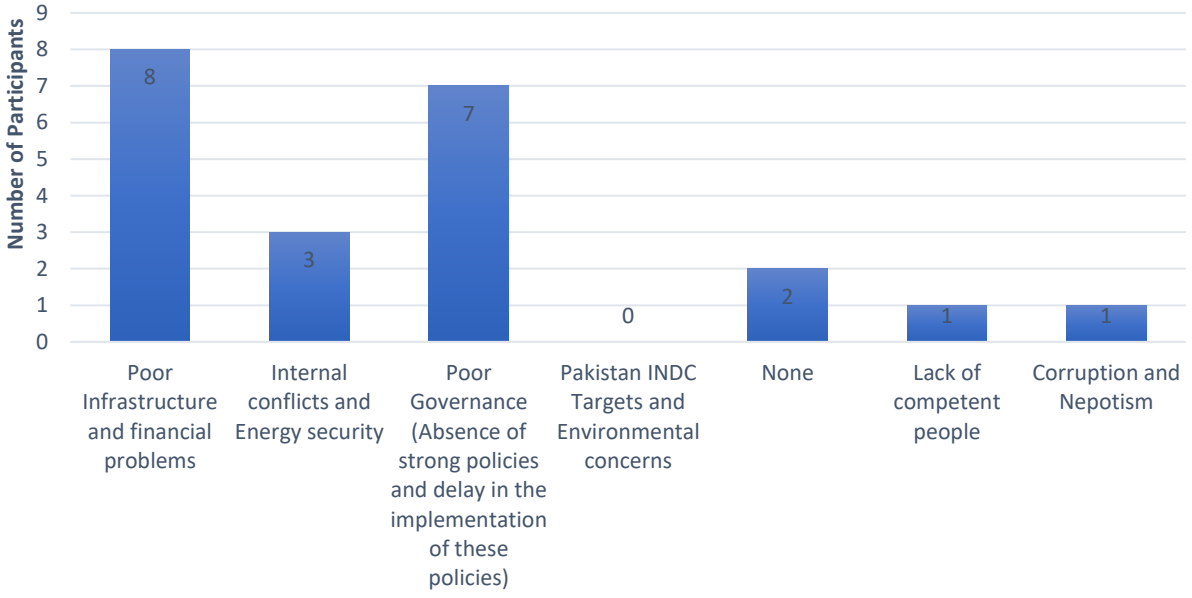

Fig. 3. Number of stakeholders for each theme who identified the primary barrier to the completion of CPEC energy projects.

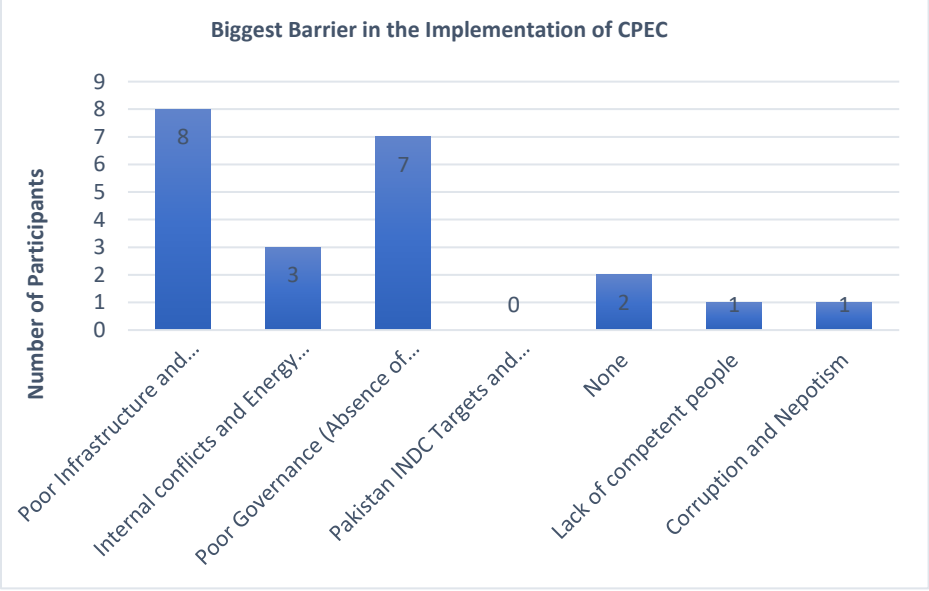

Fig. 4. Obstacles to the Successful Implementation of CPEC Energy Projects [17].

Table 5 Stakeholder Identification of Key Barriers to the Successful Implementation of CPEC Energy Projects

Biggest Barriers in the implementation of CPEC	
Barrier	**Number of votes**
Poor Infrastructure and Financial Issues	8
Domestic Challenges and Energy Security	3
Poor Governance	7
Pakistan's INDC Targets and Environmental Issues	0
No Barrier	2
Lack of skilled personnel	1
Corruption and Nepotism	1

Figure 6 illustrates the decisions taken by stakeholders from each walk of life and provides further details on the choices made by the stakeholders from the aforementioned backgrounds.

Following is a breakdown of the respondents' votes as shown in Figure 5, 2 lawyers each cast a vote in favor of "Poor Governance" and "Poor Infrastructure". Each of the four business owners cast a vote for Pakistan's inadequate infrastructure, internal conflicts, poor governance, and lack of competent people in important positions in Pakistan. Poor governance garnered 3 votes from the 5 academicians, while poor infrastructure and Domestic Challenges each received one vote. Six government officials voted, with three choosing "Poor infrastructure," two choosing "none (no barrier at all)," and one choosing "bad governance." Each of the two energy industry experts selected "internal conflicts" and "corruption and nepotism" as their top choices. Two out of the three decision-makers chose "poor infrastructure," while one opted for "poor governance."

It is clear that the two main obstacles that garnered nearly identical votes from the stakeholders are:

1. Poor infrastructure and financial difficulties

2. Poor Governance (Absence of strong policies and delay in the implementation of these policies). In the final phase of the study, the obtained results were subjected to validation. This involved re-engaging with the same group of 22 stakeholders for the third and final time. They were provided with a second questionnaire (refer to Appendix) which required them to rate each identified barrier based on its significance as an obstacle in the implementation of CPEC Energy projects. The rating scale ranged from 1 to 10, with 1 indicating the least importance and 10 indicating the greatest obstacle. It is important to note that the ratings were defined as follows:

1-star: Minimal significance, having little to no impact on the implementation of CPEC Energy projects.

10-stars: Utmost significance, posing a substantial hindrance to the implementation of CPEC Energy projects.

Out of the 22 stakeholders contacted, 17 stakeholders responded to the questionnaire during this phase. The results are given in Table 5.

Table 6 score awarded by the involved stakeholders to the CPEC Energy Projects [17]

Key Barriers to the Implementation of CPEC Energy Projects	Star Rating
Poor Infrastructure and financial problems	✶✶✶✶✶✶✶✶
Domestic Challenges and Energy Security	✶✶✶✶✶✶
Poor Governance (Absence of strong policies and delay in the implementation of these policies)	✶✶✶✶✶✶✶✶
Pakistan INDC Targets and Environmental Issues	✶✶✶✶✶
Lack of skilled personnel	✶✶✶✶✶
Corruption and Nepotism	✶✶✶✶✶

Thus, the findings appear to be in line with the earlier finding that the following are the main obstacles to the realization of the CPEC Energy Projects in Pakistan:

1. Poor Governance (Absence of strong policies and delay in the implementation of these policies)
2. Poor Infrastructure and financial problems

Equal star ratings were given to the two aforementioned concerns, but the third most frequent obstacle to the completion of the CPEC Energy Projects in Pakistan was invariably "Domestic Challenges and Energy security".

5. CONCLUSION

The obstacles to implementing China-Pakistan Economic Corridor (CPEC) energy projects were determined using a qualitative research method, focusing on the insights of key stakeholders. These stakeholders, including Government Officials, individuals from Academia, businesspersons, and representatives from the public and private sectors, as well as related agencies and NGOs, were involved in the study. The aim was to comprehensively identify barriers and difficulties associated with social, economic, environmental, technical, and policy factors within the context of CPEC by examining the discourses of these key stakeholders. Unlike previous studies that focused on barriers related to specific factors individually, this research adopted a holistic approach to consider barriers and difficulties associated with all the aforementioned factors in a single study, drawing from the insights of key stakeholders from both Pakistan and China.

Thematic analysis was employed for this research, necessitating a thorough understanding of the topic, which was achieved through a comprehensive literature review. Based on the review, four impediment factors were identified:

- Power Policy Reforms (Poor Governance, Delay in Policy implementation)
- Infrastructure Challenges (Poor Congestion Management, Line losses, Electricity theft)
- Domestic Challenges (Energy Security, Provincial Conflicts, Delays in project completion)
- Environmental Issues

Following the identification of these factors, semi-structured interviews were conducted with 22 stakeholders. This approach allowed stakeholders to either validate the identified problems or bring forth new issues that had not been identified in the literature review. The initial interviews revealed additional barriers, including concerns over CPEC investment being seen as a Chinese debt trap, corruption, nepotism, and the presence of incompetent individuals in key institutions in Pakistan. The interviewees provided their reasons for selecting these barriers, which were also incorporated into the research.

From the first round of interviews, it became evident that Infrastructure Challenges and Power Policy Reforms were the most prominent barriers, receiving 8 and 7 votes, respectively, out of the 22 stakeholders. Domestic Challenges in Pakistan received 3 votes. These results highlighted the critical impact of these obstacles on the implementation of CPEC energy projects.

A second round of interviews was conducted, with 17 stakeholders participating. They were asked to rate the prevalence of each identified barrier on a scale of 1 to 10, with 1 being the least important or prevalent barrier and 10 being the most prevalent barrier. The results reaffirmed the persisting prominence of Poor Infrastructure Challenges, Poor Power Policy Reforms, and Poor Governance, as these barriers received the highest ratings from the stakeholders. Once again, Domestic Challenges and Energy Security issues were recognized as the third most prevalent barriers to the implementation of CPEC Energy projects.

5.1 Limitations

This study has certain limitations that need to be recognized. Firstly, the sample size of stakeholders interviewed was relatively small, with 22 participants in the initial round and 17 in the second round. While the participants offered valuable insights from their expertise, the perspectives represented were limited. Future research could involve interviewing a larger and more diverse group of stakeholders representing various backgrounds and regions across Pakistan.

Secondly, as a qualitative study based on interviews, the findings cannot be generalized to the wider population. Quantitative surveys with representative sampling could provide data to complement these qualitative findings. Finally, the thematic analysis approach, while allowing for in-depth examination of perspectives, relies on subjective interpretation of the interview data. Additional researchers could conduct independent analyses to corroborate the findings.

Similarly, a comparative study with a different approach and different software can be developed on the same theme.

5.2 Future Research

To build on this research, future studies could utilize mixed methods combining qualitative interviews with quantitative surveys to assess the prevalence of the identified barriers among a broader population.

Additionally, specific policy analyses could be undertaken to evaluate potential solutions and provide concrete recommendations to address the major obstacles surfaced in this study.

Comparative analyses of CPEC energy projects and similar Chinese investments in other countries could also offer useful insights. Examining the experiences of other countries may reveal transferable strategies and best practices.

Longitudinal studies tracking projects over time could determine whether the recognized impediments persist or are mitigated. Such research could aid ongoing monitoring of CPEC energy initiatives and adaptation of policies and procedures.

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Appendix A

Table 4: Feedback provided by the participants [17]

Category	Code	Case	Responses
Infrastructure Challenges	**Line Losses and Electricity Theft**	**G4**	The issues of line losses and electricity theft have persisted for a long time in Pakistan and need to be addressed directly. However, these problems should not hinder the addition of new capacity to the system. Improving the technical infrastructure, management, and recovery requires enhanced effort.
Environmental Issues	**Pakistan's INDC to Paris Agreement**	**G4**	Pakistan's contribution to global climate change is negligible. As a developing nation, it requires low-cost energy, similar to other countries at this stage. Even developed nations continue to use coal for energy production.
Internal Conflict	**Terrorism**	**G4**	Pakistan does not face internal conflict. Previous law and order concerns were mainly restricted to regions near Afghanistan, a historically unstable area. Through determined efforts by the government, the security situation has normalized, and terrorism threats have been effectively countered. Any remaining concerns are related to foreign-sponsored sabotage, which the government is prepared to handle. Security for CPEC projects has also been reinforced.
Infrastructure Challenges	**Line Losses**	**A5**	CPEC projects aim to boost Pakistan's economic growth. However, line losses and electricity theft caused by certain citizen behaviors negatively affect the country by increasing costs and harming national interests. These actions are both unethical and economically detrimental.
Environmental Issues	**Pakistan's INDC to Paris Agreement**	**A5**	Decades ago, China faced similar challenges. Its industrialization caused significant pollution, but this was a phase many developed countries, including the US and UK, went through. Economic transformation eventually reduces pollution and increases technological advancements. Pakistan is in a similar developmental phase.
Other Concerns	**Chinese Debt Trap**	**A5**	The historical relationship between China and Pakistan is built on mutual support during difficult times. Over the years, the two nations have strengthened their diplomatic, economic, and cultural ties. Collaboration, rather than creating adversaries, is a more effective way to achieve strength and progress.
Power Policy Reforms	**Poor Governance**	**B4**	Investors prefer stable and incentive-driven policies. Sustainability in governance is essential. The progress of CPEC energy projects

			indicates that Pakistan's policies are not entirely ineffective.
Power Policy Reforms	**Delay in Implementation**	**B4**	Many CPEC projects have been completed despite challenges, demonstrating that delays in the energy sector were not a major hindrance.
Other Concerns	**Chinese Debt Trap**	**B4**	CPEC investments are foreign direct investments, not loans. Pakistan needs more such initiatives. Criticisms of Chinese investments often ignore the same actions by Western countries.
Infrastructure Challenges	**Congestion**	**P3**	Pakistan's energy infrastructure is inadequate and underutilized. The high transmission and distribution (T&D) losses worsen when additional energy is introduced without resolving these issues.
Infrastructure Challenges	**Line Losses**	**P3**	To maximize the benefits of power plants, Pakistan must heavily invest in T&D infrastructure. Developing SEZs and increasing industrial production will enhance the efficiency of these plants.
Environmental Issues	**Impact of Coal-Fired Power Plants**	**P3**	While coal is cost-effective and easier to deploy, Pakistan lacks sufficient coal resources and must rely on imports. The government should carefully evaluate its energy strategy.
Power Policy Reforms	**Poor Governance**	**P3**	Short-term CPEC energy projects have succeeded due to governmental facilitation, which highlights some positive steps in governance.
Environmental Issues	**Pakistan's INDC to Paris Agreement**	**P3**	Pakistan's energy mix includes hydropower, thermal, and renewables, minimizing reliance on coal. The country is on track to meet its Paris Agreement targets.
Power Policy Reforms	**Delay in Implementation**	**P3**	None of the CPEC energy projects were delayed due to domestic challenges or terrorism. The government's proactive measures ensured timely implementation.
Other Concerns	**Chinese Debt Trap**	**P3**	Unlike cases like Sri Lanka's Hambantota Port, China has shown flexibility in its
			agreements with Pakistan, offering soft loans and extended grace periods due to their close relationship.
Infrastructure Challenges	**Energy Shortage**	**E2**	Post-2010, Pakistan experienced its worst energy crisis, leading to prolonged electricity outages. This severely impacted the economy and increased unemployment.
Infrastructure Challenges	**Line Losses**	**E2**	Pakistan's outdated transmission infrastructure struggles to meet modern energy demands. Significant upgrades are urgently required.
Infrastructure Challenges	**Electricity Theft**	**E2**	Theft within the distribution system is a societal issue. Stricter policies and regulations have been introduced to address the problem effectively.
Environmental Issues	**Impact of Coal-Fired Power Plants**	**E2**	Coal power plants were chosen for their immediate feasibility amidst Pakistan's energy crisis, despite environmental concerns.
Internal Conflict	**Provincial Conflicts**	**E2**	Pakistan's diversity is its strength. Disagreements on provincial benefits do not threaten the greater national interest or the progress of CPEC projects.
Other Concerns	**Chinese Debt Trap**	**E2**	The notion of a debt trap is often politically motivated. CPEC-related debt constitutes a small portion of Pakistan's total external debt.

Appendix B

Questionnaire 1

INTERVIEW WITH THE KEY STAKEHOLDERS INVOLVED IN THE ENERGY PROJECTS OF CHINA PAKISTAN ECONOMIC CORRIDOR (CPEC):

Date: Name of Institution:
Position in this institution:

Name:
Age/Sex:

Number of years working with this Institution:
Occupation:

1. What impact (positive or negative) will China Pakistan Economic Corridor (CPEC)’s energy projects have on Pakistan’s economy?

……

2. Do you think Pakistan has a kind of infrastructure that is ready to embrace the added capacity of the CPEC energy projects?

……

3. Pakistan is facing huge line losses (more than 16% as of 2017) and electricity theft. Do you think that these factors may cause problems in the transmission of added energy capacity?

……

4. Out of the total added energy capacity through CPEC energy projects, 69% of it, will be produced by coal power projects which may cause environmental and health problems in Pakistan. While many other countries including China, have banned energy production through coal-fired power plants, why is Pakistan still allowing energy production through this resource?

……

5. Do you think that Pakistan Government Policies and the traditional delay in projects due to policies implementation may cause delays in the implementation of CPEC energy projects too?

……

6. In your opinion, how can Pakistan Government meet the INDC targets to the Paris Agreement if Pakistan Government allows 69% production of Energy out of all CPEC energy projects through coal-fired power plants?

……

7. To what extent can factors like Domestic Challenges and terrorism in Pakistan impact the implementation of CPEC energy projects?

……

8. In your opinion, which of these are the biggest threats and challenges in the implementation of CPEC energy projects? And why?
   a) Poor infrastructure and financial problems
   b) Domestic Challenges and Energy Security
   c) Absence of strong policies and delay in the implementation of these policies
   d) Pakistan's INDC and targets to meet the Paris Agreement

……

9. In your opinion, what are the Chinese reasons to invest heavily in Pakistan? Is the global media's perception of the Chinese debt trap somehow linked with CPEC also?

……

Questionnaire 2

On a scale of 1 to 10, please rate these factors on the extent to which they pose to be a threat or a barrier to the implementation of CPEC Energy projects

Please note that 1 is the weakest threat and 10 is the strongest threat

No.	Factors	Your Rating
1	Poor Infrastructure and Financial problems	
2	Poor Governance (Absence of strong policies and delay in the implementation of these policies)	
3	Pakistan INDC Targets and Environmental Issues	
4	Lack of competent people	
5	Corruption and Nepotism	