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CPEC AND THE CHALLENGES FOR THE ENERGY SECTOR OF PAKISTAN

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ABSTRACT
China launched the Belt and Road Initiative (BRI) in 2013, with the broad objective of connecting over 65 nations in Asia, Europe, and Africa through infrastructural investment and economic development. The development of energy infrastructures is a key component of the China-Pakistan Economic Corridor (CPEC), a centerpiece of the BRI. It has been said that CPEC will "alter the game" for Pakistan. The present energy situation is a severe problem for Pakistan. This study examines the difficulties that Pakistan's energy industry must overcome and how CPEC might aid in overcoming those difficulties. The analysis in this study discusses several energy projects launched under CPEC. In light of the energy industry challenges, this article finds that CPEC appears beneficial. However, because progress on these initiatives is being made slowly, Pakistani authorities must alter their approach if they want to profit fully from CPEC.

Keywords: CPEC, Pakistan, energy sector, challenges for Pakistan
JEL Codes: P28

I. INTRODUCTION
Since the electricity industry is operating at a 7,440 MW deficit, Pakistan is experiencing a severe energy crisis. In Pakistan's efforts to meet the nation's energy demands, the lack of power has remained a significant obstacle. Currently, Pakistan is producing 17,560 MW, whereas its energy requirement is over 25,000 MW2. So, around the nation, load shedding and unexpected power outages have become commonplace. In metropolitan regions, load shedding has occurred for six to ten hours, while in rural areas, breakdowns have lasted for fifteen hours, according to complaints. Pakistan continues to struggle with a lack of electricity, load shedding, and massive cyclical borrowing in the power industry despite completing more than half of the CPEC energy projects.

One of the critical elements falling under the purview of CPEC is the energy infrastructure. Notwithstanding the COVID epidemic, the energy sector of the CPEC achieved excellent progress, particularly in the timely execution of power-producing plants launched under the purview of CPEC phase I. Phase II of CPEC begins with the conclusion of phase I. The main focus of phase II is industrial collaboration, and one of the critical elements in creating SEZs is the accessibility of enough energy. Therefore, the conclusion of the energy projects anterior to the start of CPEC phase II was unavoidable. Pakistan was one of the nations that had severe energy issues. 2011 saw a spike in electricity shortages that surpassed 7,000MW. Pakistan's scarcity of capacity for electricity generation contributed to the energy shortage. The energy shortage arose primarily due to the inability to engage investments at the levels required for maintaining and expanding power output in tandem with the escalating demand.

In contrast hand, Pakistan built new power plants when the CPEC was inaugurated in 2014, greatly enhancing the nation's potential for energy production. The potential to create more power than Pakistan's needs exists now. In 2020, Pakistan obtained a fixed capacity of 35,972MW, based on the findings of the Pakistan Economic Survey 2019-2020. Pakistan's utilization capability in that same year was something in the neighborhood of 25,000MW. The power industry's main structural issues were the installation of power plants beyond the CPEC cooperative and the growth of power-producing units. The CPEC energy structure has already resolved these issues.

II. LITERATURE REVIEW
There has been adequate literature researched for this study's purposes. China has been trying to affect Pakistan's geographic advantages for the past 10 years to balance off the influences from abroad that are seeking to undermine its sovereignty. There is no denying that the China-Pakistan Economic Corridor (CPEC). is China's most significant

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current attempt to increase the power and vitality of its strategic ties with Pakistan, which are powerful, long-standing, durable, robust, and significant. Power production is the main responsibility of CPEC. Energy industry-related initiatives will receive $33 billion in funding. In the past years, a significant amount of work was expended on improving people's quality of life. subsequently to the industrial rebellion. The global economy and energy usage both grew quickly during this period, which is characterized as the "industrial revolution." (Raza, H., Osama, A., & Hena, S. 2018). According to the China-Pakistan Economic Corridor (CPEC) agreements, several projects have been planned and implemented to enhance Pakistan's industrial and energy sectors (Hadi et al., 2018). Pakistan and China now work together more often in a variety of fields, including business, farming, power, construction, and interpersonal relationships. For Pakistan's future development, the bilateral industrial and academic relationship will reduce the inequalities and connect the two states (CPEC, 2019). Even though it is well recognized that the industrial sector is the foundation of every nation's economy, Pakistan's industrial sector only accounts for 19.74% of the country's GDP. Less than $25 billion in exports are made by Pakistan (Zulkifal, 2020; Bibi and Ali, 2021). For the examination of the collections described in the task agreement for this CPEC energy endeavor, Pakistani authorities are retained; nevertheless, anything might well be discovered along the same company under the provision that Pakistani authorities are used. The literature study focuses on the concepts and theories chosen concerning the challenges facing the energy industry, the CPEC energy projects, and suggestions for solutions.

III. PAKISTANI ENERGY SECTOR INVESTMENTS FROM CHINA

The electric power industry of Pakistan is the target of most Chinese investments there. The earliest harvesting projects funded by the CPEC aim to increase the energy system's capacity by 10,400 Megawatts through the use of hydropower projects, coal-fired power plants, wind farms, solar-panel parks, and liquefied natural gas (LNG) plants. As of 2015, there were 22,571 Megawatts of installed potential (Rizvi 2015). Hydro sources provide 7,097 Megawatts, or a portion of this total installed capacity, while thermal sources contribute 15,474 Megawatts. Even by the end of 2018, it is anticipated that these additional 10,400 Megawatts would raise Pakistan's overall capacity for power production to 32,971 Megawatts. The lack of energy can be resolved in the short term if the government's plans are implemented and all the projected power plants are functioning and operating.

IV. PAKISTAN'S ENERGY DEMAND AND CPEC ENERGY PROJECTS

Pakistan's Energy Demand and CPEC Energy Projects Ever since the turning of the century, Pakistan has experienced a steady but significant worsening of its energy shortage. As an illustration, the overall energy deficit in 2011 exceeded 6,000 megawatts (MW), as opposed to a deficit of 4,000 MW in 2004. Multiple reasons, including "insufficient capacity increase, restricted investigation and insufficient utilization of hydro, coal and renewables possibilities and inappropriate utilization energy resources," contributed to the total shortage. Kugelman asserts that Pakistan's oil, gas, and coal sources are significantly underutilized. Less than 4% of potential oil reserves, 19% of potential gas reserves, and 1% of potential coal deposits have been verified.

There is often a need for roughly 23,000 MW in situations of growing demand, especially during the summer, as opposed to the capacity of about 16,000 MW. As a result, a 7,000 MW energy imbalance "intensifies consumer problems, interrupts agricultural and industrial output, increases expenses, and renders Pakistani products unviable abroad." The national economy is also negatively impacted by the energy imbalance, with a loss in GDP of between 4 and 7 percent predicted (GDP). Aiming to "reduce the present power supply-demand imbalance by 2018 and accommodate to increased upcoming demand by the installation of 25,000 MW by 2025," the government stated in its long-term strategy statement Vision 2025.

V. CONCERNS WITH PAKISTAN'S ENERGY INDUSTRY

Since about ten years ago, power cuts have become a typical occurrence in Pakistan's energy industry, particularly concerning electricity. Ironically, Pakistan has a wealth of undiscovered natural resources, including coal, gas, and oil, which makes the current energy situation not only unfortunate but also comical. A gap between installed capacity and genuine output means that although the country has a total installed capacity of about 25,000 MW, there is now a 4,000–5,000 MW deficit. 2015 saw oil (35%) natural gas (29%) and hydroelectricity (30%) as Pakistan's main means of power generation. In addition, the nation has experienced fuel shortages, particularly for CNG (compressed natural gas), which has grown to be a preferred and affordable option for drivers in recent decades. The entrance of CPEC is a blessing for Pakistan's energy industry given this troubling background of energy-related problems.

VI. CPEC'S ENERGY PROJECTS

21 energy projects that fall within the purview of CPEC energy projects would collectively produce 12,000 megawatts of electricity. About US$25 billion will be spent on the 21 energy projects. Currently, 10 energy initiatives have been finished and are running at full efficiency. The total cost of the finished energy projects was USD 9.7 billion. Out of 10 constructed energy projects, are power-producing facilities that have been supplying the national grid with about 5420MW, while one project is the Matiari-Lahore energy transmission system. With a span

of around 900 kilometers, the transmission system has a 4,000 MW transfer speed. Six power-producing facilities with a total development cost of US$ 7.1 billion and a 3870 MW power production potential are being built as part of the CPEC energy infrastructure. In addition, 5 power projects are being considered and are awaiting permission. These pipeline projects are expected to cost USD 5.912 billion and have a 3244.7 MW capacity for power production.

CPEC-Energy Priority Projects

Sr. No	Projects	MW	Estimated Cost (US$ M)
1	Port Qasim Electric Company Coal Fired, 2X660, Sindh	1320	1,980
2	Sahiwal 2x660MW Coal-fired Power Plant, Punjab	1320	1,600
3	Engro thar 4x330MW Coal-fired, Thar, Sindh	1320	2,000
	Surface mine in Block II of Thar Coal field, 6.5 mtpa, Thar Sindh		1470
4	Gawadar Coal Power Project, Gwadar	300	360
5	HUBCO coal power plant 1X660 MW, Hub Balochistan	660	970
6	Rahimyar Khan Coal Power Project, Punjab	1320	1,600
7	SSRL Thar Coal Block 1-6.5mpta Thar, Sindh		1,300
	SSRL 2x660 MW Mine Mouth Power Plant,	1320	2,000
8	Quaid-e-Azam 1000MW Solar Park, Bahawalpur, Punjab	1000	1,350

CPEC-Energy Priority Projects

Sr. No	Projects	MW	Estimated Cost (US$ M)
9	Dawood 50MW wind Farm, Bhambore, Sindh	50	125
10	UEP 100MW wind Farm, Jhimpir, Sindh	100	250
11	Sachal 50MW Wind Farm, Jhimpir, Sindh	50	134
12	Sunnec 50MW wind Farm, Jhimpir, Sindh	50	125
13	Suki Kinari Hydropower Station, KPK	870	1,802
14	Karot Hydropower Station, AJK & Punjab	720	1,420
15	Matiari to Lahore Transmission line		1,500
16	Matiari to Faisalabad Transmission line		1,500
	Total (Priority)	**10400**	**21,486**

VII. CHALLENGES OF CPEC IN PAKISTAN'S ENERGY SECTOR

Challenges that are faced by CPEC in Pakistan's energy sector are the following.

Challenges of CPEC in Pakistan's energy sector →

- Circular debt
- Poor transmission network
- Power theft
- Finance
- Security
- Technical Issues
- Capacity building
- Environment challenge
- Corruption
- Rising cost
- Chronic energy shortages and substantial underinvestment

VII.I. CIRCULAR DEBT

Considering the greatest energy costs in the area, the energy sector continues to be plagued by significant losses and cyclical debt problems. The circular debt in Pakistan's energy industry reached an all-time high of PKR 498 billion over the FY 2020–2021. 13 With PKR 2476 billion, the total circle debt has surpassed all prior records. The challenge of circular debt is mostly brought on by the growing costs of imported fossil fuel, the unreasonable cost per unit charged by Independent Power Producers (IPPs), and the failure of certain significant users to make timely payments. Circular debt problems in the electricity industry have not received much attention from CPEC. Rather, the difficulties in the electricity industry have become more severe as a result of the coal-fired power stations.

VIII. INEFFICIENT TRANSMISSION NETWORK

One of the main reasons for the electricity sector's collapse was an inadequate transmission system, along with other technical problems. The benefits of the CPEC energy projects have not yet been seen by Pakistan's citizens, particularly in the country's existing impoverished regions. In Baluchistan, for instance, 60% of the province is not wired into the national grid. The remaining 40% of Baluchistan that is linked to the national grid has energy needs of around 2000 MW, but the current transmission network can barely handle 1200 to 1300 MW. 15 As a result, it has further widened regional inequities and the impression that Baluchistan is being marginalized by the rest of Pakistan.

VIII.I. POWER THEFT

Another significant issue that is harming the energy sector is power theft. Power theft solely cost the energy industry PKR 53 billion in 2018, and the price is likely to have increased afterward. 16 Additionally, the problem of outstanding bills is a major worry. As per DISCOs, the collection of lower bills alone will cost the power sector

PKR 171 billion in 2019. The energy crisis in Pakistan is a result of the country's inability to upgrade its power infrastructures and switch to sustainable energy resources. It is quite far out in the renewable energy sources like windy and sun electricity, which are more affordable than hydroelectric and regional coal by a factor of two.

VIII. II. FINANCE

The shortage of financial means is among the major issues CPEC's energy projects are experiencing. The funding necessary for energy projects cannot be supplied by the Pakistani government. International financial institutions are likewise unable to provide the authorities with the necessary funding. For the different investment programs, the officials have made several different finance options possible. Transportation and infrastructure projects for the CPEC are funded by long-term, low-interest governmental loans from China. Energy-related CPEC projects entail overseas direct investments and commercial lending from Chinese financial firms, whether by Chinese investors or joint ventures with a large foreign ownership percentage. Non-CPEC energy projects can be financed by private local funding, private corporate funding, or government-subsidized loans from foreign financial organizations.

VIII.III. SECURITY

Security is another issue. Since a very long time ago, terrorists have been a major problem in Pakistan.

VIII.IV. TECHNICAL ISSUES

Technical problems also exist with the CPEC energy projects. Most of the technical problems are connected to the transmission and circulation of power. The running and upkeep of the power plants is another problem that the energy projects are dealing with.

VIII.V. CAPACITY BUILDING

The CPEC's energy projects are also having trouble developing their capacity. The majority of the capacity-building concerns are connected to the instruction of the staff who will be running the power plants. The capacity expansion of transmission firms is another challenge that energy projects are now dealing with.

VIII.VI. ENVIRONMENT CHALLENGE

Environmental and social challenges are present in the CPEC's energy projects as well. The majority of the environmental problems are connected to power plant pollutants. The social problems are largely connected to the eviction of residents from the locations in which the power stations are being built (Pandya et al., 2017). Shortage of investment, inefficiency, and Pakistan's heavy reliance on foreign oil and gas are just a few of the problems the country's energy industry is facing. Air pollutants, water scarcity, and an increase in the frequency of dangerous waste disposal facilities are just a few of the country's many environmental problems. There are still some major eco-friendly concerns regarding the CPEC that are related to energy plans within Pakistan. The major asset of the CPEC, US$33 billion, is still owed to 19 energy projects to address the energy crisis in these regions. Three-quarters of the newly premeditated energy decisions are still based on traditional coal-fired power stations in the provinces of Sindh (Thar-I and Thar-II coal power plants), Punjab (Sahiwal then Salt Range coal power plants), while also Balochistan (Hub and Gwadar coal power plants) (CPEC 2019). 30% of the energy assets beneath these CPECs are under attack from renewable energy cohort alternatives including hydropower, solar, and wind power projects to prevent greenhouse gas emissions in this area (CPEC Authority).

VIII.VII. CORRUPTION

Additionally, corruption problems are present in the CPEC energy projects. The majority of the corruption concerns surround the selection of contractors to build power plants. The mishandling of finances by the authorities of the energy projects is another factor in the corruption problems (Crooks, 2017). China's resolve commits roughly $28 billion to the outline of the far-off direct asset this $46 million. Nevertheless, Pakistan still needs to decide how to spend the remaining $18 billion, despite its desire to continue moving forward by taking advantage of China's negotiated concessions.

VIII.VIII. RISING COST

The current rise in energy prices has provided us a preview of what the market can look like in the future if the switch to low-carbon sources of energy is not properly facilitated or encouraged. Pakistan may have a very difficult and devastating winter as a result of officials' failure to develop long-term power management plans.

VII.IX. CHRONIC ENERGY SHORTAGES AND SUBSTANTIAL UNDERINVESTMENT

Another issue is the ongoing lack of funding for infrastructure improvements and severe energy outages. The government places a 2 percent annual price of GDP on these issues for the economy. Heavy dependence on furnace oil during a time of soaring oil prices, coupled with administrative and operational inadequacies and poor tariff setting, resulted in significant and ongoing failures in the power sector, which then in turn caused the sector to

accumulate arrears (also known as "circular debt"), underutilize its capacity, and invest heavily in latest energy sources. Power cuts that lasted an average of 10 to 12 hours per day were caused by the energy supply-demand mismatch that resulted. In addition, public investment represented just approximately 3.5 percent of GDP on average, which is much less than the above 6% of Gdp average in comparable growing nations

VIII.X. Upcoming obstacles for the CPEC energy sector

The political climate in Pakistan poses a potential threat to CPEC since it is unstable and erodes confidence in China's government and investors. The National Grid of Pakistan is close to achieving its goal of having access to about 10,000 megawatts of power in 2018. Future obstacles in the CPEC energy industry include the ones listed below.

1. Maintaining energy security: CPEC's energy industry has several difficulties, including maintaining energy security. The viability of the CPEC plan depends heavily on the energy sector, which is why. To satisfy the increasing energy needs of the CPEC projects, the energy sector must ensure the uninterrupted and constant delivery of electricity.
2. Dealing with upcoming energy needs: Managing upcoming energy needs is yet another challenge the CPEC energy sector confronts.
3. Increasing energy consumption is a problem that the CPEC energy industry must overcome. This is because a significant portion of the nation's overall energy utilization is accounted for by the energy industry. The industry may increase energy consumption by using best practices and so more effective technology.

VIII.XI. OVERCOMING ENERGY CHALLENGES BY CPEC

The lifeblood of each nation's economy is said to be its access to energy. It is the most dynamic tool for a nation's socioeconomic progress. Pakistan has had serious energy shortages as a result of population increase and industrial demand. Political unpredictability, a geometrically growing demand for energy, and inadequate efficiency are the main causes of Pakistan's poor energy output. Since electricity supply is one of the primary requirements in this age of contemporary technology, no meaningful remedy to the issue has yet been discovered, and it still plagues the inhabitants. In all regions around Pakistan, particularly in the main cities, power outages and load shedding (planned outages) are frequent occurrences.

VIII.XII. MACROECONOMICS

- Reforms implemented by the government in previous decades have resulted in appreciable progress. In FY2015/16, power outages in the residential segment averaged roughly 6 hours per day and in the industrial sector, less than 2 hours per day. This improvement was made possible by lower oil costs, attempts to bring electricity rates nearer to price restitution, increased payments, and decreased losses. Parallel to this, efforts to increase tax revenue and rationalize spending have allowed the public sector growth program to be expanded by 0.5 percent of GDP accumulative over the previous three years. This is because the concentration of debt servicing has slowed significantly and there is now more room to do so.
- Increasing the external reserves and producing export earnings. To withstand the era of rising BoP outflows, it would be crucial to significantly boost the State Bank of Pakistan's (SBP) foreign exchange reserves by taking benefit of the current cheap oil prices. To preserve long external sustainable development and realize the positive advantages of CPEC from improvement in energy resource and transportation infrastructure, it will be essential to implementing powerful and prolonged proposed reforms that aim to boost export markets by enhancing competitive advantages and the economic outlook.

IX. CONCLUSION

Pakistan has crises in its energy sector like power cutoffs, shortage of its resources, theft of power, etc. Therefore, CPEC also facing these challenges in Pakistan's energy sector. The industrial sector in Pakistan has to adopt the best strategy to counter Chinese domination and profit from CPEC. On the one side, China-Pakistan Economic Corridor offers opportunities, while on the other, it poses a threat. But Pakistan's industrial sector should focus on using the best strategies to be benefited from CPEC. Under the CPEC, the energy sector of Pakistan has many challenges. Technology issue is one of them that must be counted because the construction of several mega projects, personnel with technical ability will be needed in the future, thus Pakistan must launch an endeavor to train a trained workforce. Similarly, to encounter other challenges in the energy sector the government must speed up CPEC projects. In Pakistan's energy sector, especially about electricity or power outages have grown commonplace. Given this alarming history of energy-related issues, CPEC's entry is a gift for Pakistan's energy sector. Despite the fact that CPEC presents both a threat and a potential to Pakistan's energy industry, the government should nevertheless implement various policies and methods, to address the challenges. To meet the country's energy demands, a lot of power plants are built and placed in various locations. As a whole, CPEC will contribute to Pakistan's energy sector growth as well as give its citizens access to employment opportunities.

X. RECOMMENDATIONS

1. To cope with the challenges of energy sector the whole nation should set a goal to use renewable energy resources as its primary energy resource. Both money and time are hugely necessary.
2. To meet the aim of the renewable energy industry challenge, the existing channels must be used to their fullest potential.
3. The power collaboration under the aegis of the CPEC, the appeal of FDI, discussions with territorial and worldwide organizations for new investment in Pakistan's power industry, and the utilization of the country's reserves may not only solve the challenges of the power industry but, to a certain extent, they will also be beneficial in resolving the concerns of weather change as Pakistan has already experienced unparalleled hardship from rising temperatures.
4. The needs of Pakistan's power industry must be taken into consideration while choosing new projects for the CPEC power sector in order to meet with its challenges.
5. Since the nation has already demonstrated its ability to produce excess energy, the launch of new power transmission initiatives and the upkeep of current ones ought to be the major objectives for CPEC power generation.
6. To confront the cpec's challenges in the energy industry, the redirect investment on the technical aspects, which includes the electricity distribution system and combat energy theft, Islamabad has to revise the 6 power-producing projects that are now under development and the 5 that are being considered.
7. The next administration must engage with the IMF to lift the outgoing administration's levies on sustainable energy sources, which were a requirement for an IMF bailout and can play a crucial part in overcoming the challenges facing the CPEC energy industry.
8. To meet with financial challenge and financing early shutdown, Pakistan could sell its fossil-fired plants under the Energy Transition Mechanism of the Asian Development Bank.

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