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Credit Rating Company Limited

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## PAKISTAN POWER SECTOR REPORT

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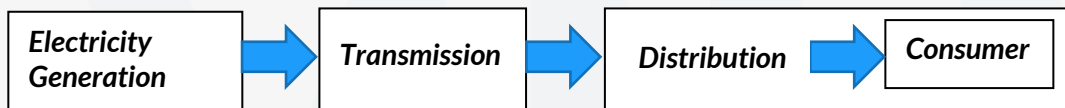
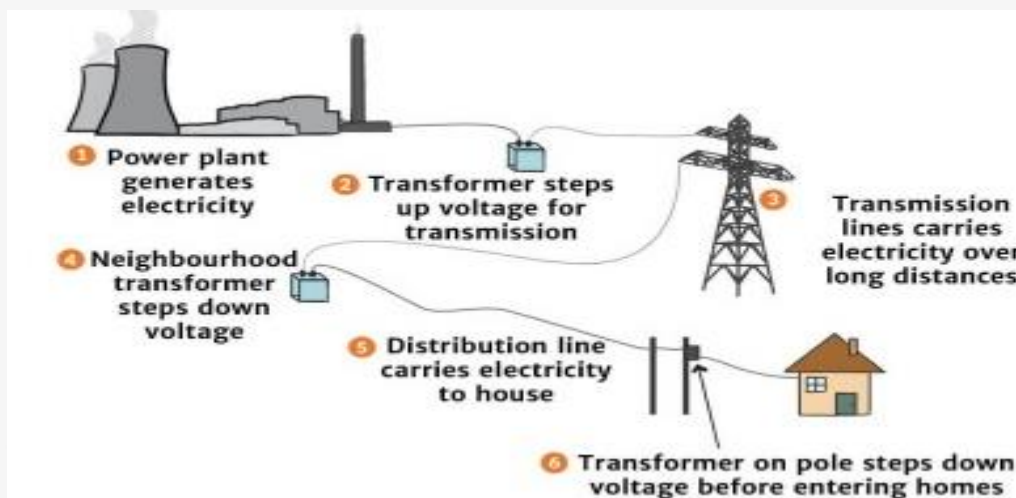
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## INTRODUCTION

Electricity generation is the process of generating electric power from sources of primary energy. Usable electricity is not freely available in nature, so it must be "produced". Electricity is most often generated at a power plant by electromechanical generators, primarily driven by heat engines fueled by combustion (Gas/Oil/bio) or nuclear fission but also by other means such as the kinetic energy of flowing water and wind. Other energy sources include solar photovoltaics cells and geothermal power.

After electricity has been generated, a system of electrical wires carries the electricity from the source of generation to our homes and businesses. These lines can be found overhead or sometimes in the ground, and, combined, transmission and distribution lines make up what is commonly called "the grid." Transmission and distribution are two separate stages or systems on the grid. Transmission is the "interstate highway" of electricity delivery. It refers to the part of electricity delivery that moves bulk electricity from the generation sites over long distances to substations closer to areas of demand for electricity. If transmission is the interstate highway of the grid, distribution is the city street. It is the last leg of the delivery of electrical power from generation to the consumer. Distribution is the power that turns on and runs the appliances we use every day to keep our food fresh, our clothes clean and our homes either cool or warm.

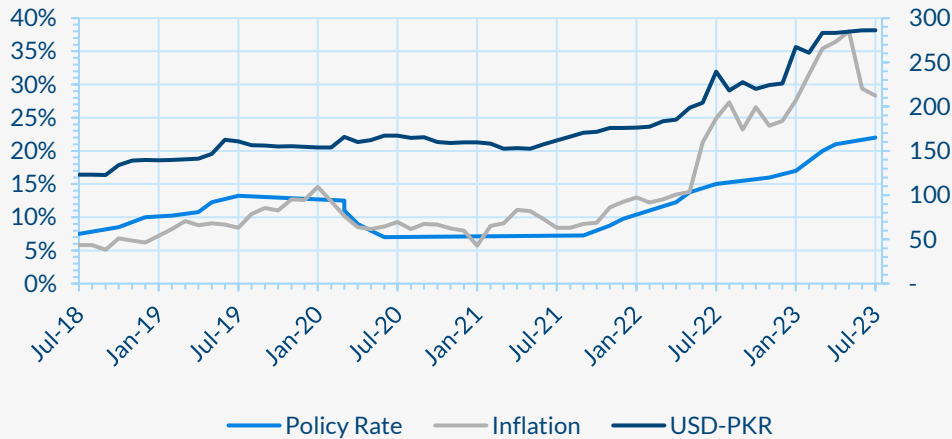


Power sector is crucial for global economic growth and development. The power generation market has experienced rising demand due to population growth, urbanization and economic expansion. The demand is expected to increase further given ambitious economic growth targets of the nations. Environmental degradation resulting from burning of fossil fuel for electricity generation is a serious issue facing the power sector, which is being addressed through regulations limiting emission to environment and moving to renewable sources of energy.

## ECONOMIC OVERVIEW

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The Pakistan economy is undergoing severe stress due to a combination of domestic and external factors. GDP growth has fallen to just 0.29% in FY23 down from 5.7% in FY22; however, the same is expected to improve to 3.5% during FY24. Persistently high inflation above 30% continues to erode purchasing power while tight monetary policy is hindering investment and growth. Moreover, import restrictions imposed to preserve foreign exchange reserves have led to shortages and production disruptions across industries. The devastating floods in 2022 damaged agriculture, infrastructure and livelihoods, inflicting losses of over \$30 billion as per World Bank estimates.



Pakistan's energy sector has been a major retardant of economic growth. Despite more than required generation capacity Pakistan has been facing acute energy crisis over the years which has had a significant negative impact on Pakistan's economy.

- Businesses have been forced to close or scale back operations due to power outages, and the lack of reliable electricity has made it difficult for industries to operate at full capacity.
- Power outages have caused inconvenience and hardship for citizens, particularly during the hot summer months. Inadequate access to electricity has also made it difficult for people to access basic services such as education and healthcare.
- The energy crisis has contributed to increased poverty in Pakistan, as many people have lost their jobs or seen their incomes reduced due to power outages and the resulting economic damage.
- The energy crisis has led to increased use of fossil fuels and wood-burning for power generation, which has contributed to air and water pollution and deforestation.
- The energy crisis has led to reduced foreign investment in Pakistan, as investors are deterred by the lack of reliable electricity and other infrastructure.
- Pakistan's energy crisis has led to increased production costs, which has resulted in reduced competitiveness in international markets.

Overall, the energy crisis in Pakistan has had a wide-reaching and negative impact on the country's economy and society, and resolving the crisis will be crucial for achieving long-term economic growth and development.

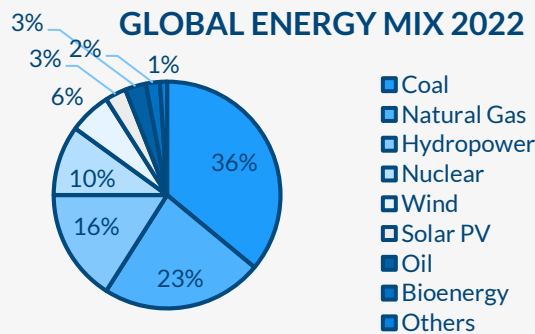
## GLOBAL PERSPECTIVE

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The three principal drivers of increase in energy demand are the surge in economic activities, population growth and rapid technological transformation in the world. In 2022, coal, gas and hydro accounted for around 73% of global electricity production. China, US and India were the top producers. The global power generation market is projected to grow from USD 1.8 trillion in 2022 to USD 3.9 trillion by 2032 at 8% CAGR. Key growth drivers are population growth, urbanization and transition to smart grids.

Fossil fuels (coal, natural gas, oil) continue to dominate global electricity production, accounting for around 61% of total generation in 2022. However, the share of renewables has been increasing steadily over the years. In 2022, renewables accounted for 29% of global power output. The top 3 sources in global power generation currently are Coal, natural Gas, and Hydropower. Other major sources are nuclear, wind, solar PV, oil, and bioenergy.

Transition from fossil fuels to clean energy sources is underway globally but at different speeds across countries. China generates around 50% of its electricity from coal. In comparison, the US produces 20% from coal while European countries are phasing out coal. The US and European countries rely more on natural gas and nuclear along with expanding renewables aggressively. Developing countries still have a major share of coal and gas. Renewables growth is faster in these countries but from a smaller base. Going forward, the share of renewables is expected to rise significantly given falling costs and global climate change goals. But coal and gas will remain major sources in the medium term.



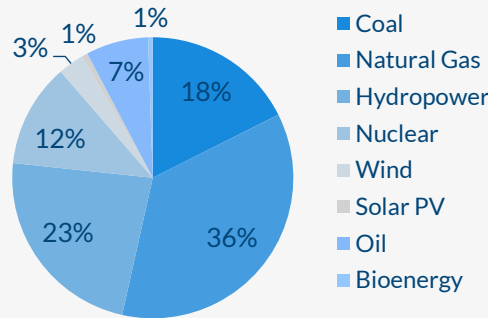
## PAKISTAN SECTOR

## POWER

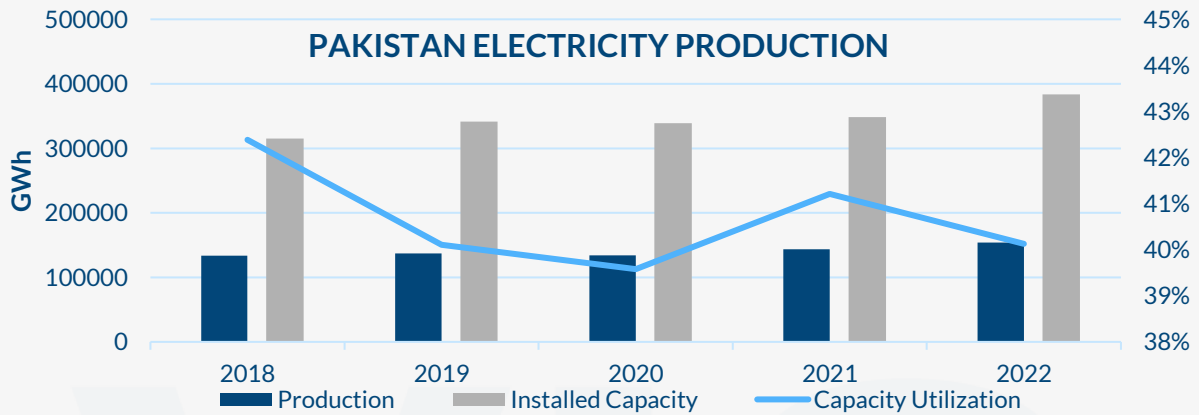
### CAPACITY AND PRODUCTION

Pakistan has a total installed power generation capacity of 43,775 MW as of 30 June 2022 which includes 26,683 MW thermal, 10,635 MW hydroelectric, 1,838 MW wind, 630 MW solar, 369 MW bagasse and 3,620 MW nuclear. A coal based plant of 1,320 MW has started production in February 2023 taking the installed capacity to 45,095 MW, while further capacity of 11,308 MW, mainly hydropower and Thar coal, is under construction. Going forward the Government plans to focus on hydropower, local coal and renewable sources for further capacity additions. Additionally there are a number of small captive power plants (CPPs) set up by textile, sugar, cement and other heavy industries. They have been set up due to the inconsistency in supply of national grid and lower production cost. These CPPs have estimated installed capacity in the range of 2,000 to 4,000 MW and supply excess power to the national grid after meeting their in-house requirement.

### PAKISTAN ENERGY MIX 2022



Electricity generation has increased steadily from 2018 to 2022, growing at a CAGR of 8.5% over this period from 133,588 GWh in 2018 to 153,874 GWh in 2022. Whilst the installed capacity additions have been robust in the last few years, the capacity utilization however has remained relatively low, hovering in the range of 40-45% over 2018-2022 (assuming 8760 hours per year of operations). This indicates inability to fully utilize installed capacity due to factors like power plant maintenance, fuel supply issues, transmission constraints etc.

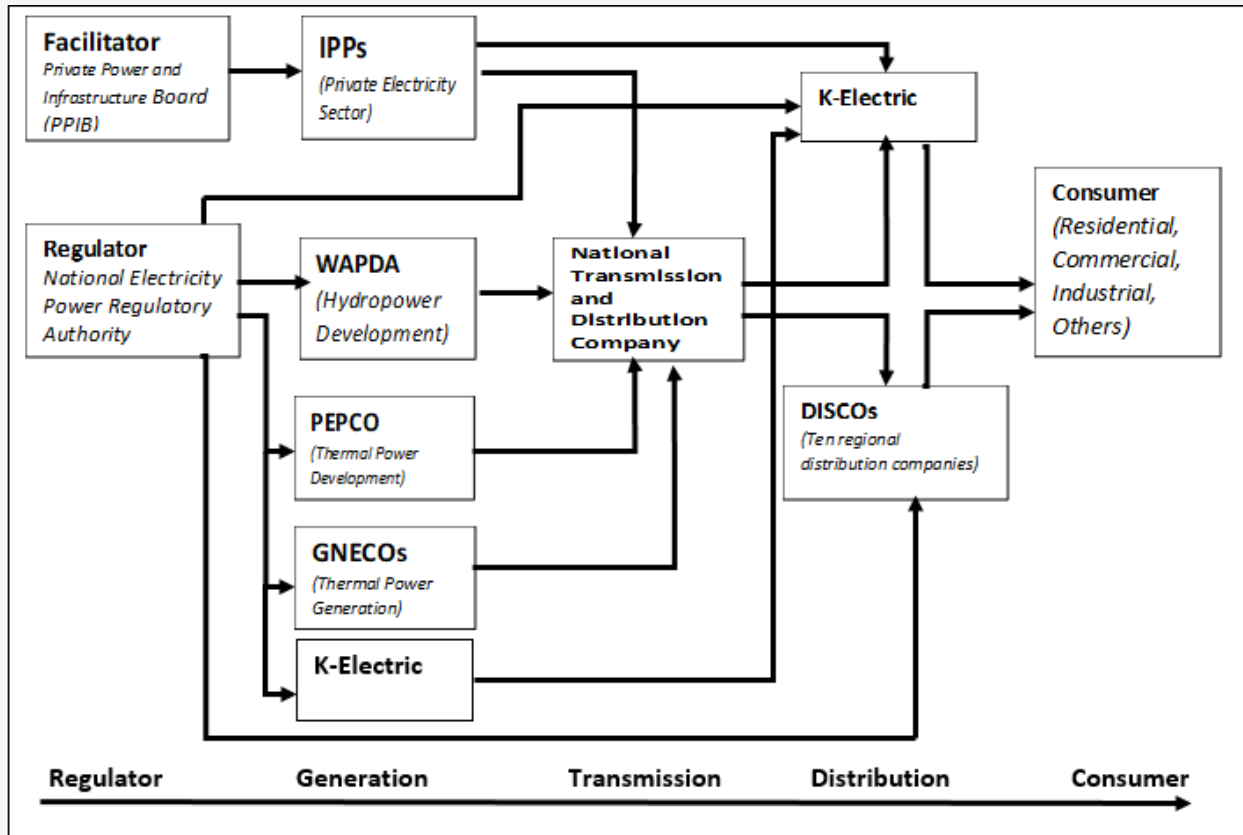


Some 80% of the population in Pakistan have access to electricity. In 2022 the maximum total demand coming from residential (47%), industrial (28%), commercial (7%), agricultural (9%) and others (8%) stands at nearly 31,000 MW, whereas the transmission and distribution capacity is stalled at approximately 22,000 MW. This leads to a deficit of about 9,000 MW when the demand peaks. This additional 9,000 MW required cannot be transmitted even though the peak demand of the country is well below its installed capacity leading to long hours load shedding.

## POWER SECTOR STRUCTURE

Historically Pakistan's power sector was dominated by vertically integrated, state-owned companies that were involved in all aspects of the electricity supply chain - generation, transmission, and distribution. The power sector has now been opened up significantly to private sector participation, especially in generation and marginally in distribution. The transmission grid and regulatory enforcement however largely remain under state control though a 900 km 660 KV 4,000 MW capacity transmission line has since been commissioned under CPEC projects. Also some of the private sector companies have been licensed by NEPRA to setup transmission lines on a build-own-operate-transfer (BOOT) basis.

### Pakistan Power Sector Structure



### Generation

WAPDA's role in power generation has decreased over the years. It now accounts for around 30% of the country's power generation capacity mainly in hydropower. Private sector power producers, especially independent power producers (IPPs) now account for over 50% of installed generation capacity in Pakistan. There are 46 IPPs having combined installed capacity of 22,174 MW. New power projects are primarily being developed by IPPs. Major private power companies include Hub Power Company, Port Qasim Power Plant, SSRL Thar Coal Power Plant, China Power Hub Generation Company and KAPCO. Many IPPs have Chinese investment. Renewable energy generation from solar and wind projects is increasing, mostly being set up by IPPs. The government has also been promoting construction of hydroelectric power projects in Khyber Pakhtunkhwa and Azad Kashmir regions. These are being developed with Chinese assistance. KESC has been privatized and rebranded as K-Electric. It handles all generation, transmission and distribution for Karachi and adjoining areas.

Provincial governments have also started contributing in power generation. Government of Punjab has set up 2,500 MW of power projects either on own or in participation with the private sector. Similarly Government of Sindh is actively participating in Thar coal projects.

## Transmission

The National Transmission and Dispatch Company (NTDC) is the dominant transmission company but private sector participation is increasing to upgrade the transmission network to international standards. NTDC owns and operates the 500kV and 220kV national transmission grid network across Pakistan that carries electricity from generating power plants to distribution companies. NTDC's transmission system consists of approximately 12,789 circuit kilometers of transmission lines and 159 grid stations. The transmission network interconnects the generation facilities in different parts of Pakistan with major load centers and distribution companies. NTDC is responsible for system planning, expansion, operation and maintenance of the transmission network. It has to ensure safe, reliable and efficient transmission of power. The Power Policy 2015 aims to promote further private investment in transmission infrastructure and allow third party access to the transmission network on open access principles. In recent years, some private transmission companies have also been licensed by NEPRA to setup transmission lines on a build own-operate-transfer (BOOT) basis. These include Matiari-Lahore HVDC line by Pak Matiari-Lahore Transmission Company. To upgrade and expand the transmission system, several new transmission line and grid station projects are underway such as 660kV Siddiq-Neelum Jehlum HVDC project, 500kV Faisalabad West grid station etc. The transmission network faces issues like overloaded lines, high transmission losses and unreliable power supply. Investment is required to upgrade it to a robust smart grid.

## Distribution

Electricity distribution and retail supply in Pakistan is still dominated by publicly owned DISCOs. There are 10 public sector distribution companies (DISCOs) owned by WAPDA and K-Electric (formerly KESC), which is the only privatized DISCO. These DISCOs are monopolies, responsible for distributing electricity to consumers within their allocated geographical regions.

The DISCOs purchase electricity from NTDC or generation companies and deliver it to end consumers including residential, commercial and industrial customers. The DISCOs operate extensive 11 kV and 132 kV sub transmission and distribution networks comprising lines, poles, transformers, feeders etc. that deliver power to end consumers.

Technical and commercial losses in the distribution system are quite high, averaging around 19%, primarily due to power theft, poor infrastructure and low collection. To improve this, DISCOs are carrying out investments in network upgrades, smart metering, and anti-theft programs. Some DISCOs like IESCO have installed AMI meters to automate meter reading and billing. Load shedding and service reliability remains a major issue especially in summer when electricity demand exceeds supply DISCOs then resort to scheduled power cuts. The government is undertaking reform programs like the DISCO Performance Improvement Project to improve operations, management and consumer service in DISCOs.

## Regulators

The National Electric Power Regulatory Authority (NEPRA) is the central power sector regulator in Pakistan. It was established in 1997 to promote competition and private investment in the energy market and aims to balance interests of power producers and consumers. NEPRA is responsible for licensing, tariff determination, and setting performance standards for generation, transmission and distribution companies. It reviews and approves power purchase agreements with IPPs.



Provincial regulators and other bodies like Oil and Gas Regulatory Authority (OGRA) also play important oversight roles for different aspects of the energy market. OGRA regulates gas supply to thermal power plants. National Transmission & Dispatch Company (NTDC) - Manages power purchase agreements with IPPs in addition to its transmission functions.

In addition, there are provincial electricity regulatory authorities that oversee electricity regulation within their respective provinces with limited autonomy. These include PERA in Punjab, SERA in Sindh, BERA in Balochistan and KERA in Khyber Pakhtunkhwa.

Other key governmental agencies that work in tandem with the NEPRA and power companies and enable planning, project facilitation, procurement, infrastructure coordination and rural access expansion for Pakistan's power sector include:

- Private Power & Infrastructure Board (PPIB) - Facilitates private investment in the power sector by supporting projects through processing agreements and clearances.
- The Alternative Energy Development Board (AEDB) promotes adoption of renewables in Pakistan through policy advocacy, facilitation of projects, and wind/solar resource mapping. It has since been merged with PPIB.
- Central Power Purchasing Agency (CPPA) - Procures power from generation companies through power purchase agreements on behalf of distribution companies.
- National Power Control Centre (NPCC) - Carries out integrated operation and real-time scheduling of generation facilities and transmission network.
- Pakistan Atomic Energy Commission (PAEC) - Promotes and oversees nuclear energy generation.
- Rural Electrification Board - Implements rural electrification projects in coordination with DISCOs.

## POWER SECTOR DEREGULATION

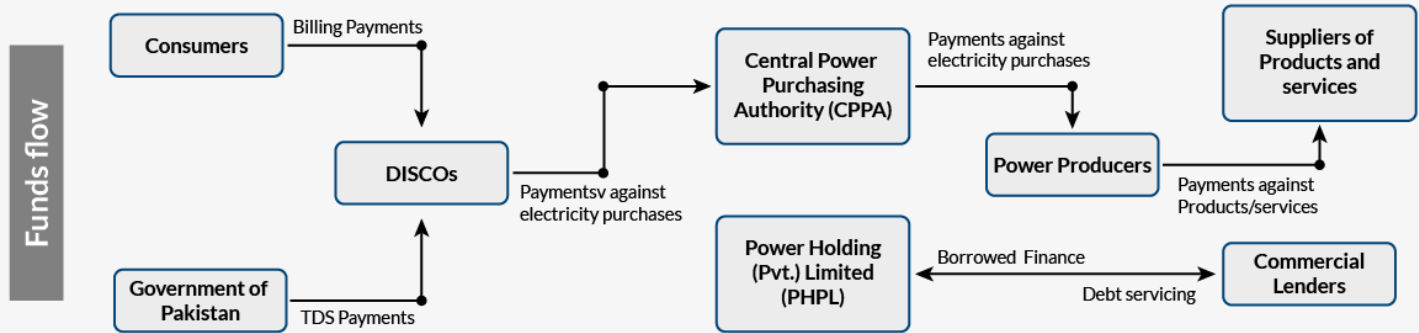
Pakistan plan to introduce the Competitive Trading Bilateral Contracts Market (CTBCM) to deregulate the power sector, allowing private power generators and consumers to purchase and sell electricity; though the government has missed many commitments to IFIs in this regard. Successful implementation of the CTBCM will result in transition from multi-seller-single-buyer model to multi-seller-multi-buyer model thus bringing more competition between the participants in the generation, transmission, distribution and consumer of electricity.

## SECTOR ISSUES

Pakistan's power sector is beset with major issues such as rising circular debt, weak demand management, transmission and distribution losses, capacity payments and reluctance for structural reforms. Aging infrastructure, opaque policies, reliance on imported fuel, lack of competition, sustainability issues with coal and adoption of renewable energy are other key challenges.

### RISING CIRCULAR DEBT

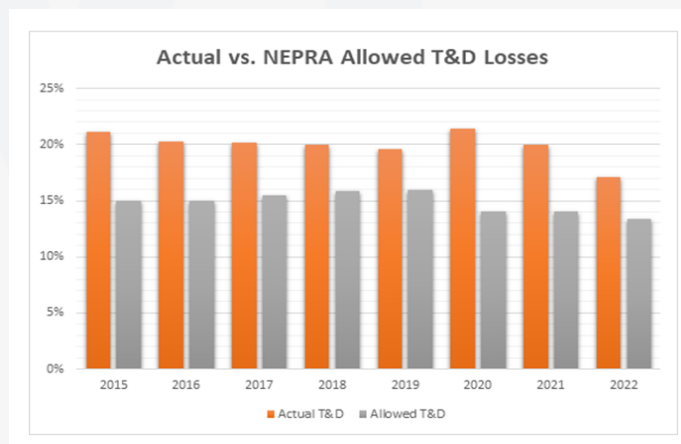
Circular debt is the net unfunded outstanding liability position of the power distribution companies (DISCOs) to the Central Power Purchasing Authority-Guarantee (CPPA-G). This cash flow shortfall incurred from the non-payment of obligations by consumers, distribution companies, and the government.



The power sector circular debt in the electricity sector has increased 3.8 times since 2016, from Rs. 689bn to Rs. 2,631bn as of end April 2023 as under:

As of April 2023	Rs in Billion
Payables to IPPs	1,767
Fuel Payables	99
PHPL Payables (borrowing cost to bridge circular debt)	765
<b>Total</b>	<b>2,631</b>

Historically, five key contributors to the circular debt flow have been (i) high cost of power generation eventually contributing to the DISCOs’ collection and operational inefficiencies, (ii) pitfalls and delays in the tariff determination, (iii) high transmission and distribution losses and poor revenue collection by the DISCOs, (iv) partial (and often delayed) tariff differential subsidies (TDS) payment by the government to DISCOs and K-Electric, and (v) high financial costs on borrowings to bridge the circular debt and expensive late-payment penalty charges on the CPPA-G payables. Shift of National Grid power consumption to domestic consumers has also contributed significantly to rise in circular debt. Domestic consumers are subsidized by the government, which does not make timely payments to the DISCOs timely, which in turn default on payments to fuel suppliers. Power theft is also a serious issue in domestic consumer segment resulting in low recoveries further adding to the circular debt. The NEPRA 2022 State of Industry Report revealed that DISCOs exceeded the permitted T&D losses of 13.41% by 3.72 percentage points resulting in substantial financial losses of PKR 113 billion in FY 2021-22



A circular debt issue has built up menacingly in the gas sector too. Combined, the twin problem is an existential challenge for the economy. Though the government has renegotiated purchase agreement with a significant number of IPPs, the medium-term outlook for the resolution of the electricity circular debt issue is not very promising.

## Excess Installed Capacity

Currently there is some 14,000 MW of excess capacity (difference between installed capacity and peak demand) in the system due to limitation of the transmission and distribution lines for evacuation of electricity from power plants to end consumers. Overly optimistic economic growth projections, upcoming decommissioning of some IPPs and inefficient/unfeasible high cost of production of some of the power plant were used to justify the larger-than-needed generation capacity along with the ironclad sovereign guarantees and take-or-pay contracts have given rise to multiple issues in the power sector. Planned capacity additions will further aggravate the issue.

## Fuel Supply Chain Management

Since the electricity mix of Pakistan is thermal fuel dominant, management of the supply chain of primary fuels is vital to ensure that the efficient and cheap power generation capacity shall remain available to suffice the electricity demand. The power sector faced a shortage of RLNG in recent years which compelled generation from expensive power plants adding substantially to the electricity cost. This issue can be resolved by better Supply Chain Management of RLNG including enhancement of gas transmission and distribution infrastructure, development of storage facility for RLNG, and implementation of hybrid GSA models to optimize the utilization of RLNG.

## Electricity Cost

The cost of fuel and electricity has enhanced cost of overall production, consequently higher prices have substantially increased cost of living which further eroded the purchasing power of households across the world. Currently, global economy faces higher energy prices which may remain intact due to the Russian-Ukraine war. The war has led to significant disruptions to the production and trade of commodities for which Russia and Ukraine are key exporters. World Bank's (WB) latest forecasts indicated that war in Ukraine is set to trigger the largest commodity shock. This would contribute to huge price surge for energy related goods including oil and natural gas. The WB report further revealed that energy prices are set to increase more than 50 percent, pushing up cost for households and businesses. This situation has raised concerns at global level, particularly for the developing economies where provision of energy subsidy has become a major challenge due to weak fiscal position.

## Aging Infrastructure

The existing generation equipment and the system mostly rely on aging infrastructure. A large portion of Pakistan's power generation capacity is from old and inefficient power plants. Also the transmission and distribution infrastructure in Pakistan is inadequate and outdated, leading to significant losses of electricity during transmission and distribution.

## OUTLOOK – STABLE

Pakistan's energy requirements are increasing and demand for energy in the coming years will rise substantially. Constraints in the transmission and distribution networks, increasing electricity cost, rising circular debt and the economic challenges however are likely to somewhat dampen attractiveness of the power sector in Pakistan.

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