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Institute of Policy Studies
Islamabad

Pitfalls in Power Sector of Pakistan

Accumulation of Circular Debt - Causes, Consequences and Way Forward

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Pitfalls in Power Sector of Pakistan

Accumulation of Circular Debt – Causes, Consequences and Way Forward

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Foreword

Institute of Policy Studies, Islamabad, founded in 1979, is an autonomous not-for-profit, civil society organization dedicated to promoting policy-oriented research. Since its inception, energy policy is one of the priority research areas of the institute. Energy, water, and climate change is the dedicated program of IPS with the principal focus currently on renewable energy transition in Pakistan. Moreover, the program also oversees the essential topics associated with energy; mainly energy economics, climate change impacts, off-grid electrification strategies, green financing, and energy markets.

Circular debt has been an entangled and unresolved issue of the power sector of the country for more than a decade. Apart from the issues of governance, inadequate policy frameworks and failure in implementation of the policy decisions and ambitions have mainly contributed to the accumulation of circular debt. Moreover, the reliance on imported fuels for power generation is the accepted fact mainly resulting in the exponential increment in the cost of generation.

We have also failed to maintain an efficient electricity network. Thus the financial losses kept increasing, resulting in increasing accumulation of circular debt. The report in hand includes a detailed overview of the power sector, the governing policies, tariff structures of the generation facilities, the factors contributing to circular debt and financial analysis of the concentration of these factors, and suggestions and recommendations for the resolution of the issues.

While presenting this report, I would like to thank the worthy members of IPS Energy Steering Committee including Mr. Mirza Hamid Hasan, Mr. Ashfaq Mehmood, Ms. Ameena Sohail, and Mr. Syed Akhtar Ali for their valuable inputs and feedback on this study.

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Executive Summary

Availability of affordable and adequate energy, of which electricity is a major component, is a basic requirement for rapid economic development and growth of every country in the modern world. Pakistan is a low-income developing country with a severe energy crisis, affecting badly the overall economy of the country. The power sector of Pakistan has been strangled with issues that are continuously enhancing the circular debt. Some of the highlighted factors which contribute to the exponential rise of circular debt include; dependence on imported and expensive fuel, the high share of generation from thermal sources, unfavorable rupee to dollar parity, wrong economic choices, poor governance and policy lapses, inadequate recoveries of DISCOs revenues, high transmission and distribution losses, vertical-integrated power markets and lack of competitiveness. In the overall installed capacity, 67% of generation comes from thermal power stations based on residual furnace oil, imported and local coal, and re-gasified liquefied natural gas. Besides, the market structure of Pakistan has been developed as partially monopolized, where the state institutions play a dominant role. The vertically integrated market of the power sector results in non-existent competition between the entities. The escalation of circular debt immensely disturbs the energy affordability of the consumers, where regular price hikes are required by the regulatory authority to maintain the proper cash flow of the public and private entities of the power sector. The major contribution to the debt has been due to the government policies to regulate the uniform tariff, while the generation prices kept increasing due to the rise in the international oil market and increasing rupee devaluation. The power sector policies of 1994, 1998, 2002, and 2015 have allowed a cost-plus tariff regime based on take or pay. Moreover, to attract foreign investments, the IPPs were allowed to include the variable payments in the capacity component of the tariff, adjustable to the rupee-dollar variations. Furthermore, the low merit orders of certain IPPs with a large capacity as determined in the economic dispatch by the system operator worsens the condition due to high payables to IPPs under capacity payments. It has been observed that capacity payments have increased by an average of 43% in the year 2022 due to currency devaluation. The governance issues and inefficiencies in the distribution sector add up the contribution to circular debt, apart from the supply-side determinants. High technical losses, due to inadequate infrastructure account for the loss of Rs. 520 billion. This financial loss is then ultimately left unrecoverable, appearing in the circular debt. In addition, the incapability to recover the billed amount contributes to the loss of Rs. 23 billion a year. The demand-side constraints due to negligence and the conventional culture of operations are required to be focused on swift accelerated reforms for modernization.

On an overall scale, if all of the major power sector issues of the country are highlighted and factors associated with the issues are analyzed, governance and policy lapse are major areas needing to be resolved under the comprehensive framework with the speedy practical implementation of reforms. About the resolution of the pitfalls, some of the practical implemental solutions/resolutions presented in the report are summarized as follows:

1. The transition towards renewable energy is of paramount importance based on distributed generation, development of business models to boost renewable energy at the grassroots level of society, provision of incentives in tariff structure, and development of utility-scale projects.

2. Liberalization of the energy market needs to be incorporated leading to the opening up of the sector to more competition, involving the relaxation of government restrictions, in parallel with the inclusion of business entities to commercialize the operations. Hence, deregulation of the power

sector, privatization, and competitive trading of energy are the key implementing steps for opening up the power markets.

3. Renegotiations and resettlement of generation tariffs for IPPs are required as the dependence of energy generation on IPPs is significant in the energy mix. The foreign currency components in the capacity payments, which are leading towards the accumulation of circular debt, should be re-negotiated and replaced expediting the indigenous resources.

4. The distribution companies, administering the operations and maintenance, supply, distribution, construction, and expansion of the distribution grid network within their respective areas of jurisdiction, require the division and segregation of the operations. Subdivision of the DISCOs and deregulating of the administrative and operational activities leading towards the public-private partnership can resolve the obscure/complicated issues of the distribution sector.

5. Rapid transition towards mini and micro grids is a necessity for rural electrification and far-flung areas located outside the jurisdiction of grid access.

6. Capacity-building for indigenous resources is required as generation costs have a strong relation to the dependence on the foreign market for resources, O&M, installation, fuel, and consultancies, which can be resolved by a gradual process of building indigenous resources.

Chapter 1

Inception

Electricity has remained a crucial issue for the last two decades in Pakistan. Although many ambitious reforms have been planned, the lack of implementation remains a significant dilemma in the sector. Electricity is a requirement of every industry, and this issue drastically impacts the country's economy. Pakistan is going through an immense economic crisis, and it is the need of the hour to overcome the energy crisis for the overall furtherance of the economy.

Electricity generation in Pakistan is mostly reliant on imported fossil fuels, which increases generation costs due to economic uncertainties. Furthermore, driven by losses in the distribution sector, the federal government has to subsidize electricity tariffs for consumers to maintain energy affordability. This imbalance in the cash flow has caused the emergence of circular debt. Moreover, some areas in Pakistan face a huge electricity shortfall, and consumers suffer 14-16 hours of load shedding. Pakistan's power sector is going through a cosmic energy crisis, which has created the following issues: electricity bills and tariff rates have a high rate of escalation, load shedding is the dominant concern in some areas irrespective of having excess generation capacity, immense distribution and recovery losses, and lack of an implementation plan to reduce the circular debt.

1.1 Issue of Circular Debt in Power Sector

Circular debt is a longstanding issue in Pakistan's power sector that has been present since 2006 when the government failed to increase tariffs in response to rising international oil prices. The debt has been exacerbated by technical inefficiencies, power theft, and a lack of balance between the receivables from the DISCOs and the payables to the IPPs. Tariff differential subsidies have been used to cover the gap between the cost of electricity and the notified tariff for consumers, which has led to increasing payables to the IPPs and a lack of funds for fuel procurement. The debt pile has continued to grow, reaching Rs. 366 billion by 2010, despite the implementation of measures such as quarterly adjustments and pass-on criteria. The government has injected liquidity to clear the debt temporarily, but the underlying issues such as inefficiencies in the distribution companies and underutilization of capacity remain unaddressed. The circular debt issue has persisted in Pakistan, and despite several efforts by the government to address the issue, it remains unresolved. The issue of circular debt has led to load shedding, power outages, and a lack of investment in the power sector, hindering economic growth and development in the country.

1.2 Targets Set by the Government in National Electricity Policy, 2021

As defined in the National Electricity Policy, 2021,[1] the supply of reliable, secure, efficient, and affordable electricity is one of the primary drivers for the sustainable growth of a nation's economy. The policy's vision is to ensure universal access to electricity through a self-sustainable power sector, developed and premised on optimal utilization of indigenous resources; integrated planning approach; efficient, liquid, and competitive market design; and affordable and environment-friendly outcome for consumers. It is targeted to ensure the accessibility of electric supply to all areas, including the far-flung regions, for the country's socio-economic development. Moreover, energy security, including the

[1] http://www.mowp.gov.pk/userfiles1/file/National%20Electricity%20Policy%202021.pdf

uninterrupted availability of energy sources, is an essential goal for the power sector. To ensure the sustainability of the sector, measures shall be taken to minimize environmental degradation, technical and operational sustainability, integrated development of the sector, and financial self-sustainability, including progressive elimination of circular debt. Efficiency, transparency, competition, financial viability, indigenization of research and development, and environmental responsibility are the key guiding principles of this policy.

For generation facilities, the determined targets imply emphasizing the least-cost option and ensuring that the consumer gets the cheapest electricity. To transition towards a cleaner, affordable, and secure generation mix, it is determined to reduce reliance on imported expensive fuel and shall move towards optimal utilization of local resources such as coal, hydro, renewable sources, local gas, and nuclear. Distributed generation is considered a sustainable solution for the electrification methodology.

For the transmission system, which serves as the backbone for sustainable and secure delivery of affordable electricity, efforts shall be made to develop a robust transmission network that complements generation plans for the smooth dispersal of power between generating stations and load centers. Such integration will ensure smooth operations of the power sector while avoiding congestions and blackouts/brownouts. Additionally, the distribution segment is the interface of the entire sector with the consumers. The financial viability of the entire sector is premised on the efficient operations of the distribution system and timely recoveries from consumers. The existing operations have resulted in the non-recovery of costs determined by the regulator, leading to the accumulation of circular debt, which threatens the sustainability of the entire sector.

The electricity policy indicates that effective and efficient performance of system operations is crucial for the power sector, as it enables safe, reliable, non-discriminatory, and economic dispatch of electric power from generation companies. Moreover, to address the woes of the power sector, the policy also endorses and guides the Competitive Trading Bilateral Contract Market (CTBCM).

1.3 Economic Indexes and Issue of Energy Affordability in Pakistan

Pakistan is a low-income developing economy with a population of 227 million,[2] the fifth most populous country in the world. It is the 24th largest worldwide in terms of GDP based on purchasing power parity (PPP). The nominal GDP of Pakistan stands at $347 billion with a nominal GDP per capita of $1,562 (160th worldwide). The GDP, based on PPP, stands at $1.329 trillion with a GDP (PPP) per capita of $5,973 (140th worldwide).[3] According to the World Bank, Pakistan has important strategic endowments and development potential. Its labor market is the 10th largest globally and Pakistan is number 67 among the global exporters. Yet, there is a large inequality within the society (Gini: 30 as per World Bank) and 21% of the population lives under the poverty line.[4] Pakistan is a semi-industrial economy and textiles, leather goods, sports equipment, chemicals, and carpets are its primary export commodities. The economy is suffering from internal political turmoil, a rapidly growing population, and mixed levels of foreign investments. Import/export contrariety has influenced the economy and dampened the GDP growth of the country.

[2] https://en.wikipedia.org/wiki/Economy_of_Pakistan#cite_note-35
[3] https://www.worldstopexports.com/pakistans-top-10-exports/
[4] https://energypedia.info/wiki/Pakistan_Energy_Situation#Overview

In the era of technology and advancements, access to energy is the prime need of the time. For Pakistan, a developing country with a weak economy and a rapidly growing population, energy affordability is a supreme issue. Extensive dependence on imported and expensive fuel for electricity generation is the major cause of costly electricity and energy hikes. The energy mix of Pakistan is thermal fuel dominant; the power sector is facing an immense shortage of re-gasified liquefied natural gas (RLNG), which has compelled the generation of expensive power plants.

Pakistan's energy mix is not balanced; the induction of renewable sources is paramount keeping in view the fuel prices, as high fuel price adjustments (FPAs) in monthly billing and tariff rates shoot up the electricity bills. This situation is affecting people badly, especially those with a small budget.

1.4 The Power Sector of Pakistan

The power sector was a monopolized business of the state, where generation, transmission, and distribution companies remained under the operational and management control of the Ministry of Energy (previously Ministry of Water and Power) till the early 1990s when the market was partially liberalized for the inclusion of independent power producers (IPPs). WAPDA – the sole company and authority responsible for hydropower generation, transmission, and distribution – was unbundled into ten distribution companies and one transmission company, while the National Electric Power Regulatory Authority (NEPRA) was initialized to regulate the power sector of Pakistan.

This transition from a completely monopolized to a partially monopolized market had one ambition at that time – to attract private investments in the generation business. At that time, the installed capacity of Pakistan stood at 10,800 MW.[5] The country faced a shortage of 2000 MW depending upon weather conditions as 60% of this installed capacity was based on hydel power generation. WAPDA had to control the hydropower facilities, while generation companies (GENCOs) oversaw the thermal generation, and IPPs were welcomed in the power sector of Pakistan. The contracts made with them were generous as the profitability and return on their investments were vibrantly guaranteed.

The IPPs, or non-utility generators (NUGs), are private entities (under an unbundled market), that own and or operate facilities to generate electricity and then sell it to a utility, central government buyer, and end users. The IPPs may be privately-held facilities, cooperatives, or non-energy industrial concerns capable of feeding excess energy into the system. IPPs invest in generation technologies and recover their cost from the sale of electricity. With the inclusion of IPPs, Pakistan's generation capacity has increased even more than its projected demand, the root cause being a lack of planning and the existence of certain policy lapses. Under the laws, NEPRA is required to regulate the sector in a manner that protects the interests of both investors and customers and helps to move the sector towards more competitiveness. The Federal Ministry of Energy (Power Division) oversees the power sector from a strategic vantage factor.

Pakistan's power sector can be visualized as three main phases: generation, transmission, and distribution.

a. The upstream part of the sector is the generation side. Electric power generation involves a variety of technologies; thermal, hydro, nuclear, solar, and wind, of which the major part is

[5] https://tribune.com.pk/story/1705399/one-power-policy-another

fossil fuel-based power generation having an installed capacity that contributes 57% of the total energy mix.

b. The state-owned transmission company, National Transmission & Despatch Company (NTDC), links the power generation units with load centers spread all over the country, establishing and governing one of the largest interconnected networks.

c. The distribution sector consists of eleven distribution companies, among which ten are state-owned under the Ministry of Energy, except K-Electric, which was privatized in 2005.

During FY 2021-22, a peak demand of 28,253 MW was witnessed in the system during June 2022 while in the winter season, the peak demand of the country came down to 15,962 MW during December 2021.

1.5 Statistical Overview of the Power Sector

The generation mix of Pakistan is diversified, ranging from hydro to thermal to nuclear power plants and renewable energy (RE) from wind, solar, and bagasse/biomass. Pakistan also imports electric power from Iran for the far-flung areas of Balochistan. The IPPs, which are private entities, also are part of the power generation besides the public sector.

a. Installed Capacity

The country's total installed capacity as of June 2022 was 40,813 MW (excluding K-Electric). Out of this, 33% is the share of RE which comprises hydro, solar, wind, and bagasse-based technologies, and 67% of installed capacity is contributed by thermal projects comprising local gas, local coal, imported coal, RFO, RLNG, and nuclear-based technologies. Moreover, in this 46% of the thermal generation share is of IPPs. Currently, 78 IPPs are operating in Pakistan and are based on imported fuel; of these 44% are based on natural gas, 30% on RFO, 21% on imported coal, 4% on local coal, and 1% on hydro. The installed capacity of the Central Power Purchasing Agency (Guarantee) Ltd. (CPPA-G) system is 40,813 MW out of which 23,821 MW is thermal (GENCOs, IPPs, SPPs), 10,635 MW is hydroelectric, 1,838 MW is wind, 530 MW is solar, 369 MW is bagasse and 3,620 MW is nuclear. The addition of the 1,145 MW K-3 nuclear power plant has significantly increased the nuclear power generation capacity in the country.

Table 1.1: Installed Capacity (MW)

Resource	*MW*
WAPDA Hydel	9443
IPPs hydel	1192
GENCOs	4731
IPPs	18750
SPPs/CPPs	340
Nuclear	3620
Wind	1838
Solar	530
Bagasse/Biomass	369

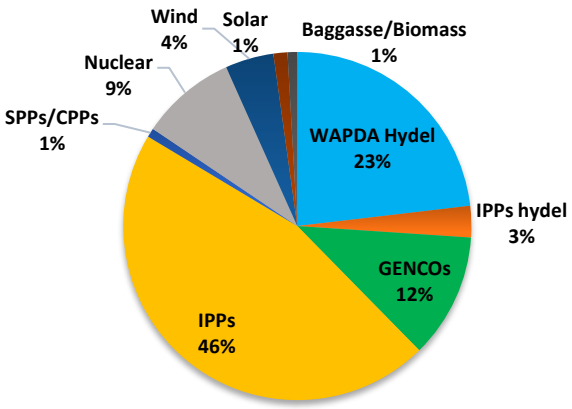

Figure 1.1: Fuel-wise Installed Capacity (MW)

b. Electricity Generation (GWh)

Total electricity generation in the country (including K-Electric) for FY2021-22 remained at 154,046.69 GWh. The total generation in the CPPA-G area remained at 143,108.69 GWh, which is 93% of the total generation. This comprises 35,546.28 GWh from hydro, 82,604.62 GWh from thermal sources (GENCOs, IPPs, SPPs), 18,247.77 GWh from nuclear, 6,195.66 GWh from renewables including wind, solar, and bagasse, and 514.36 GWh import from Iran.

Table 1.2: Electricity Generation

Resource	*GWh*
WAPDA Hydel	36982.54
IPPs hydel	1818.01
GENCOs	6802.93
IPPs	68,708.63
SPPs/CPPs	216.8
Nuclear	10871.01
Wind	2899.94
Solar	711.63
Bagasse/Biomass	710.56

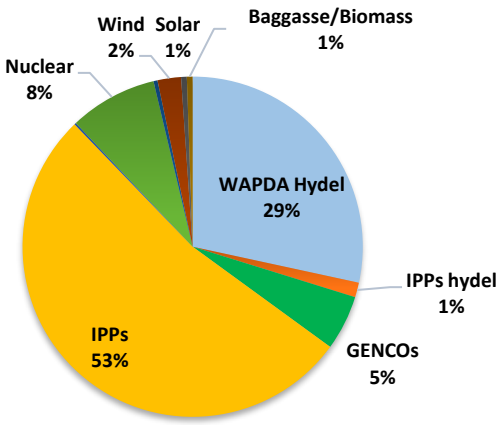

Figure 1.2: Electricity Generation (GWh)

1.6 Power Market of Pakistan as Vertically Integrated Monopoly

Pakistan's power market is currently structured as a single buyer model and is vertically integrated. Pakistan's power sector comprises three main segments: generation, transmission, and distribution. Overall, the power sectors come under the jurisdiction of the Power Division, Federal Ministry of Energy. It is the executive arm of the Government of Pakistan for all power sector issues pertaining to generation, transmission and distribution, pricing, regulation, and consumption. It also coordinates the plans of the national electricity sector and formulates policies and specific incentives.

Under the vertically integrated model, the government-owned power generation companies were responsible for producing electricity, which was then transmitted through the national grid managed by the NTDC. The distribution companies (DISCOs) were responsible for delivering electricity to consumers and managing the billing and collection of revenue. However, this model was marred by inefficiencies and mismanagement, resulting in accumulation of circular debt and a lack of investment in the power sector. In 2011, the government introduced power sector reforms aimed at unbundling the power sector and introducing competition in the market. Under the new model, the power sector was unbundled into separate entities responsible for generation, transmission, and distribution. The government established NEPRA to regulate the power sector and introduce competition in the market. The power generation sector was opened up to private investors, and the government introduced a competitive bidding process for new power generation projects. The transmission sector remains in the public sector and is managed by the NTDC, while the distribution sector was unbundled into DISCOs and privatized.

Despite the reforms, the power market in Pakistan continues to face challenges such as circular debt, technical inefficiencies, and power theft. However, the unbundling of the power sector has introduced competition and encouraged private investment, which has helped to increase power generation

capacity and improve access to electricity in the country. The generation facilities, comprising GENCOs, WAPDA, IPPs, CPPs, and renewable-based projects, are connected with the NTDC which acts as the national grid. On behalf of the distribution companies, CPPA acts as the sole market for power procurement from generation companies. The distribution companies are fed through the network of NTDC.

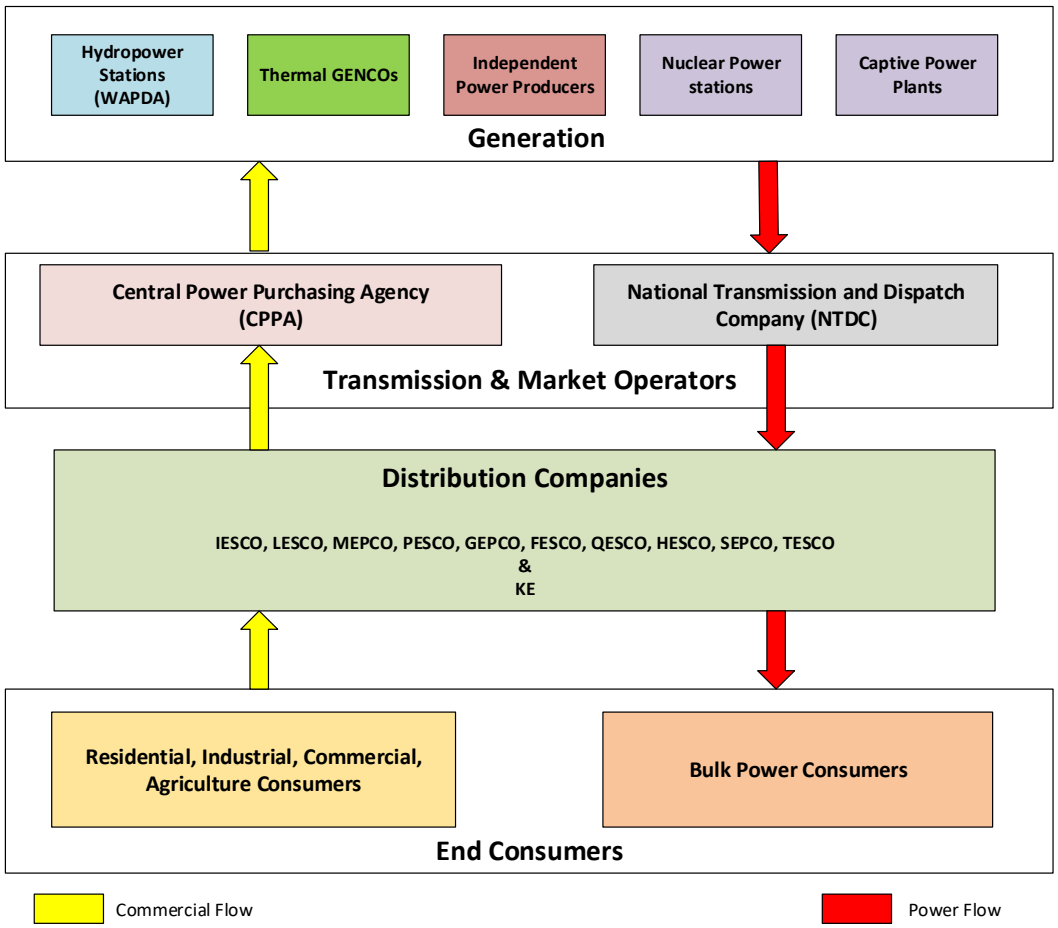

Figure 1.3: Vertically Integrated Market of Pakistan

1.7 Power Sector Policies of 1994, 1998, 2002 and 2015

a. Salient Features of 1994 Power Policy

On account of acute energy shortfall issue with the installed capacity of 10,800 MW, the federal government issued the policy framework and stimulus for private sector power generation projects in March 1994. This policy offered attractive terms to the national and international stakeholders conducive to investing in the power sector.

The policy proffered an upfront tariff for bulk power of Rs. 1.952/kWh (US cents 6.5/kWh) on average for the first 10 years. The levelized tariff was settled as Rs. 1.776/kWh (US cents 5.9/kWh) over the life of the projects, i.e. 25-30 years. The offered two-part tariff consisted of capacity and energy charge components. The capacity charges were committed to be paid on a monthly basis and comprised debt servicing, fixed O&M cost, insurance expenses, and return on equity. The energy charges were to be

paid based on the actual units of energy consumed or sold to WAPDA/KESC and were included in the fuel price as pass-through item.

According to the power policy of 1994, the tariff was designed in such a way that if fuel cost is reduced due to higher thermal efficiency depending on the use of technology, an equivalent increase was to be allowed in the indexation component of the capacity charge so that the overall tariff remains unchanged. The tariff offered exchange rate indexations/adjustments, fuel price variations, and adjustments due to inflation where applicable.

Based on the 1994 policy, 18 IPPs were installed with a capacity of 6,115 MW. These power generation facilities were primarily based on imported residual fuel oil and low BTU gas.

b. Salient Features of 1998 Power Policy

The Government of Pakistan drafted the Power Policy of 1998 to move towards competitiveness in the power market. The policy allowed the restructuring of WAPDA into the following:

a. National Electric Power Regulatory Authority (NEPRA), an independent regulatory authority
b. Five public limited generation companies (GENCOs)
c. National Transmission & Despatch Company (NTDC), a public limited company
d. Eight public limited distribution companies

WAPDA was mandated as an organization responsible for hydropower generation, maintenance of existing dams, and extension of hydropower. NEPRA was formed as a power regulatory authority for regulating the vertically integrated power market by authorizing the tariffs, licensing power generation, transmission, and distribution companies, approving the capacity extension plans, and monitoring overall control of the power sector.

Due to the expected shortfall, the total capacity demand was projected to reach 25,500 MW by July 2008, with the importance of promoting power generation through hydropower and indigenous coal. Contrary to the previous policy, it allowed cost plus tariff for power generation and aimed to bring more competitiveness based on energy and capacity charges. To ensure commercial sustainability, the energy charges and non-debt component of capacity charge were set to remain constant or diminish over time while debt-related components based on principal, interest and fees payment were indexed over the loan payment stream of any project. Further, the bidders were offered components in energy and capacity purchase prices which were subject to adjustment for variations in the exchange rate between the Pakistan rupee and the US dollar. On the other hand, based on Pakistan Wholesale Price Index (WPI), the bidders were allowed to include components scalable for rupee inflation.

c. Salient Features of 2002 Power Policy

The Power Policy of 2002 was prepared and implemented in continuation of the Policy for New Private Independent Power Projects 1998. The main objectives of this policy were to provide sufficient capacity for power generation at the least cost and to avoid capacity shortfall. Hydel projects in the private sector were aimed to be implemented on Build, Own, Operate and Transfer (BOOT) basis; however, thermal projects were required to be established either on BOOT or Build, Own, Operate (BOO) basis.

The policy indicated the capacity payments for hydropower to be approximately 60% to 66% of the levelized tariff due to the relatively low energy purchase price. The companies were allowed to import plant and equipment not manufactured locally with exemption from the payment of income tax, including turnover rate tax and withholding tax on import. The indexations on the component of the capacity charges were based on rupee inflation and exchange rate fluctuations.

The tariff for the generation facilities was composed of two parts; energy purchase price and capacity purchase price. The capacity power price to be paid was fixed, provided the plant was available for dispatch to the standard defined in the power purchase agreement. The energy purchase price was to be paid based on the number of units of energy dispatched.

Under the Power Policy of 2002, 14 IPPs with a cumulative installed capacity of 3,801 MW were erected, mainly based on imported fossil fuels.

d. Salient Features of 2015 Power Policy

The Cabinet Committee on Energy prepared a roadmap under the multipronged strategy to overcome the energy crisis by 2018. As a result, the federal government issued the Power Generation Policy of 2015. It covered not only the private and public sector power projects but also those based on public-private partnerships and those developed by the public sector with the intention of subsequent divestment. Like the other policies, it envisaged a two-part US dollar indexed tariff comprising capacity and energy purchase price.

The federal government guaranteed the payment obligations of its power purchaser and on behalf of the provincial/Azad Jammu and Kashmir/Gilgit-Baltistan government entities. It also ensured the convertibility of PKR into USD and the remittance of foreign exchange to cover necessary payments related to projects. Moreover, to mitigate the exchange rate variation risk, specified adjustments for exchange rate variation were also provided within the policy. As per the previous policy, it provided exemption from income taxes, import of equipment not locally manufactured at a concessionary customs duty rate of 5%, and repatriation of equity along with dividends. Further, NEPRA allowed USD equity on internal rate of return (IRR) of up to 20% in the tariff. The PPIB and relevant public sector departments in the provinces, AJ&K and GB were mandated to implement the policy by providing a one-window facility to prospective project sponsors. Accordingly, seven IPPs with a capacity of 8,253 MW were installed under the Power Policy of 2015 based on imported coal and RLNG.

The list of power generation facilities installed under the respective policies are provided in **Appendix II**.

Chapter 2

Tariff Structure for Generation, Transmission and Distribution Facilities

In Pakistan, the tariffs are regulated by NEPRA for ensuring pass-through of the expenses and indexations to the consumer side. The generation, transmission, and distribution tariffs are regulated and indexed by NEPRA based on adjustable components in their determination. Through the transfer price mechanism, the generation costs are transferred to the distribution companies as specified in the commercial codes. This pass-through mechanism, the end-consumers' tariff, includes the costs incurred by the generation facilities, transmission companies, distribution utilities and market operation costs of the power sector.

The vertically integrated market of the power sector is working as; CPPA is the sole procurement agency to buy power from the generation facilities as per the subjected power purchase agreements. The basket price of energy is calculated based on the units of energy dissipated with the cost elements of the energy and capacity charges. Secondly, CPPA charges the power purchase price based on the uniform transfer price from all distribution companies by determining pool generation cost. Upon the installation of the facility, the regulator authorizes the "reference tariff", which is based on both the components of energy and capacity charges. The payable tariff is subjected to the indexations due to variation in fuel price, rupee-dollar exchange rate, variation in consumer price index (CPI) or local inflation. The accumulation of the debt payments to the IPPs has been majorly observed due to the indexations granted on the energy and capacity charges.

2.1 Transfer Pricing Mechanism of Energy and Capacity

Due to the vertically integrated market structure, the generation costs of all the facilities are cumulatively accounted as pool generation costs consisting of the components of energy and capacity charges calculated and transferred to the distribution companies. To calculate the transfer prices, the distribution companies are termed as "market participants representing demand" and total transfer charges incurred to them are given as:

$$Transfer\ Price = Transfer\ Charges + Use\ of\ System\ Charges^{6} + Gross\ Sales\ Tax$$

The transfer charges represent the recovery of the cost of procuring power from the generation companies according to the power purchase agreement. It contains the components of energy and capacity, whereas the mathematical representation is given as:

$$Transfer\ Charges = Capacity\ Transfer\ Charges + Energy\ Transfer\ Charges$$

Capacity transfer charges describe the cumulative sum of capacity charges incurred by the generation plants. The capacity transfer charge is the product of the capacity transfer rate and maximum demand indicator. The capacity transfer rate is the unit price chargeable for the pool generation capacity charges and is calculated as:

[6] Use of system charges indicates the costs incurred by National Transmission & Despatch Company and Central Power Purchasing Agency for their functions and operations.

$$Capacity\ Transfer\ Rate = \frac{Sum\ of\ the\ capacity\ payments\ to\ generation\ companies}{Sum\ of\ maximum\ demand\ (in\ kW)\ of\ the\ market\ participant}$$

The capacity transfer rate is multiplied by the maximum demand of the market participant to calculate capacity charges in case the distribution companies are being considered as market participants. The charges are calculated monthly as per the following mathematical representation:

Capacity Transfer Charges = Capacity Transfer Rate x Maximum Demand (kW)

In the same manner, the energy charges incurred by the generation companies are transferred, based on the units of energy consumed, with the following formulations:

Energy Transfer Charges = Energy Transfer Rate x Energy Demand (kWh)

$$Energy\ Transfer\ Rate = \frac{Sum\ of\ the\ energy\ component\ of\ the\ generation\ companies}{Sum\ of\ maximum\ demand\ (in\ kWh)\ of\ the\ market\ participant}$$

2.2 Type of Power Purchase Agreements: *Take or Pay, Take and Pay*

The power purchase agreements are accorded based on two settlements; *take or pay* and *take and pay*. The take or pay agreement indicates the capacity and energy procurement separately, while the bulk consumer is required to pay both components of power. In the take or pay settlement, the cumulative power purchase accounts irrespective of the energy units being consumed, where the charges to be paid shall cover the expenses of the power generating company for the installed or available capacity it has offered for dispatch. Currently, 78 IPPs are operating in Pakistan, where, with the exemption of bagasse-based power plants, the power purchase agreements are based on a take or pay contract. Any amount of capacity provided by the IPPs has to be paid by the government, regardless of the energy dissipated or utilized, which is basically the guaranteed amount payable by the government to these IPPs.

Contrary to take or pay, take and pay is the arrangement of the power purchase agreement in which the billing or the charges are paid based on the energy generated by the power generating plants. The energy component is composed of fuel component and fixed and variable charges with the inclusion of a component that covers the capacity charges for that respective power station. This concludes that if the power generating station generates no energy in the billing cycle, the power purchase charges shall be null subject to no units of energy being penetrated into the grid.

2.3 Determination of Generation Costs for Generation Companies

Under the power generation policies of 1994, 1998, 2002, and 2015, the generation facilities are offered cost plus tariffs based on energy and capacity components. The energy charge components are composed of the energy units generated and dissipated by the generation companies. As the generation facilities are mostly dependent on the energy mix composed of imported fossil fuels, the fuel prices vary vastly and the component of "fuel price adjustments" is allowed to be incurred in the energy charges for the power generation plants. On the other hand, the indexations are allowed on the capacity component of the power plants, depending on various factors. Generally, one of the chronical factors contributing excessively to the circular debt of the power sector is the take or pay settlement, where capacity charges are to be paid irrespective of the dissipated energy, also on the other hand, is subjected to the indexations.

a. Energy Charge Component

Energy charge is the variable cost or operational cost measured in *PKR/kWh*. It is charged upon the actual energy units being consumed from the power facility, and it is further based on *fuel cost component* and *variable O&M*. The fuel cost component is revised after one month and consumers are bound to pay that price as *FPAs* in monthly electricity bills compliant to the transfer pricing mechanisms.

b. Capacity Charge Component

Capacity charge is the fixed cost to be covered in the power purchase agreement incurred by the generation facilities in the erection, installation, and commissioning of the power facility. Generally, capacity charges also include the costs and expenses of the IPPs incurred during the operational cycle. It is usually subjected to the capacity available by a power plant for the number of hours and measured in *PKR/kW/hour*. Capacity payments are payable subject to the firm capacity of the power plant, which is a guaranteed amount to be paid by the government. The quarterly indexations are provided to the IPPs in the fixed charges component of their investments. The capacity payments are dependent and indexable to the following components:

i. O&M foreign
ii. O&M local
iii. Cost of working capital
iv. Insurance
v. Debt services
vi. Return on equity
vii. ROE during construction

2.4 Adjustments Formulations for Capacity Charge Components

The power policies of 1994, 1998, 2002, and 2015 made excessive instruments for foreign investments. The fixed costs, insurances, return on equity, return on equity during construction, debt servicing, actual interest during construction, and the variable costs for the O&M subjected to the foreign currencies allowed indexations based on the fluctuations in the currency exchange rates. The major components in the capacity charges of the power facilities are allowed to be indexed quarterly in the financial year. The detailed structural formulations allowable to be indexed based on the foreign currency component is described in the table given in **Appendix III** of this report.

2.5 Tariff Settlement for Transmission Facilities

Being the vertical integrated and regulated market of power, the transmission tariff for the companies performing transmission operations are determined by NEPRA. Generally, the tariff for the transmission system is calculated on two factors; Use of System Charges (UoSC) and Transfer Charges. The UoSC is calculated according to the capital and operational cost incurred by the transmission company and constituted in fixed and variable charges. While, the Transfer Charges, as explained and elaborated in the previous sections, is the amount of the generation tariff to be transferred to the distribution companies. The transmission tariff is calculated as:

$$Transmission\ Tariff = Use\ of\ System\ Charges + Transfer\ Charges$$

2.6 Distribution and Consumers' Side Tariff Determination

The distribution tariff is determined with the inclusion of pass-through prices of transfer charges, which includes generation and transmission costs. Distribution Margins are additional components to recover the costs associated with the distribution of power. Due to the regulated market, the distribution companies in Pakistan does follow the uniform tariff against the categories of the consumers, for which the tariff is determined by NEPRA.

The quarterly and fuel price adjustments, as the part of pass-through costs from the generation facility as determined by the regulator, is transferred in the consumers' bills by distribution companies which reflect the additional costs associated with the generation facilities amid the currency indexations and variations in the fuel price respectively. The consumers' tariff is being followed by the category, for which six categories of the electricity consumers is defined as; residential, commercial, industrial, general services, agricultural, single-point supply and special contracts. The consumers' tariff on the other hand is constituted on the fixed charges, variable charges, quarterly adjustments and fuel cost component, for each category of the consumers.

For the distribution companies, the tariff is calculated as:

$$Tariff\ for\ DISCOs = Transfer\ Price + UoSC + MOF + DM$$

Chapter 3

Rise in Circular Debt and Implications of Various Factors

While evaluating the issues affecting the power sector of Pakistan, circular debt comes up as the most prominent aspect. Circular debt started to balloon in the mid-2000s and by 2021 it had jumped to about Rs. 2491 billion[7] – a significant increase since June 2018.[8] Many factors are responsible for this surge, but in order to reduce the circular debt, power tariff hikes are applied across all consumers. These hikes have an adverse effect on the energy affordability of consumers, and the government has to provide an influx of subsidies to maintain energy affordability.

The factors contributing to circular debt are found in the generation and distribution sectors. One of the prominent aspects is high generation cost, followed by technical losses and inadequate bill recoveries in the distribution sector. Particularly if the generation costs are assessed, reliance on imported fuels and increase in capacity payments based on dollar-rupee indexations are the primary reasons where receivables from consumers are not enough to meet the actual cost incurred on generation and distribution of power. So subsidies have to be provided to settle the balance of payments to the IPPs in order to maintain energy affordability.

The factor of political economy in the increase in circular debt cannot be overlooked as commercially the IPPs are perceived to be earning excess profits against investments. The majority of the IPPs have opted for the cost plus tariff regime, where price determination includes foreign currency components to be reflected in the tariff. On the other hand, many of the IPPs are owned by influential business individuals who have established themselves in major commercial and financial activities.

3.1 Origin of Circular Debt

The issue of circular debt surfaced in 2006 when the government failed to raise consumer tariffs in the wake of the increase in international oil prices – in Pakistan a major part of power generation is through fossil fuel-based power plants. Along with that, the rupee suffered a major depreciation, leading to a sudden jump in capacity payables, while the notified tariffs remained unchanged. Further addition to the debt was contributed by technical inefficiencies and power thefts. The unbalance in the receivables from the DISCOs and the payables to the IPPs was covered through tariff differential subsidies.[9] A gap emerged in cost of electricity (per unit) and notified tariff for consumers which raised the due payables to the IPPs, further increasing the incapacity of the power generation companies to pay for fuel procurement. In the FY-2006, the debt amounted to Rs. 111 billion.

At the end of FY-2009, oil prices increased further in the international market following the global financial crisis. As a result, the circular debt pile rocketed to Rs. 236 billion. An amendment on the consumer tariff was applied and general sales tax was implemented on consumption of more than 100 units. This helped in an insignificant reduction in circular debt, as energy affordability was reduced

[7] Central Power Purchasing Authority Statistics and breakdown of circular debt submitted to Power Division, Ministry of Energy. http://mowp.gov.pk/userfiles1/file/Oct-21%20CD%20for%20websdsdsd.pdf

[8] Circular debt grows by Rs498b in FY21. https://tribune.com.pk/story/2308694/circular-debt-grows-by-rs498b-in-fy21

[9] TDS is the difference between the electricity tariff (plus certain surcharges) paid by consumers and the allowable costs of electricity utilities determined by the regulator, NEPRA

with the rise in tariff and power outages escalated throughout the country amid the fall in generation capacity. The generation capacity fell by 2500 MW owing to the forced decrease in capacity factor by the government and insufficient fuel supply due to unpaid amount to the IPPs. The underutilization of capacity became yet another reason of increase in circular debt as capacity payments are committed to be paid to the IPPs irrespective to the utilization factor.

By 2010, the cumulative debt had risen to Rs. 366 billion. The government took the tough decision to include quarterly adjustments due to currency devaluation and fuel price adjustments in the bills of customers. However, this 'pass-on' measures were not sufficient to cover the escalating costs of power generation.

The interventional actions by the government were intended to inject finances to lower the circular debt pile. Yet, no focus was placed on improving system efficiency to control the fast pace of debt accumulation. By 2013, the circular debt was temporarily cleared by the direct liquidity injection of Rs. 342 billion, but the expensive mix of power generation remained. With the setting up of new generation facilities on take or pay mode of tariff settlement, capacity payments further escalated due to the underutilization of capacity.

One of the most ignored factors of management which immensely contributed to circular debt is the technical and administrative inefficiencies in the distribution companies. The distribution companies have the losses in technical and administrative domains beyond the targets set by the regulatory authority, where no policy incentives have been available for improvements. The government is looking at short-term solutions to circular debt whereas the issue requires a complete roadmap.

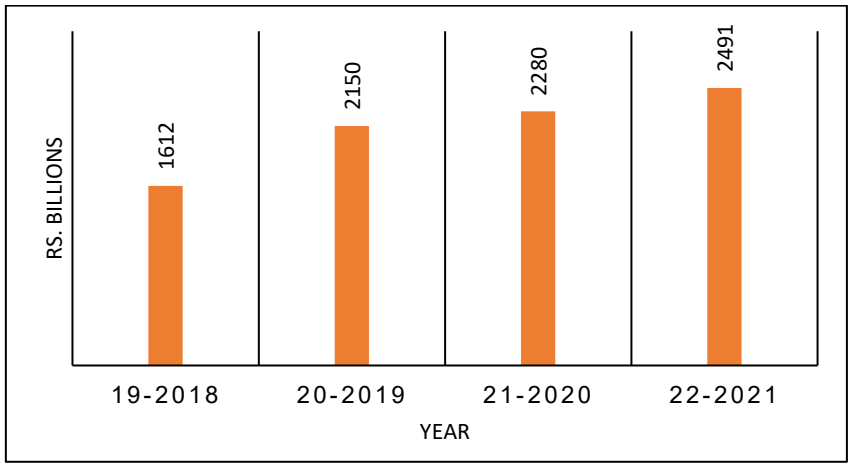

Figure 3.1: Rise in circular debt from 2018 to 2022

3.2 Factors Contributing to Circular Debt Accumulation and Increment

There are a number of interlinked factors that contribute to accumulation of circular debt. Primarily, the generation costs are high which are not adequately recovered by the distribution companies in the applicable tariff of the consumers. Further, the transfer mechanism of these generation costs does not allow for the proper allocation of costs to the customers. On the other hand, if this is done properly, energy affordability may plunge. Cumulatively, the factors may be summarized as follows:

a. The high cost of generation, due to the reliance on imported fuels, escalates due to price variation in the international market.
b. Technical inefficiencies in the distribution network in the country including inefficient transformers, cables and infrastructure increase the subsequent power losses.
c. Issues in the administrative sphere of the distribution companies leads to malpractices by the consumers such as electricity theft and non-payment of bills.
d. The components in the generation costs based on dollar are adjusted with the devaluation of the rupee. On the other hand, these escalations are not transferred to the customers to maintain affordability.

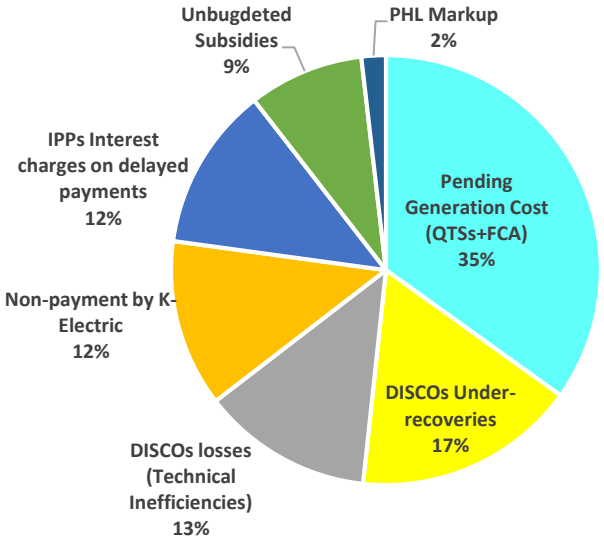

Figure 3.2: Breakdown of the factors contributing to circular debt

Table 3.1: Debt amounts accumulated for the year 2020-21

Contributing Factors	Rs. in Billions
Pending Generation Cost (QTSs+FCA)	133
DISCOs Under-recoveries	64
DISCOs Losses (Technical Inefficiencies)	49
Non-payment by K-Electric	48
IPPs Interest Charges on Delayed Payments	47
Unbudgeted Subsidies	33
PHL[10] Markup	7

From the breakdown of the factors mentioned, the major contribution to circular debt comes from generation costs, where the impact of energy and capacity payments is cumulatively higher. The administrative lapse in distribution utilities comes second, based on incompetency in recovery of the billed amount. On the other hand, technical losses are a long-neglected issue by the distribution companies. The latter portion of this chapter explains the issues regarding these factors.

[10] Pakistan Holding Limited is a subsidiary of the Ministry of Finance and is responsible for managing and controlling various state-owned enterprises in the country.

3.3 Attributes of Circular Debt from Supply-Side Excess Payments

The power policies developed to set up generation facilities allow the *take or pay* settlement of the tariff, where the capacity payments are sanctioned irrespective of the energy generation by the units. This implies guaranteed payments from the government against the investment risks to the IPPs, which is not fully coverable in the consumer tariff. Comparing energy and capacity components of the generation facilities, it has been analyzed that capacity payments, subjected to the low capacity factors of the generation facilities, have been increasing owing to less demand. To assess the impacts of capacity payments on circular debt, the financial analysis of 13 IPPs, with a collective capacity of 7229 MW, has been carried out in this report (for which the analysis has been done with their gross capacity in MW), to demonstrate the variables contributing to circular debt.[11] The sampling of these IPPs is based on different fuel types, generation capacities, and governing policies. The mode of *take or pay* settlement of tariff is responsible for uncontrollable escalation in capacity payments, which account on an average 43% for the 13 power generation companies in the overall payments.

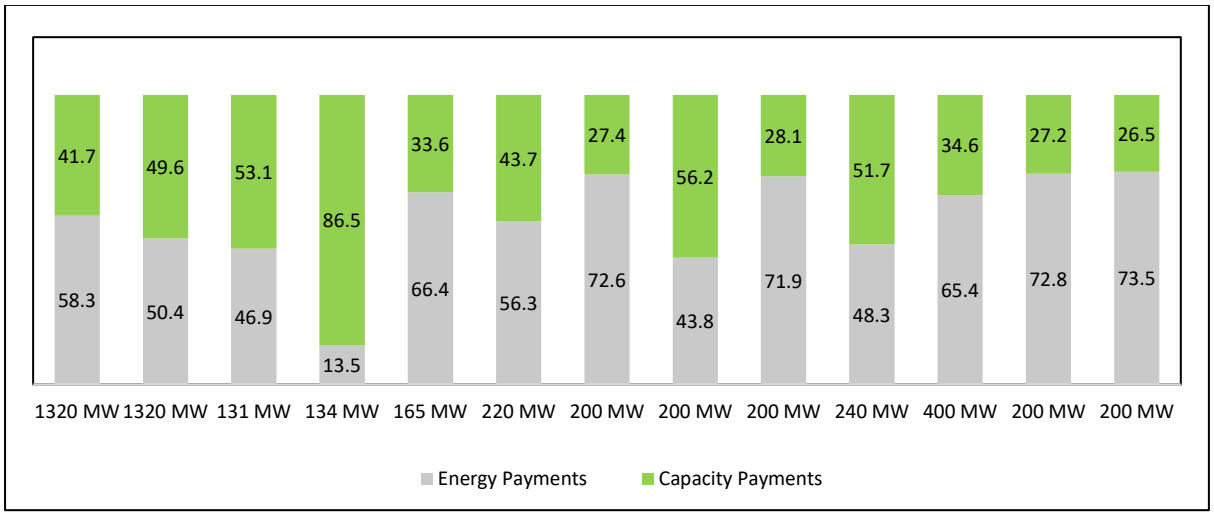

Figure 3.3: Percentages of energy and capacity payments for 13 IPPs analyzed for the year 2021-22

a. Increment in Capacity Payments

The capacity component of the generation cost is majorly in foreign currency, which makes it adjustable to currency devaluation. The following components in capacity payments are adjustable to currency devaluation and as such have a direct impact on circular debt.

a. O&M foreign
b. Insurance
c. Debt services
d. Return on equity
e. Return on equity during construction

[11] The data comprising of energy and capacity payments has been assessed and analyzed from National Electric Power Regulatory Authority's notifications on quarterly adjustments, fuel price indexations and generation licenses. (Website link: https://nepra.org.pk/tariff/Generation%20IPPs.php

The capacity tariffs are adjusted quarterly through NEPRA, and analysis of the given data quantifies an average 37% increase in capacity component of tariff in the year 2022, subject to rupee devaluation. Collectively, debt amounting to Rs.183 billion is accounted as increase in capacity payments against the reference tariff by NEPRA. These payments are partially collected through quarterly adjustments in the consumer tariff, while being parked in PHL accounts on which the applicable interest rate further increases the payable amounts. Table 3.2 shows the comparison of payables of capacity payments for selected IPPs in the analysis.

Table 3.2: Comparison of payables of capacity component of selected IPPs against reference tariff

Independent Power Producer	**Capacity payments subjected to reference tariff per quarter**	**Capacity payments for the quarter Jan-March 2022**	**Capacity payments for the quarter April-June 2022**	**Capacity payments for the quarter July-Sept 2022**	**Capacity payments for the quarter Oct-Dec 2022**
	Rs. Millions	Rs. Millions	Rs. Millions	Rs. Millions	Rs. Millions
1320 MW	9421.3	16842.4	17893.6	23039.6	24858.3
1320 MW	9863.2	16445.4	16476.2	21830.5	24097.2
131 MW	672.8	814.4	845.4	843.5	855.6
134 MW	287.0	538.2	553.5	542.7	595.1
165 MW	316.8	658.2	678.5	756.9	657.9
220 MW	863.0	1025.4	1068.9	1070.2	1106.1
200 MW	635.5	763.4	793.7	794.3	820.6
200 MW	546.1	673.0	698.6	701.7	962.0
200 MW	533.7	658.9	684.8	690.2	698.9

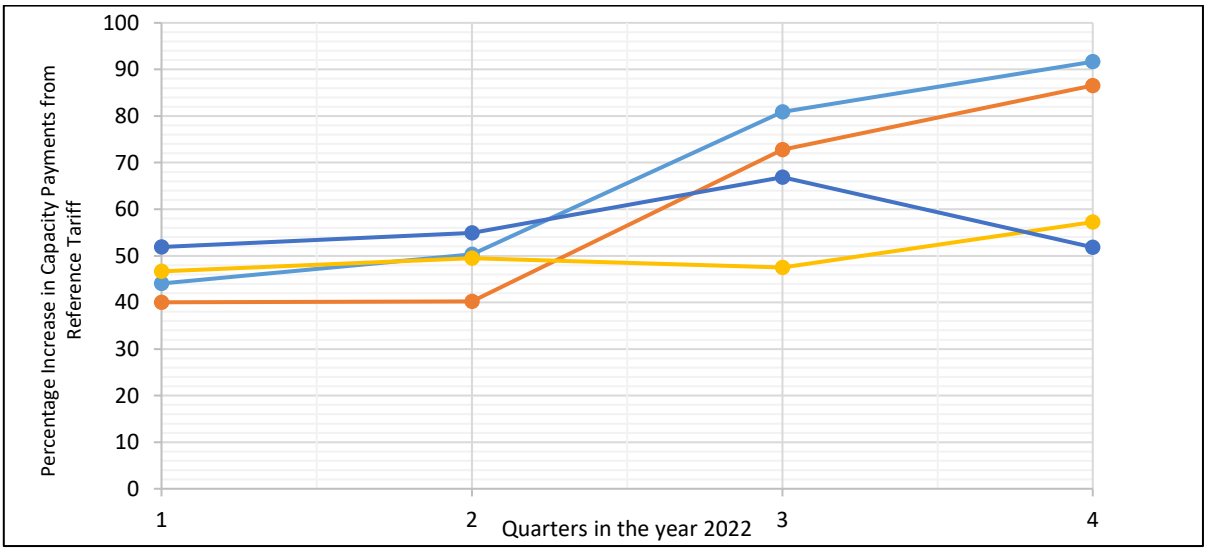

Figure 3.4: Percentage increase in capacity payments from referenced in 2022 for selected IPPs

As seen in Figure 3.4, the increase in payments has escalated up to 90 percent for some IPPs. Higher the generation capacity of a power plant, higher shall be the escalation rate of capacity payments. This implies that the inclusion of larger power generation stations on *take or pay*, of more than 1000 MW, contributes more to the circular debt problem. The formula for calculation of capacity payments is:

$$Capacity\ payment\ for\ given\ quarter = Generation\ capacity\ (kW) \times Revised\ tariff\ \times No.of\ hrs\ in\ operation$$

b. Impact of Low Capacity Factor for Generation Facilities

The imbalance in energy and capacity payments also arises due to very low capacity factor. Capacity factor means the average energy produced by a generation facility in due interval of time. Ideally, the capacity factor should be close to 100%, but there are various aspects which affect the capacity factor of the generation facilities. These include:

a. Insufficient fuel provision, minimizing the operations of the generation facilities
b. Routine and declared maintenance
c. Unplanned and forced shutdowns

The disturbed fuel supply chain and low demand is believed to be the primary reason for low capacity factor. Circular debt restricts the government's position to pay for fuel supplies, which in turn incapacitates the IPPs from importing fuels. On the other hand, the lower capacity factor does not affect the profitability of IPPs due to the guarantee of capacity payments. The minimization of the capacity factor can also be attributed to the low position in the economic dispatch list.[12] Due to low allocations in the determined merit order by NPCC, capacity payments are obligated to some of the IPPs with higher generation capacity, while their capacity factor remains relatively low.

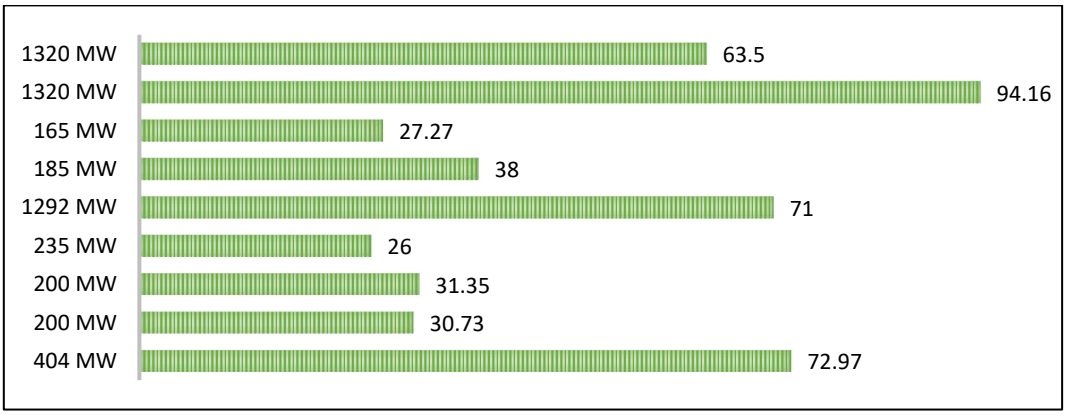

Figure 3.5: Capacity factors reported in State of Industry Report 2021-22 for selected IPPs

Contrary to *take or pay*, if a comparison of energy generation and capacity/energy payments is made, a clear difference in payments can be seen. The *take and pay* settlement of tariff is applicable on bagasse-based power generation and comparison of the two modes explains the escalation of capacity payments due to capacity factor.

[12] Merit dispatch list is prepared fortnightly by the system operator, NTDC, based on the economic dispatch of power on the energy prices of the IPPs.

Capacity payments in *take and pay* can be passed on to the consumers where no additional quarterly adjustments in their bills are required due to the inclusion of capacity components in the energy delivered by the power generation facility. Table 3.3 below compares the energy delivered with the energy and capacity payments. Evidently it can be seen that the IPPs on *take or pay* tariff with 174 GWh of energy delivered into the system have payable capacity charges that are about 23 times more than the power generation facility with *take and pay* settlement of tariff that delivered 160 GWh of energy. This is because of a relatively very low capacity factor but very large power capacity (MW).

Table 3.3: Comparison of Energy Delivered and Charges for Take-Or-Pay and Take-and-Pay Tariffs of Power Generation

		Energy Generated (GWh)	**Energy Charges (Rs. Millions)**	**Capacity Charges (Rs. Millions)**
Take or Pay	1320 MW	174.51	3587.31	22938.88
	134 MW	121.63	1835.42	2353.45
Take and Pay	26.53 MW	144.44	972.1	733.19
	57 MW	160.56	1081.53	965.99

c. Inefficiencies in Generation Companies (GENCOs)

Generation companies (GENCOs) are defined as government-owned and administrated thermal power stations. There are four such companies:

a. Jamshoro Power Company Ltd (GENCO-1)
b. Central Power Generation Company Ltd (GENCO-2)
c. Northern Power Generation Company Ltd (GENCO-3)
d. Lakhra Power Generation Company (GENCO-4)

These power stations use furnace oil, coal, and natural gas as the primary fuel source. With an installed capacity of 7120 MW, these generation plants have remained in the spotlight as inefficient national companies with insignificant output in terms of technical yield. Due to dependence on imported fossil fuels, these companies with their inefficient infrastructure have been obligated with capacity payments despite very low capacity factor.

The State of Industry Report 2021-22 by NEPRA reveals that the GENCOs remained connected with the system with less than half the capacity owing to various reasons. One of the reasons is believed to be inefficient and outdated machinery and as such shutting down of these generation facilities would incur less losses compared to their operationalization on the net capacity. Furthermore, issues related to governance and administrative malpractices are also roadblocks in maintaining the profitability of these companies. Resultantly, the huge reduction in the installed capacity and capacity factor has been neglected by the system planners and policymakers since a long time and no effort has been made for improvement. To minimize the losses incurred due to inefficiencies of GENCOs, swift implementation of the following steps is required:

i. Power plants with efficiency less than 30% should be retired immediately. This shall lessen the impacts of the huge burden of costs associated with energy generation and capacity payments.

ii. In order to maintain efficiency at more than 30%, a comprehensive roadmap is required for improvement and altering the fuel sources. Collectively this would be very beneficial for minimizing the cost of power.

Table 3.4: GENCOs Installed Capacity, Available Capacity and Impact of Reduction in Capacity

	Company	Installed Capacity (MW)	Net Capacity (MW)	Fuel and Turbine Type	Reduction in Net	Energy Loss	Financial Impact (Rs.
GENCO I	Jamshoro Power Company Limited (1 to 4)	880	649.02	Furnace oil / Steam Turbines	6.78	2923	0.294
	Jamshoro Power Company Limited (5 & 6)	1320	1200	Coal / Steam Turbines	0	0	0
	Gas Turbine Power Station Kotri	144	106.5	Natural Gas	The plant is commercially operating at zero capacity factor		
GENCO II	Thermal Power Station Guddu	1655	1400	Natural Gas	12.69	7213	0.471
	Guddu 747 Combined Cycle Power Plant	776.7	720.79	Natural Gas	No reduction in net capacity and loss quoted		
GENCO III	Thermal Power Station Muzaffargarh	1350	1183.52	Furnace Oil / Steam Turbine	11.98	4986	0.628
	Gas Turbine Power Station Faisalabad	144	132	Natural Gas	The plant is commercially operating at zero capacity factor		
	Steam Power Station Faisalabad	132	97	Natural Gas / Steam Turbine	9.55	934	0.007
	Combined Cycle Power Plant Nandipur	565.65	510	Furnace oil / Gas + Steam	1.31	9625	0.077
GENCO IV	Lakhra Power Generation Company	150	93	Lignite Coal / Steam Turbines	11.36	1.143	0.053

Table 3.5: Capacity Factor of GENCOs

Power Generation Facilities		Capacity Factor (%)
GENCO I	Jamshoro Power Company Limited (1 to 4)	50
	Jamshoro Power Company Limited (5 & 6)	0
	Gas Turbine Power Station Kotri	0
GENCO II	Thermal Power Station Guddu	0
	Guddu 747 Combined Cycle Power Plant	26.89
GENCO III	Thermal Power Station Muzaffargarh	59.96
	Gas Turbine Power Station Faisalabad	0
	Steam Power Station Faisalabad	59.03
	Combined Cycle Power Plant Nandipur	34.12
GENCO IV	Lakhra Power Generation Company	0

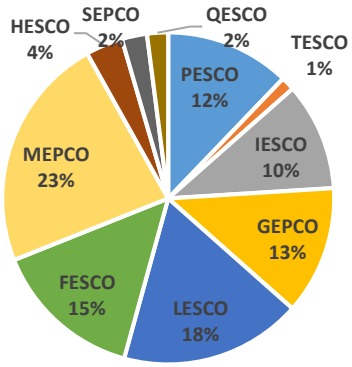

Figure 3.6: Percentage of consumers served by each DISCO

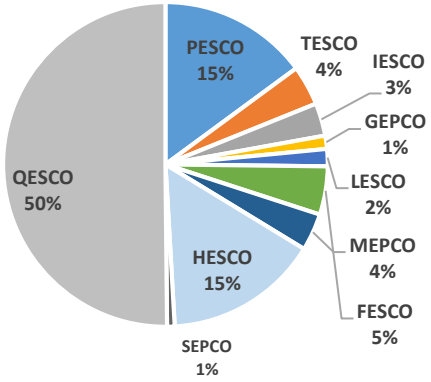

Figure 3.7: Percentage comparison of jurisdiction area

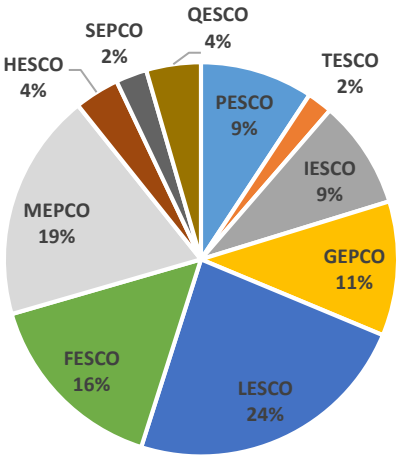

Figure 3.8: Percentage comparison of energy sold by each DISCO

3.4 Attributes of Circular Debt from Demand-Side Inefficiencies

The distribution companies are intermediaries between the supply-side and demand side participants., which are mandated to carry out operations to supply power to the end-consumers. In the four provinces, 11 distribution companies are operational of which 10 are state-owned. Due to state monopoly in the distribution system, competitiveness in this sector is evidently non-existent.

Circular debt, as mentioned in various portions of this report, is greatly associated with disruptions in the power supply chain. This supply chain starts from the generation-side and distribution companies are responsible for the delivery of power and collection of revenues from the customers. The revenues are the payables for the generation plants, transmission companies and fuel suppliers, thus giving an important role to the distribution companies in the overall supply chain.

According to the State of Industry Report by NEPRA, the allowed transmission and distribution losses are a cumulative 17.13%, while the targeted allowable losses are 13.41%. If the financial impact of these losses is calculated, it amounts to Rs. 520 billion annually. Apart from this, the incapacity of the distribution companies to recover the billed amounts is yet another issue. The under-recoveries of the distribution companies are Rs. 230 billion, making an overall contribution of Rs. 720 billion a year into the debt.

The inefficiencies in the power distribution system of the country receive no attention from the state as well as the distribution companies' management. The mis-governance and mismanagement of the state assets needs to be corrected to check the high losses which are controllable with proper planning and modernization strategies. Keen attention is required to control the losses and under-recoveries, which increase the gap in debt payments due to high cost of fuel and escalating capacity payments.
Generally, the power distribution system can be segregated into two components of operations; *wire-line business*,[13] and *electricity sale*. After the NEPRA Amendment Act of 2018, electricity sale was excluded from the ambit of distribution, while an electric supply license has to be acquired for administrative operations. The current dual operations of the distribution companies are valid and applicable for a term of five years.

Table 3.6: No. of Consumers, Area of Service and Energy Sale (in GWh) for Year 2021-22

DISCOs	No. of Consumers	Area of Service (Sq Km)	Energy Sold in GWh (FY 2021-22)
PESCO	4,038,313	101,741	9,166
TESCO	444,146	27,219	2,046
IESCO	3,485,617	22,255	8,782
GEPCO	4,159,712	8,975	10,905
LESCO	5,887,248	11,727	23,327
FESCO	4,869,142	32,816	15,425
MEPCO	7,614,953	25,390	18,516
HESCO	1,196,494	104,877	3,638
SEPCO	814,778	5,165	2,528
QESCO	679,391	342,321	4,430
Total	**33,189,794**	**686,486**	**107,860**

[13] Wireline business implies the commercial management of distribution network infrastructure.

a. Losses Due to Technical Inefficiencies: T&D Losses

Transmission and distribution losses are purely dependent on the infrastructure of the distribution network. A distribution network comprises various voltage levels equipment, based on transformers, reactive power devices, protection devices, and power cables. Adequate operations and timely maintenance are the major determinants of any efficient system, while the infrastructure yields more losses than profit due to aging.

In the case of distribution companies, technical inefficiencies cost Rs. 520 billion in the year 2021-22 in terms of energy lost due to an aging infrastructure. The achievement of zero percent loss is unrealistic even for the most efficient system, rather the utilities try to minimize the losses through adequate and required interventions. The aggregated losses incurred by the DISCOs are mainly due to negligence in maintenance and replacement of equipment. The state-owned DISCOs are not affected by increasing losses contrary to the private sector entities where such losses lead to a commercial fallout in their operations.

Table 3.7: T&D Losses in the Year 2021-22 of the State-owned DISCOs

	Units Purchased (GWh)	Units Sold (GWh)	Units Lost (GWh)	Target as Determined by NEPRA (%)	T&D Losses (%)	Impact of T&D Losses (Rs. Billions)
PESCO	16560	10355	6205	20.73	37.47	153.8
TESCO	2284	2071	213	9.31	9.33	3.7
IESCO	13027	11961	1066	8.15	8.18	21.9
GEPCO	12678	11528	1150	9.2	9.07	24.7
LESCO	28334	25070	3264	9.08	11.52	72.7
FESCO	17512	15918	1594	9.34	9.1	33.4
MEPCO	22548	19202	3346	12.79	14.84	75.1
HESCO	6010	4034	1976	19.07	32.88	45
SEPCO	4489	2890	1599	17.41	35.62	43.7
QESCO	6716	4831	1885	14.49	28.07	46.3
Total	**130158**	**107860**	**22298**	**13%**	**17.13%**	**520.3**

Technical losses in a distribution network occur due to the energy dissipated through the conductors, transformers, transmission and sub-transmission lines, and distribution lines. These types of losses depend on the characteristics of the equipment and their operational mode. Technical losses of the distribution companies are due to the following reasons:

i. Length of the transmission and distribution lines exceeds the optimal length required for the respective voltage level. The low-voltage transmission system incurs more technical losses than the high-voltage transmission system.

ii. Inadequacy in the sizes of the conductors used in the distribution system, where the inappropriate conductor sizes enhance the losses due to thermal heat components.

iii. Installation of transformers away from the load center causes increased concentration of losses in the low-voltage system.

iv. Low-power factor occurs when the reactive power compensation is not provided.[14] The power factor is required to be compensated through reactive devices, whereas if the power factor is left unbalanced, it increases the losses in the system as voltage fluctuation increases, affecting the power quality.

v. Inadequate transformers with iron cores and malfunctioned windings are in operation at the distribution level (11 kV and below) for which the distribution companies do not implement maintenance and replacement mechanisms.

vi. Overloading of the distribution lines is yet another factor, which increases the losses as the infrastructure of the distribution companies is obsolete.

vii. Abnormal conditions in which the overall system is operated contributes immensely to the technical loss of energy.

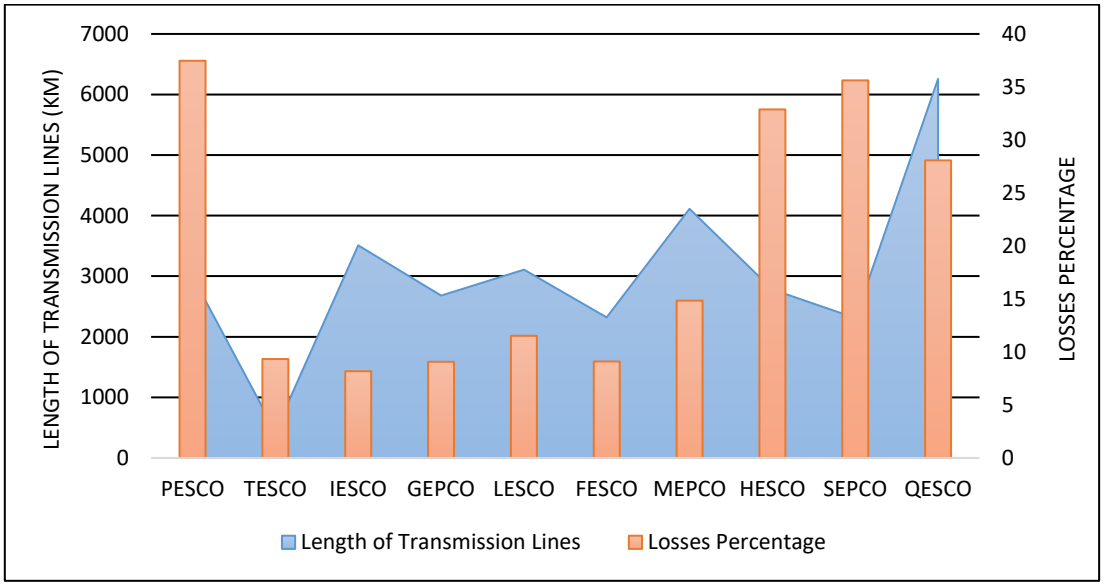

Figure 3.9: Length of transmission lines and losses incurred in DISCOs

In view of Figure 3.9 and points mentioned above, the majority of the distribution companies face issues related to obsolete infrastructure. Particularly, if the technical losses of PESCO and QESCO are observed, these are evidently more due to the large jurisdiction areas served by these distribution companies. The population density in Balochistan is comparatively very low, and the existence of only one distribution company creates issues in the delivery of power in the whole province. Likewise, for PESCO, the area under its jurisdiction mainly comprises mountainous regions with low-voltage transmission system. System maintenance in this case is overlooked and more the energy is dissipated, more the losses incur.

[14] Power factor is the ratio of active power to the reactive power in a system. These two components of power are balanced for the stable operations of power system. Active power is required for the resistive load, while reactive power serves the magnetic or inductive load, e.g. motors, pumps, etc. The power factor correction is a necessary component of power system stability.

Table 3.8: Comparison of Overloaded Transformers and 11 kV Feeders in DISCOs

DISCO	Total No. of Transformers	No. of Overloaded Transformers	Percentage	Total No. of 11 kV Feeders	No. of Over-Loaded 11 kV Feeders	Percentage
PESCO	259	95	36.68	1,193	386	32.36
TESCO	57	8	14.04	302	141	46.69
IESCO	273	23	8.42	1,293	49	3.79
GEPCO	181	51	28.18	949	156	16.44
LESCO	441	70	15.87	2,058	451	21.91
FESCO	249	45	18.07	1,265	129	10.2
MEPCO	317	46	14.51	1,726	318	18.42
HESCO	128	25	19.53	583	93	15.95
SEPCO	134	32	23.88	562	93	16.55
QESCO	180	47	26.11	735	302	41.09

b. Losses due to Non-Recovery of the Billed Amounts

The losses due to under-recovery burdens the national treasury with Rs. 23 billion every year. The recovery amount is targeted to be equal to the billed amount by the DISCOs, where the breach of the target demonstrates the inefficiency of the DISCOs in proper administration of finances. The consolidated comparison of the non-recoveries of the DISCOs is presented in the Figures 3.10.

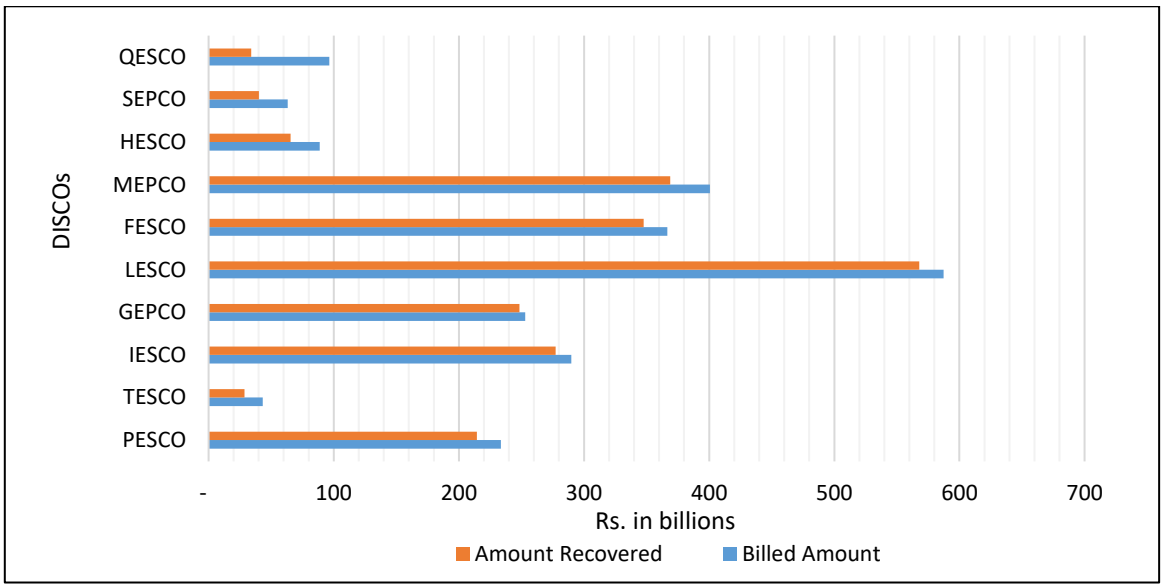

Figure 3.10: Comparison of billed and recovered amount of DISCOs for the year 2021-22

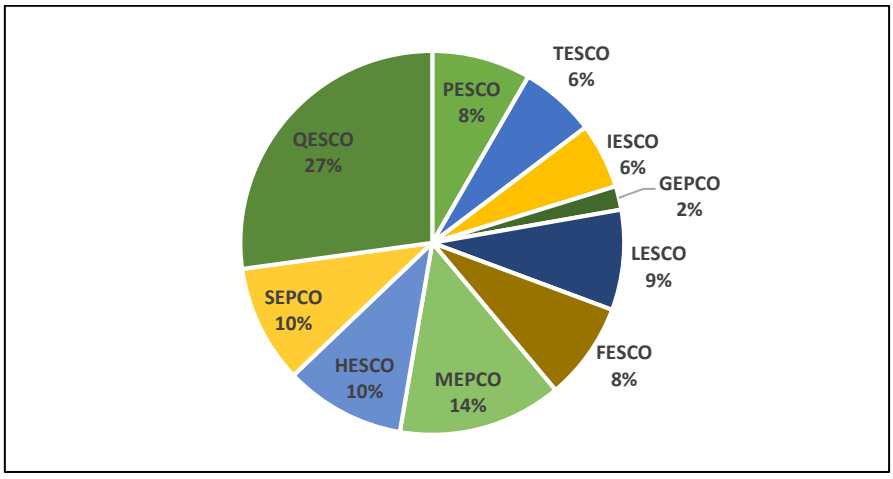

Figure 3.11: Percentage-wise losses of DISCOs

As seen in the figure above, QESCO has the highest loss ratio due to non-recoveries of bills. Further, MEPCO, HESCO and SEPCO also have high amounts under this head. The main factor behind the non-recovery of the billed amounts are governance issues. The regions with less economic prosperity and less buying power have a greater role in the non-recovery rates of DISCOs. The cumulative breakdown of the financial status of the DISCOs with losses incurred due to non-recovery of bills is shown in Table 3.9.

Table 3.9: Billed and Recovered Amounts of DISCOs for Year 2021-22

DISCO	Billed Amount (Rs. Millions)	Amount Recovered (Rs. Millions)	Recovery Percentage (%)
PESCO	233,591	214,419	91.79
TESCO	43,386	28,728	66.22
IESCO	289,977	277,284	95.62
GEPCO	252,986	248,407	98.19
LESCO	587,306	567,887	96.69
FESCO	366,707	347,777	94.84
MEPCO	400,711	368,972	92.08
HESCO	88,892	65,530	73.72
SEPCO	63,209	40,314	63.78
QESCO	96,523	34,053	35.28
Net Total	**2,423,292**	**2,193,375**	**90.51**

Chapter 4

Recommendations and Suggestions

In the wake of the issues and the after-effects of crisis, as in the power sector of Pakistan, there is a dire need for improvisation to avoid the uncontrollable fallout. The main issue identified, as discussed in the former chapters of the report, is circular debt which has potentially jeopardized the progressive development of the sector. The government policies and the decisions to curb or control the circular debt mostly consider raising power tariffs by decreasing subsidies, which have severe after-effects on energy affordability.

The transition towards renewable energy, liberalization of the power market, renegotiations and resettlement of the generation tariffs for the IPPs, improvements in the efficiencies, and reliance on the indigenous resources are some of the salient recommendations that are necessary to be adopted, which in turn would lead to gradual reduction in the burden of circular debt.

4.1 Short-Term Solutions: Renegotiations with IPPs & Improvements in Distribution Companies

A. Renegotiations and Resettlement of Generation Tariffs for IPPs

The guarantees rendered by the government against the investment risk of the IPPs obligate the capacity payments, which are indexable with the variation of the rupee-dollar parity. These guarantees are putting an extraordinary burden on the treasury as the receivables from the consumers are not equitable to the net payments, energy affordability being the primary consideration.

The capacity component of the tariff is comprised of the costs based on dollars which is indexed quarterly. The profitability of the IPPs is required to be assessed, by which the correlation of the excessive capacity payments needs to be quantified with the available capacity. The capacity payments are required to be based on the local currency components, for which the necessary interventions are needed in the generation policies. Further, for the IPPs established under the former policies, negotiations are required to compel the IPPs to settle the foreign indexed components of capacity payments in rupee. Further, resettlement of the generation tariff can be made based on the duality, where the term-wise tariff can be offered, maintaining the profitability of the IPPs.

a. **Emphasis on dual contracts:** Currently, all the power purchase agreements are based on take or pay contracts, in which capacity payments are necessarily required to be paid against available generation capacity irrespective of the utilization factor of the capacity. It is prudent that new contracts should be on such conditions that allow capacity charges for the first couple of years when the return on investments is achieved and debt servicing from the banks is fully met. Afterward, the payments can be settled on take and pay contracts, i.e. involving the capacity charges along with energy charges but only for the actual energy to be used. The payback period for the IPPs is two to four years, the capacity payments can be perceived to provide excessive profit generation because of the guaranteed payment by the government.

b. **Detailed audit of IPPs:** To overcome the issue of circular debt, the most judicial approach requires a thorough audit of all the IPPs, which will help in counter check of set-up cost, actual fuel usage,

heat rates, O&M component of the tariff, interest during construction (IDC), and net annual plant capacity (NAPC) factor of IPPs. These factors have immense impact on the payments being made to IPPs, but at the time of installation, tariff settlement based on cost plus tariff regime, and quarterly adjustments of the capacity components, are factors not accounted for audit or assessment.

B. Improvements in Distribution Companies

The distribution companies are responsible for administering the operations and maintenance, supply, distribution, construction, and expansion of the distribution grid network within their respective areas of jurisdiction. It is an evidently highlighted issue that there is a lack of workforce and technical resources in almost every DISCO. As compared to service area and population, it is very difficult for DISCOs to cater the entire problematic issues including technical inefficiencies, inadequate bill recoveries, and power theft in order to make the improvements in the distribution network. It is advisable to deregulate the *administrational and operational* activities of the DISCO, promoting public-private partnerships. Accelerated by the competitiveness in business, the overall workload of DISCOs would be divided and would also help to accelerate improvisations in the operational management and power markets. Moreover, transmission and wired business would remain under the jurisdiction of DISCOs. The public-private partnership is a dire requirement to lower the financial losses of the DISCOs.

a. **Division of DISCOs into sub-units**: Presently, 10 DISCOs are operating in the country, composed of five distribution companies in Punjab (IESCO, LESCO, FESCO, MEPCO, and GEPCO) and three in Sindh (SEPCO, HESCO, and privately owned KE). In Khyber Pakhtunkhwa only two (PESCO and TESCO) and one in Balochistan (QESCO) have been formed. Compared to electricity consumers and jurisdiction areas of provinces, it is advisable to subdivide these DISCOs based on the optimal distribution network area and population density. This division into sub-units will lower the burden of incapacities of DISCOs for electrification and will help to improve the efficiencies by reduction of T&D losses. Furthermore, to curtail the 'hooks culture' and recovery losses, it will not be difficult to tackle non-recoveries when areas or consumers under the DISCOs are subdivided. This subdivision will improve the performance of the DISCOs, especially in Khyber Pakhtunkhwa where T&D and recovery losses are enormous.

b. **Mini-grids based rural electrification**: Electrification of far-off areas is yet another pressing issue faced by DISCOs, due to low population density in the areas outside of the grid coverage. Mini-grids based on renewables, especially biomass and solar hybrid power plants, can serve the best purpose for rural electrification. Pakistan is an agriculturally rich country and has huge potential for biomass fuel. The environmental conditions are favorable for solar plants as well, where micro/mini grids can serve the purpose in the area having no grid access. The northern areas of Pakistan are faced with the same issues of weak distribution grid infrastructure, where there is ample opportunity for micro-hydropower stations.

4.2 Medium- and Long-Term Solutions

C. Transition Towards Renewable Energy

i. Promotion of Renewable Energy-Based Distributed Generation

One of the prominent and long-lasting issues with the power sector is associated with the technical inefficiencies in distribution companies. The market structure of the power sector implies the

unidirectional power flow, which increases the technical losses due to the lengthy low-voltage grid infrastructure, particularly in rural areas. Moreover, laxity in bill recovery is yet another serious issue, causing financial losses escalating to billions annually.

The integration of renewable energy sources in the category of distributed generation allows the generation facilities in the vicinity of the load centers. Presently, the tariff regimes and models for implementing distribution generation are non-existent while having the immense potential of applicability in the country's rural areas. The development of community-scale distributed generation facilities based on private partnerships can yield twofold advantages; with the lowering of technical losses, it can improve the recovery rates of receivables with the inclusion of communities' ownership. The *energy-only-tariff* settlements with the distributed generation companies can be ensured owing to the fewer investment risks. To promote the distributed generation based on renewable energy sources, the following market interventions are necessary to be developed:

a. **Development of business models:** The inclusion of business models for distribution generation shall grant a swift uptake of low-cost and clean energy integration with the grid. Renewable energy supply companies (RESCOs) can be highly instrumental in increasing the share of alternative energy sources in line with the Alternative and Renewable Energy Policy, 2019, while supplying low-cost energy to the grid. As the energy can be traded on market competitiveness, the capacity obligations can be minimized. Flexibility and ease of doing business should be a prominent step in adoption of distributed generation to increase investment, construction, and other operations. The feasibility of certain business models can be assessed while business models for distributed generation can be implemented based on successful international experiences in planning in terms of stimulating the stakeholders' participation in the investment and operational management of distributed generators.

b. **Provision of incentives in tariff structure:** For the promotion of distributed generation, certain provision of incentives will be beneficial, i.e. change in tariff structure and feed-in tariff. The feed-in tariff has proved an excellent accelerator to promote renewable energy, especially for community-scale plants. The need for public-private partnership is an essential element where lucrative business opportunities can arise. For proper and efficient utilization of distributed generation-based infrastructure, an insight into energy demand, effective project management, and forecasting of future demand based on past trends require attention.[15] Moreover, distributed generation systems are subjected to include a mix of state, local or federal policies to enhance the financial attractiveness.

ii. Utility-Scale Renewable Energy Projects

On a utility scale, competitive bidding and hybrid power plants can be reasonable solutions to boost renewable energy with the least cost options. The percentage share of renewable energy based on solar, wind, and biomass merely counts for 5.47% of the installed capacity, while there exists an enormous potential for the applicability of renewable energy projects in the country. Due to the fuel cost component in the generation tariffs for conventional power plants based on imported fuels, the average energy price escalates more than the recovery, adding to the circular debt. Renewable power generation

[15] Muhammad Hamza Naeem and Lubna Riaz, "Renewable Energy-Based Distributed Generation in Pakistan," *Policy Perspectives* Vol. 19(1): 65-84. DOI: 10.13169/polipers.19.1.ra3

at the utility scale is beneficial to lowering the average energy prices, being that no fuel component is involved.

The maturity of solar, wind, and biomass technologies has promised cost reduction for energy generation. Compared with conventional power generation facilities, global trends present a massive reduction in energy tariffs over a project's lifetime. This can be significant in reducing the average tariffs. Moreover, the capacity payments for the renewable plants may be lowered owing to developing the projects on competitive bidding and hybrid settlement.

a. **Competitive bidding of renewable power plants:** By definition, competitive bidding means to auction a large quantity of the volumes. For energy procurement, competitive bidding on renewable energy projects would provide the least cost options based on the energy and capacity payments. The future development of renewable energy projects should include competitive bidding to lower the overall average power price.

b. **Hybrid renewable energy projects:** Scalability and site specification are some of the considerable constraints in developing renewable energy projects. Moreover, one issue with these alternative sources is the intermittency and variability in the power output. To address the issue of renewable energy intermittency and variability, hybrid renewable energy plants may lead to many fold advantages. Solar photovoltaics have the least site specification constraints, which enables the integration of solar technologies with wind farms, biomass, hydropower, and tidal energy. The hybrid integration of the sources shall improve the technical grid stability and can lower energy prices as the capital cost can be optimized.

D. Liberalization of the Energy Market

Liberalization of the energy market leads to the opening up of the sector to more competition, involving the relaxing of government restrictions. The liberalization of the market requires the inclusion of business entities to commercialize the operations. For the liberalization of the power sector, privatization and competitive trading are the key principles for opening up of the power markets.

In the 1990s, through the Power Sector Strategic Plan for Restructuring and Reforms – WAPDA, which was responsible for the overall operations of the power sector – was unbundled with the formation of separate generation, transmission, and distribution companies. This strategic plan was aimed to achieve complete privatization and liberalization, yet only the generation sector was opened up to include independent and captive power generation. Pakistan's power sector market is still in operation with the single-buyer model.

The most significant factor in the increment of the circular debt is the capacity payments, where the market liberalization can bring the prospects to minimize the guaranteed obligations from the government. Through market liberalization, where the capacity of the power plants can be traded similarly to energy, the existence of multiple buyers can feasibly improve competitive trading.

Furthermore, liberalization of the energy markets will increase employment levels, business efficiency, the country's potential economic development, and GDP growth and ultimately benefit the consumers. Therefore, there is a need to focus on the impacts of market liberalization on these key areas to assess how advantageous this increase in competition has on the energy market. One of the most compelling advantages that can be yielded leads to improving the efficiency of the operations and systems. The

power sector is burdened with technical inefficiencies in the distribution network which the state-owned DISCOs are incapable of improving. The influx of much-required competition is necessary where the private entities shall strive to improve the technical infrastructure to enhance profitability. Further, decentralized planning shall be the utmost focus for the distribution utilities where they would be able to procure the power on a competitive basis.

The power sector has developed its transition on market competitiveness through bilateral contracts, known as Competitive Trading Bilateral Contract Markets (CTBCM). CTBCM is developed to enhance energy trading through business-to-business contracts, where the bulk consumer[16] is allowed to procure power through bilateral and independent contracts. This step of liberalization has promoted the inclusion of electric power suppliers, traders, bulk consumers, and auction administrators under the market operations of CPPA. The operationalization strategies and analysis are yet to be assessed in CTBCM, whereas market development through CTBCM is expected to bring openness in the vertically integrated market.

International best practices have also demonstrated progressive developments in market operations after the liberalization. Considering the example of the UK, the liberalization of energy markets in the 1980s through privatization under Margaret Thatcher has lent benefits to consumers based on lowering prices due to increased competition between rival energy firms. The liberalization has proved to be compelling because instead of a single monopoly, competitive markets try and compete through price wars. On the other hand, the government is not required to assign guarantees against investment risks.[17]

E. Capacity Building for Indigenousness

Most of the pertained issues are related to the dependence on the foreign market for resources, O&M, installation, fuel, and consultancies. This creates a burden on the foreign reserves on one hand, while increment of the payments is very vulnerable to currency variations. The escalation of the payments can be controlled if indigenous resources are promoted.

Pakistan has a high reliance on foreign markets for the technical requirements of power generation. It is highly advisable to transit the local markets and capacity building towards the indigenousness of the manufacturing, fuel supply, and expertise. There is an immense demand for solar equipment and associated accessories in Pakistan, which are being imported from foreign markets. It is highly recommendable to motivate market reformations and necessary interventions to pursue ease of doing business, where the local investors can have an active participation in manufacturing, operations, fuel supply, and technical expertise with the stakeholders involving policy circles, academia, industry, business entities, etc.

[16] By definition, bulk consumer of power is meant to be the entity with consumption of more than 1 MW.
[17] William Garner, "Liberalization of Energy Markets. Effects on Gas and Electricity Generation, Distribution and Supply," (Munich: GRIN Verlag, 2012), https://www.grin.com/document/323337

Appendix I

Regulators, Facilitating Bodies and State Entities in Power Sector

National Electric Power Regulatory Authority (NEPRA)	An independent regulator with a mandate to ensure transparent competitive and commercially oriented power market operations including generation, transmission, and distribution. It also issues generation, transmission, and distribution licenses and determines tariffs for the power sector.
Private Power Infrastructure Board (PPIB)	One-window facilitator on behalf of the federal government to promote private sector participation in the power sector for large hydropower and non-renewable technologies such as RFO, natural gas, and coal.
Alternative Energy Development Board (AEDB)	An autonomous body under the Ministry of Energy with the mandate to promote and facilitate exploitation of renewable energy resources. It develops national strategies, drafts policies, and plans for the utilization and promotion of renewable energy. It coordinates and facilities commercial application of renewable energy technologies as well as facilitates private investors.
National Transmission & Despatch Company (NTDC)	State-owned public limited company, responsible for all properties, rights, assets, obligations, and liabilities of 220 kV and 500 kV grid stations and transmission lines and networks. It also provides a wheeling facility to CPPA-G purchasing power generators and selling to DISCOs.
Central Power Purchasing Agency (CPPA)	State-owned limited guarantee and market operator responsible for power procurements from generation companies, hydropower, and IPPs on behalf of DISCOs for delivery through 500 kV, 220 kV, and 132 kV networks. It serves as a central bank of the power sector.
Distribution companies (DISCOs)	State-owned power utilities. There are 10 DISCOs (electricity retail companies) operating in the country, responsible for administering the operations and maintenance (O&M), supply, distribution, construction, and expansion of 132 kV and 11 kV grid networks within their respective areas of jurisdiction.
Generation Companies (GENCOs)	Government-owned but independently operated companies responsible for the O&M of public-sector thermal power plants.
Water and Power Development Authority (WAPDA)	Statutory body under the administrative control of the federal government. WAPDA is responsible for development of large-scale hydropower projects and water sector projects to harness water and hydropower resources.

Appendix II

Independent Power Producers (IPPs) in Pakistan

Sr. No	Name of IPP	Gross Capacity (MW)	Fuel
Power Policy 1994			
1	Hub Power Co.	1292	RFO
2	Lalpir Ltd.	362	RFO
3	Pak Gen (Pvt.) Ltd.	365	RFO
4	Altern Energy Ltd.	31	Gas
5	Fauji Kabirwala Power Co. Ltd.	157	Gas
6	Gul Ahmed Energy	136	RFO
7	Habibullah Coastal Power (Pvt.) Co.	140	Gas
8	Japan Power Generation Co.	120	RFO
9	Kohinoor Energy Ltd.	131	RFO
10	Liberty Power Ltd.	235	Low Btu Gas
11	Rousch (Pakistan) Power Ltd.	450	Gas
12	Saba Power Co.	134	RFO
13	Southern Electric Power Co. Ltd.	117	RFO
14	Tapal Energy Pvt. Ltd.	126	RFO
15	Uch Power Ltd.	586	Low Btu Gas
16	Davis Energy Pvt. Ltd.	11	Gas
17	Kot Addu Power Company Ltd.	1638	Gas & RFO
18	Laraib Energy Ltd.	84	Hydro
Power Policy 2002			
19	Attock Gen Ltd.	165	RFO
20	Abzs Power Ltd.	225	RFO
21	Engro Energy Ltd.	227	Low Btu Gas
22	Saif Power Ltd.	229	Gas/RLNG
23	Power Generation Co. Ltd.	225	Gas/RLNG
24	Narowal Energy Ltd.	220	RFO
25	Liberty Power Tech Ltd.	200	RFO
26	Nishat Power Ltd.	200	RFO
27	Nishat Chunian Ltd.	200	RFO
28	Orient Power Company Ltd.	229	Gas/RLNG
29	Foundation Power Co. (Daharki Ltd)	185	Low Btu Gas
30	Sapphire Electric Company Ltd.	225	Gas/RLNG
31	Uch-II Power Ltd.	404	Low Btu Gas
32	Star Hydro Power Ltd.	147	Hydro

Power Policy 2015			
33	NPPMC Pvt. Ltd. (Haveli Bahadur Shah Power Project)	1230	RLNG
34	Quaid-e-Azam Thermal Power Pvt. Ltd.	1180	RLNG
35	NPPMC Pvt. Ltd. (Balloki Power Project)	1223	RLNG
36	Huaneng Shandong Ruyi (Pakistan) Energy Pvt. Ltd.	1320	Imported coal
37	Port Qasim Electric Power Company Pvt. Ltd.	1320	Imported coal
38	China Power Hub Generation Company Pvt. Ltd.	1320	Imported coal
39	Engro Powergen Thar (Pvt.) Ltd.	660	Local coal
Renewable Energy Policy 2006			
40	FFC Energy Ltd.	49.5	Wind
41	Zorlu Energy Pakistan Ltd.	56.4	Wind
42	Three Gorges First Farm Pakistan Pvt. Ltd.	49.5	Wind
43	Foundation Wind Energy-II Pvt. Ltd.	50	Wind
44	Foundation Wind Energy-I Pvt. Ltd.	50	Wind
45	Sapphire Wind Power Company Ltd.	52.8	Wind
46	Metro Power Company Ltd.	50	Wind
47	Yunus Energy Ltd.	50	Wind
48	Master Wind Energy Pvt. Ltd.	52.8	Wind
49	Act Wind Pvt. Ltd. (Formerly Tapal Wind Energy Pvt. Ltd.)	30	Wind
50	Gul Ahmed Wind Power Ltd.	50	Wind
51	Tenega Generasi Ltd.	49.5	Wind
52	Hydro China Dawood Power Pvt. Ltd.	49.5	Wind
53	Sachal Energy Development Pvt. Ltd.	49.5	Wind
54	UEP Wind Power Pvt. Ltd.	99	Wind
55	Jhampir Power Pvt. Ltd.	50	Wind
56	Hawa Energy Pvt. Ltd.	49.6	Wind
57	Artistics Energy Pvt. Ltd.	49.3	Wind
58	Three Gorges Pakistan Second Wind Farm Pakistan Ltd.	49.5	Wind
59	Three Gorges Pakistan Third Wind Farm Pakistan Ltd.	49.5	Wind
60	Tricon Boston Consulting Corporation Pvt. Ltd. - A	49.6	Wind
61	Tricon Boston Consulting Corporation Pvt. Ltd. - B	49.6	Wind
62	Tricon Boston Consulting Corporation Pvt. Ltd. - C	49.6	Wind
63	Zephyr Power Pvt. Ltd.	50	Wind
64	QA Solar Power Pvt. Ltd.	100	Solar
65	Apollo Solar Development Pakistan Ltd.	100	Solar
66	Best Green Energy Pakistan Ltd.	100	Solar

67	Crest Energy Pakistan Ltd.	100	Solar
68	Harappa Solar Pvt. Ltd.	18	Solar
69	AJ Power Pvt. Ltd.	12	Solar
70	Oursun Pakistan Ltd.	50	Solar
71	JDW Sugar Mills Ltd. (Unit-II)	26.35	Bagasse
72	JDW Sugar Mills Ltd. (Unit-III)	26.35	Bagasse
73	Chiniot Power Ltd.	57	Bagasse
74	RYK Mills Ltd.	30	Bagasse
75	Hamza Sugar Mills	15	Bagasse
76	Layyah Sugar Mills	41	Bagasse
77	Al Moiz Industries Ltd.	36	Bagasse
78	Chanar Energy Ltd.	22	Bagasse

Appendix III

Adjustment Components for Capacity Charges in Generation Costs

Indexations	Formulations	Legends
Adjustments in EPC Cost	EPC_{Adj} = USD (millions)/euro-dollar rate * E_{PR} + USD (millions)	EPC_{Adj} = Weighted average euro to dollar parity based upon the timing of the payment
Insurance Adjustment Mechanism for EPC Cost Variation	$Ins_{rev} = Ins_{ref}/\ EPC_{ref}$ x EPC_{Adj} x $\frac{P_{rev}}{Dollar-PKR\ rate\ at\ COD}$	Ins_{rev} = Revised reference insurance component of the tariff Ins_{ref}= Reference insurance component of tariff as per original schedule of tariff EPC_{ref} = Reference EPC in USD EPC_{Adj} = Adjusted EPC in USD P_{rev} = Rupee to dollar parity at COD P_{ref} = Reference rupee to dollar parity
Return on Equity Adjustment Mechanism for EPC Cost Variation	$ROE_{(Rev)} = ROE_{(Ref)}$ / (% *Equity USD)* x (% *Equity* $PC_{(Rev)}$ X $P_{(Rev)}$ / *Dollar-PKR rate at COD*	$ROE_{(Rev)}$ = Revised reference return on equity component of tariff $ROE_{(Ref)}$= Reference return on equity component of tariff as per original schedule of tariff $PC_{(Rev)}$ = Revised project cost after incorporating the adjustment for currency fluctuation $P_{(Rev)}$ = Rupee to dollar parity at COD
ROEDC Adjustment Mechanism for EPC Cost Variation	$ROEDC_{(Rev)}$ = *Reference Tariff* / (*Amount incurred during construction in* US$) x $EDC_{(Rev)}$ x $P_{(Rev)}$ /*Dollar-PKR rate at COD*	$ROEDC_{(Rev)}$ = Revised reference Return on Equity during construction component of tariff $EDC_{(Rev)}$ = Revised equity during construction in million USD
Debt Servicing Adjustment Mechanism for EPC	$DS_{(ev)}$= $(Debt\ amount)\ x\ (debt\ \%\ x\ PC_{(Rev)})\ x\ P_{(Rev)}$/ *Dollar-PKR rate at COD*	$DS_{(ev)}$ = Revised debt servicing component of tariff $DS_{(Ref)}$ = Reference debt servicing component of the tariff as per original schedule tariff $PC_{(Rev)}$ = Revised project cost after incorporating the

Cost Variation		adjustments for currency fluctuation $P_{(Rev)}$ = Rupee to dollar parity at COD
Adjustment due to Variation in Net Capacity	$CC_{(Adj)}$ = $CC_{(Ref)}$ *x MW/* $CN_{(IDC)}$	$CC_{(Adj)}$ = Adjusted relevant capacity charge components of tariff $CC_{(Ref)}$ = Reference relevant capacity charge components of tariff $CN_{(IDC)}$ = Net capacity at reference site conditions established at the time of IDC test
Adjustment in Insurance as per Actual	*Insurance (Rev) = AIC / (% insurance cost X project cost in millions) * AP*	AIC = Adjusted insurance component (Rs./kW/hr) as per IDC test AP = Actual premium subject to maximum of 1.35% of the adjusted EPC
Fixed O&M	F O&M$_{LREV}$ = *Reference tariff/kW/hour* *WPI_{Rev}*/Reference WPI* F O&M$_{FREV}$ = *Reference tariff/kW/hour* *$US\ CPI_{Rev}$*/Reference WPI * ER_{REV} /PKR-dollar rate at COD*	F O&M$_{FREV}$ = the revised applicable Fixed O&M local component of the capacity charge indexed WPI F O&M$_{LREV}$ = the revised applicable fixed O&M foreign component of the capacity charge indexed with US CPI and exchange rate variations F O&M$_{FREV}$ = the revised applicable fixed O&M foreign component of the capacity charge indexed with US CPI and exchange rate variations WPI$_{Rev}$ = the revised wholesale price index (manufactures) WPI$_{Ref}$ = 118.96 wholesale price index (manufactures) of January 2007 notified by Federal Bureau of Statistics US CPI$_{Rev}$ = US CPI revised US CPI$_{Ref}$ = CPI for the month of January 2007 notified by the US Bureau of Labor Statistics ER$_{REV}$ = the Revised TT & OD selling rate of US dollar

		as notified by the National Bank of Pakistan
Variable O&M	$V\ O\&M_{LREV}$ = *Reference Tariff/kW/hour* $*WPI_{Rev}$*/Reference WPI* $V\ O\&M_{FREV}$ = *Reference Tariff/kW/hour* $*US\ CPI_{Rev}$*/Reference CPI* $* ER_{REV}$ */Dollar-PKR rate at COD*	$V\ O\&M_{FREV}$ = the revised applicable variable O&M local component of the capacity charge indexed WPI $V\ O\&M_{LREV}$ = the revised applicable Variable O&M foreign component of the capacity charge indexed with US CPI and exchange rate variations $V\ O\&M_{FREV}$ = the revised applicable variable O&M foreign component of the capacity charge indexed with US CPI and exchange rate variations WPI_{Rev} = the revised wholesale price index (manufactures) WPI_{Ref} = 118.96 wholesale price index (manufactures) of January 2007 notified by Federal Bureau of Statistics US CPI_{Rev} = US CPI revised US CPI_{Ref} = 202.41 CPI for the month of January 2007 notified by the US Bureau of Labor Statistics ER_{REV} = the revised TT & OD selling rate
Adjustment Based on Actual Interest During Construction	Debt Service, return on equity and ROE during construction shall be adjusted on account of actual variation in drawdown and Interest During Construction with reference to the estimated figures.	
Adjustment due to Customs Duties & Taxes	Debt service, return on equity, and ROE during construction are adjusted on account of actual variation in customs duties and taxes with reference to the estimated figures. The impact of withholding tax on local services is not known at the point of tariff determination. However, these will be adjusted along with other duties and taxes as per the actual on the provision of documentary evidence at COD.	

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