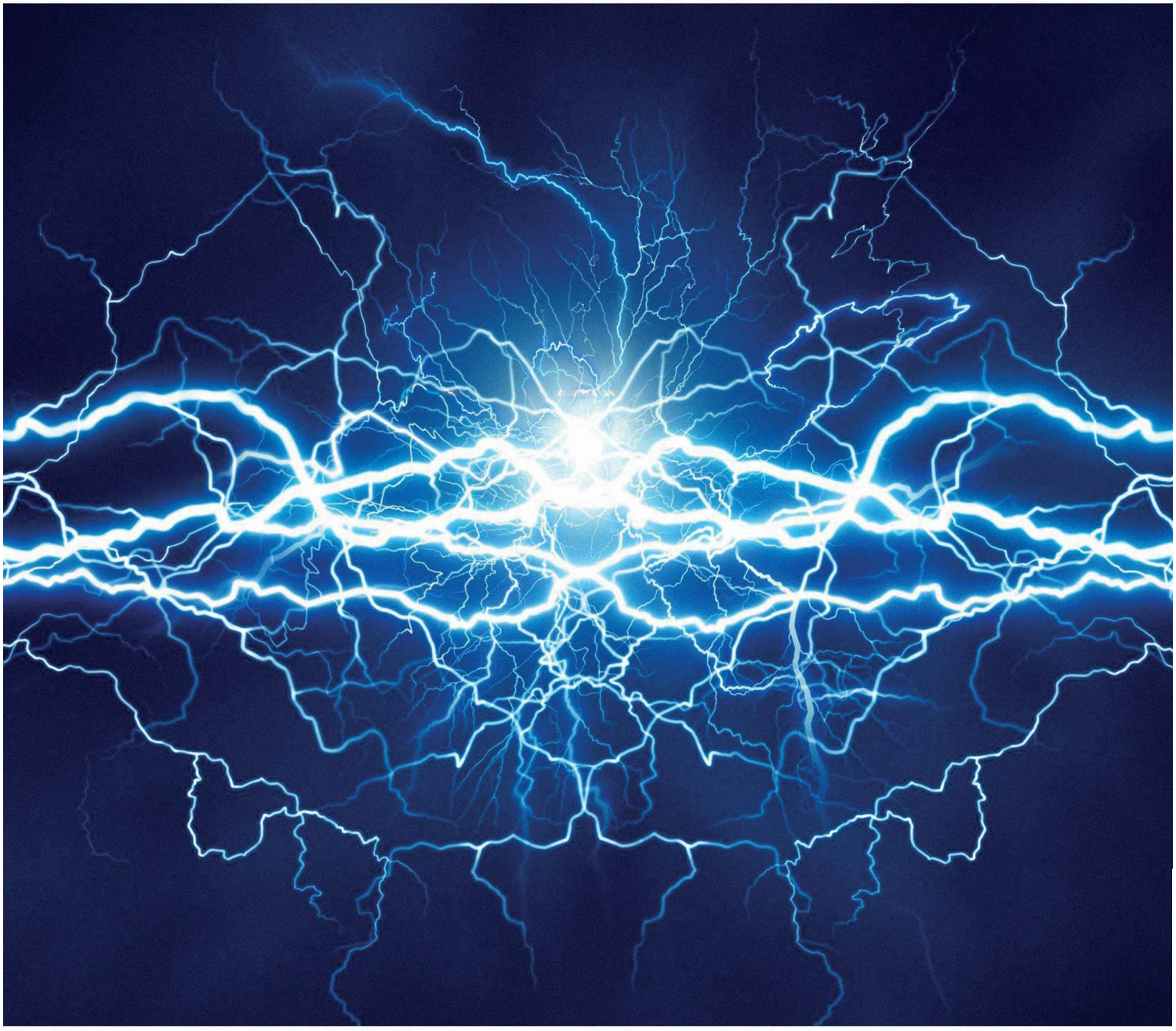
FUTURE OF COMPETITIVE ELECTRICITY MARKET IN PAKISTAN



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Future of Competitive Electricity Market in Pakistan

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Foreword

It gives me immense pleasure to present this book titled **'Future of Competitive Electricity Market in Pakistan'** authored by a very senior Fellow member of our Institute, and Chairman, Advisory Board on Power Sector - ICMA Pakistan Mr. Abid Lateef Lodhi who has diversified professional experience in the power and energy sector in Pakistan. Based on his practical experience of the power sector, Mr. Abid Lodhi has, very precisely and skillfully, explained the perspective of international competitive electricity markets with special reference to its benefits to the society and the economy. This endeavor by Mr. Abid Lodhi will certainly provide our policy makers dealing with power sector to take advantage of new developments taking place in advanced countries and enable the country to respond quickly to the emerging challenges and sustain the changing business environment.

Electricity is the lifeline of economy and contributes towards socio-economic development of any country. The electricity demand has been rising consistently due to growing industrial requirement and population explosion. Unfortunately, power generation and supply have not been able to meet this rising demand of electricity. The cost of electricity generation is also high due to faulty fuel mix which has led to massive load-shedding and power shortages in Pakistan. There is emergent need to resolve the circular debt issue by revamping the entire power sector, including tariff setting, efficiencies of power generating units, supply chain network and payment recoveries. If this is not done, the future of energy sector would remain at stake.

ICMA Pakistan is a national Institute of international repute and a trusted name in the field of professional education, corporate trainings, industry research and technical support to businesses for the promotion of best practices and to ensure corporate governance. To fulfill its national responsibility towards economic development, the Institute is working closely with the government ministries and departments, regulatory bodies, industry and corporate sector.

I congratulate Mr. Abid Lateef Lodhi and the Research and Publications Committee of the Institute for accomplishing this task and presenting such a useful publication for the benefit of professionals, industrialists, businessmen, researchers and students.

Zia Ul Mustafa, FCMA
President, ICMA Pakistan

Preface

I would like to congratulate Mr. Abid Lateef Lodhi for making a worthwhile contribution by writing this book on **'Future of Competitive Electricity Market in Pakistan'** which, I am sure, would prove to be a useful reference guide for those who want to understand the basics of the international and domestic electricity markets.

In fact, this is the second publication of Mr. Abid Lateef Lodhi which is being published by the Institute. His first book titled *'Costing and Tariff Setting in the Power Sector of Pakistan'* was published by the Institute in 2014. I am quite sanguine that the recent publication of Mr. Lodhi will not only provide useful knowledge about the dynamics of electricity market competition to our members, especially those who are serving in the power and energy sector, but it would also provide an excellent policy document for consideration by the power regulatory bodies to apply the same in Pakistan.

It is one of priority agenda of the Research and Publications Committee of the Institute to encourage our members, having vast practical knowledge of working in different sectors, to come forward and transform their experiences in writing for the benefit of members, students and other stakeholders. In the past, we had published booklets by our member writers on the construction, mineral and mining, sugar and power sectors which were widely appreciated. It is quite reassuring for the R&P Committee to facilitate in releasing this useful publication authored by Mr. Abid Lateef Lodhi.

I am sure that this book would be warmly received and appreciated by the members and other readers.

Muhammad Yasin, FCMA
Chairman, Research and Publications Committee

About the Author

Mr. Abid Lateef Lodhi, FCMA has been elected on the National Council of ICMA Pakistan for the term 2018-20. He is serving as Chairman of Advisory Board on Power Sector - ICMA Pakistan.

Currently, he is serving as CEO of Central Power Purchasing Agency Guarantee Limited, the company working under Ministry of Energy, Power Division, Government of Pakistan. He is a member of SAARC on Integrated Energy Initiatives and Member Board of Director of Power Information Technology Company. Having more than 28 years professional experience, Mr. Abid Lodhi has served in the past as Team Lead Policy, Governance & Privatization in USAID Power Distribution Program; Finance Director & Team Lead Financial Management at International Resource Group (IRG), USA; CFO Lahore Electricity Supply Company, Power and Water Utility Company of Saudi Arabia, Deputy Director Tariff NEPRA and Water and Power Development Authority. Previously, he had served as Vice Chairman of Lahore Branch Council in 2011 and Chairman CRC Committee of LBC in 2010.

SUMMARY AND ACKNOWLEDGMENTS

Pakistan Power Sector has been evolved ever since its formation and has remarkable achievements over the decades, however major restructuring started in the mid of 1990s, with aim of restructuring was to make power sector a self-sustaining business with limited/ no intervention by the Government, has not produced desired outcome. The main reason behind the failure is the piecemeal approach towards the solution without clear vision of the ultimate objective.

Over the last decade power sector performance is on declining trend, which at one side has resulted in shortage of supplies and on the other hand prices are sky-high that power sector is vulnerable to financial crunch up to the 1/3rd of the budget of entire country.

Policy maker and regulator had conflicting perspective regarding the sector which has badly affected the liquidity in the market as a result government intervention in the form of subsidies has become a norm and with limited fiscal space it is very difficult to sustain the sector.

To align the Policy Maker and Regulator, the amended NEPRA Act has required to have National Electricity Policy and National Electricity Plant which has to be prepared in coordination between the Government and NEPRA.

In wake of recent developments in the Pakistan Power Sector where the following has been prepared and submitted to NEPRA, for the first time, for regulatory proceedings;

a. Indicative Generation Capacity Expansion (IGCEP)
b. Power Purchase Price Forecast

Moreover, a Competitive Power Market Model has been prepared by CPPA-G on which NEPRA has started consultation has opened debate about the future outlook of the said market.

With this background, this book is compiled to provide the perspective of international competitive markets, how the world has transformed itself, what benefits they have gained, this book also takes the reader through transition of Pakistan power sector, what kind of competitive market can be developed based on peculiar circumstances on the sector, how it can be developed and what are the expected benefits. Accordingly, this book includes extracts from and references to various international and national books and reports which were deemed to be helpful to put the perspective right for the readers of this book.

The reader will be able to exercise his judgement that how this market will work, how it will provide benefits and at the end can provide constructive feedback for the continuous evolving power markets based on his knowledge and experience.

“Costing and Tariff Setting in Power Sector of Pakistan” was the first book and this is second book in the series which will provide insight for the power market structures internationally and with respect to Pakistan. With the rapid evolution in the sector it can be reasonably ascertained that the business models of Power Sector are changing across the globe and sector has to respond quickly as never done before in order to sustain in the changing business environment.

At the end I would like to appreciate the efforts of Mr. Shaheer Ali, Mr Omar Haroon Malik and Mr. Zubair Mahmood who have helped me to complete the book within shortest possible time.

CHAPTER-1: ELECTRICITY MARKETS AND PAKISTAN PERSPECTIVE

ELECTRICITY MARKETS FROM AN INTERNATIONAL PERSPECTIVE

Today's restructured electricity markets illustrate the importance and power of effective market design. Over the last 25 years, electricity markets have evolved to address complex economic and engineering challenges. Despite some bumps along the way, the markets have largely succeeded in the goal of providing reliable electricity at least cost to consumers. This is no simple task. Every second, supply and demand must balance. Thousands of resource and network constraints must be satisfied. And the market must send the right price signals to motivate efficient generation and investment in resources over time.

Not surprisingly, electricity market models differ in their design in different regions. Some differences reflect key differences in the market setting, but differences also arise for path-dependent reasons. However, it would possible to group these models in three categories:

- The traditional vertically and horizontally integrated utilities, almost exclusively before the 1990's
- Integrated utility that produces energy but also buys from Independent Power Producers.
- The market model, initially developed in the 1990's and which was implemented in most of developed economies.

The following figure 1 gives the historical perspective of evolution of each model:

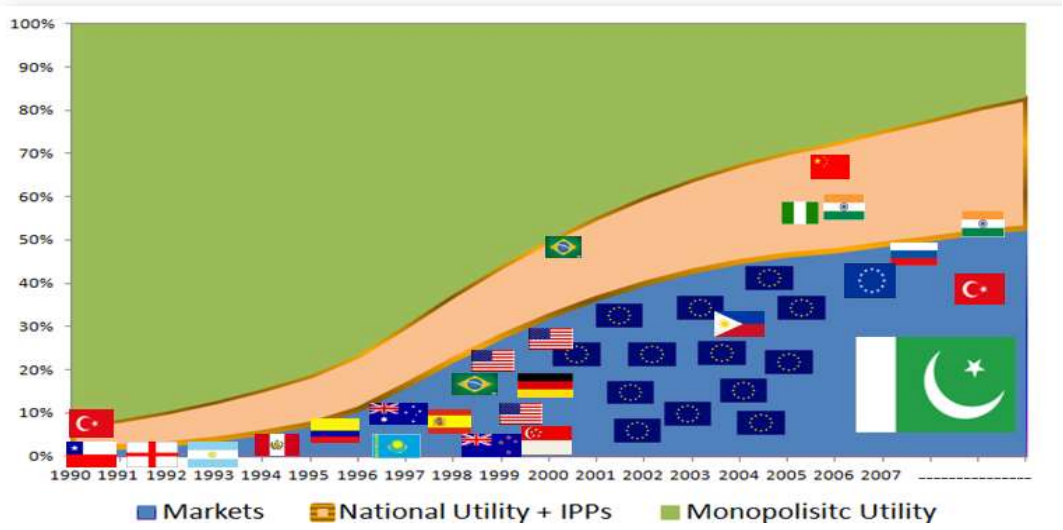


Figure 1 : Evolution of Different Market Models

Electricity markets are designed markets. They did not emerge from an unorganized marketplace. Rather, they were designed in a regulatory process in part because electricity is viewed as an essential service, but also because of its technical properties. In most of the countries, electricity began as a monopoly utility, then shifted to a power pool in which the monopoly utilities could engage in trade. The final step to markets came with the introduction of spot markets that determine the quantities

generated and consumed as well as the prices paid for energy and related services at each time and location.

Good electricity market design has always been important. Design mistakes can cost consumers tens of billions of dollars, as illustrated by the California electricity crisis in early era of its deregulation. Fortunately, because of good governance and technological progress, market designs have improved over time. Flaws have been identified and largely addressed.

Still electricity market design is far from static. New challenges are emerging with the on-going transformation of the electricity industry. The forces driving change are the expansion of renewables, demand response, distributed generation, smart homes, and battery storage (Cramton, 2017).

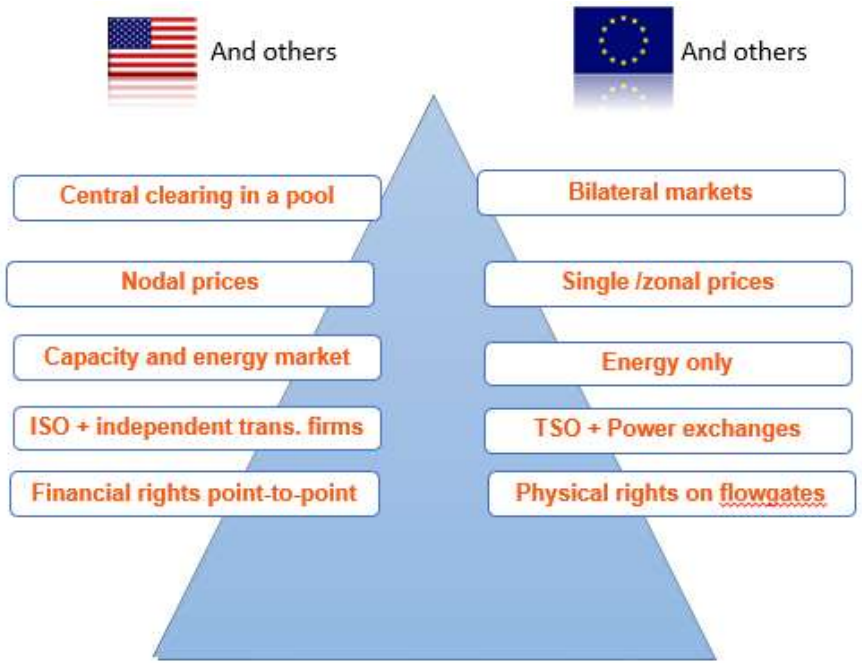


Figure 2 : Different Models for Market Design adopted by International Markets

DRIVERS OF CHANGE

Power sector reform in developed and developing countries is fundamentally different in terms of sector conditions and institutional framework. In developed economies, the main reason for reform is to improve the efficiency of the sector, by encouraging inter-regional (cross-border) trade, sharing investment risks with the private sector and offering customers' choice on their suppliers. Meanwhile, for developing countries where polices of industrialisation were encouraged, these have left the power sector with short-term excess capacity, so that new capacity was a lower priority than in most developed countries. So the main motivation for reform includes; (i) the poor performance of state-owned vertically integrated electricity companies (in terms of high costs, inadequate maintenance routes, low expansion of access to electricity service and unreliable power supply). (ii) Insufficient funds to meet the investment needs of the corporations, (iii) the need to remove subsidies in the electricity supply industry and channel the resources to other pressing public needs. (iv) The need for the sector to be competitive and contribute to growth of the economy: and lastly (v) the desire to raise revenue for the government through the sale of assets from the sector (Nworie, 2017).

The main drivers of the change towards electricity markets are summarized in figure below:

Figure 3 : Drivers to Change Market Model

PILLARS OF MARKET DESIGN

Experience in many countries illustrates the value in using markets to access flexibility. Well-designed markets encourage economically efficient and stable solutions, promote desired behaviour, and minimize unintended consequences. Yet, many uncertainties remain about how to evaluate system requirements and effectively induce and sustain investments in appropriate resources.

It is apparent that market design is a difficult task. Many competing objectives must be met, including using short-term price signals to incentivize long-term investments, minimizing market power, and providing incentives for suppliers for the many non-energy services that are needed to balance the grid. Wholesale markets in many locations are markedly uncorrelated with pricing mechanisms in the retail market. This means that participants in the wholesale markets have minimal ability to predict, plan, or account for consumer actions. Further, in some markets with scarcity pricing, spikes in wholesale prices serve only to increase total costs, and do not provide any incentives for consumers to change their behaviours to promote economic efficiency.

The challenge of appropriate market design becomes more apparent in emerging 21st century power systems. Assets such as variable renewable energy, demand response, storage, and distributed generation offer benefits that can be realized throughout the power system—generation, transmission, and distribution—and therefore are difficult to capture in current markets and regulatory structures, which deliberately segregated generation from transmission to support utility unbundling. The power system may require a transformation from a system premised on a strict separation between wholesale and retail, or generation and distribution, to one that can integrate these markets, such that assets from across the system can contribute to flexibility and reliability.

Moreover, market solutions are not the only option. Various hybrid designs—combinations of regulations and competitive markets—might serve as alternatives. A key driver in any market or hybrid design is to start with the characteristics that maximize the value of the power system and ensure that the type and quantity of services that deliver economically efficient operation and design of the power system are understood. The power system is just that, a system, relegating various design and operational issues to entities that are uncoordinated, possess imperfect information, and possess varying degrees of market power. Moreover, these entities operate in a complex market with many economic externalities; thus economies of scope (e.g., coordination of transmission and generation planning) are difficult to achieve. On balance, however, markets can enable efficiency gains that

emerge from competitive (or nearly competitive) markets in electricity. Nevertheless, market approaches remain just one option in a broader range of possible approaches, such as vertically integrated utilities (Jaquelin Cochran, 2013).

Figure 4 : Pillars of Market Design

There is an acute need for international collaboration on wholesale market design questions. A platform for collaborative analysis and modelling will help to evaluate pathways to 21st century power systems. Proposed market or hybrid market-regulation paradigms should be rigorously tested to understand both technical and financial outcomes, but also the alignment with the public policy objectives that drive market design. The 21st Century Power Partnership aims to provide this platform, and the authors of this report sincerely hope that it lays the groundwork for future collaboration.

MANDATORY POWER POOLS AND VOLUNTARY POWER EXCHANGE

Considering the dispatch purpose there are two alternative designs: (i) an integrated market in which the system operator centrally optimizes the scheduling and dispatch of resources (Power Pool), and (ii) an exchange-based market in which energy companies trade day-ahead and throughout the day at prices that clear the market absent central optimization (Power Exchange).

The first step toward markets was the creation of power pools. In a power pool, generators are required to sell their entire production to the pool. Suppliers have to purchase from this central pool to fulfil their demand. Generators submit their sale offers (volume and price / cost) to a centralized body (usually a system operator - SO). Suppliers submit their purchase bids (quantity). SO aggregates all the purchase bids and builds a supply and demand curve for the day–ahead and runs a unit commitment tool to optimize the available resources and come up with a system marginal price (SMP). Generators committed for the day-ahead are informed accordingly. In real time SO dispatches according to Security Constraint Economic Dispatch (Cramton, 2017).

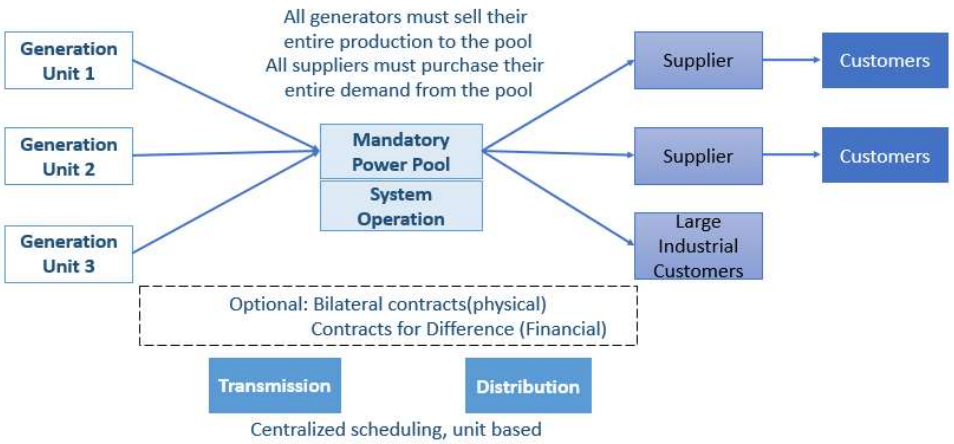


Figure 5 : Mandatory Power Pool

Central market clearing and dispatch allow the system operator to meet the twin objectives of reliability and efficiency.

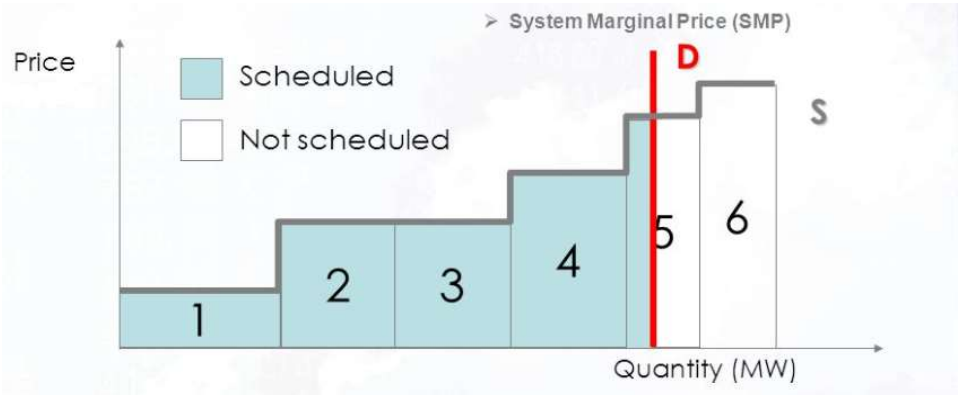


Figure 6 : System Marginal Price (SMP) in a Power Pool

Drawing from a larger fleet of generators means that the required energy can be supplied at lower cost, as low-cost resources are used more and high-cost resources are used less.

Contrary to the pool, participation in a power exchange is voluntary. Generators and suppliers can have their own bilateral contracts as well as they have the choice to sell / purchase through a power exchange. Generators / suppliers submit their bids / offers for sale / purchase of electricity.

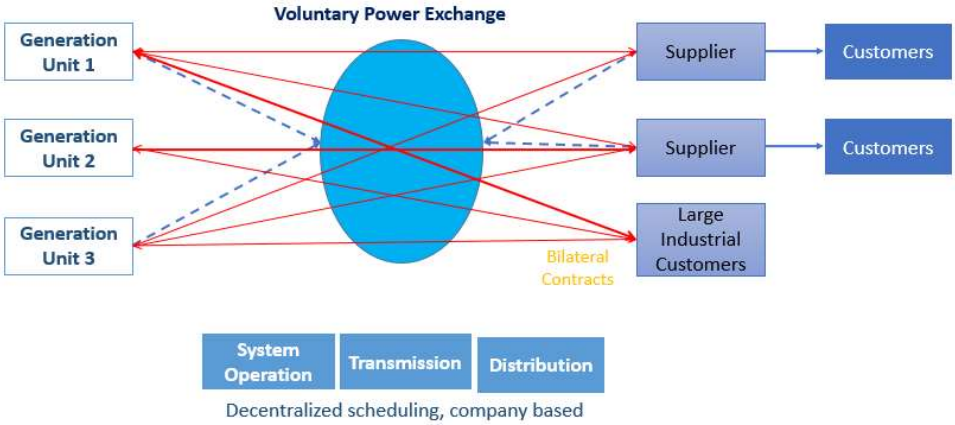


Figure 7 : Voluntary Power Exchange

A supply bid is simply an offer to supply energy at any price at or above the bid price, and similarly a demand bid is an offer to take energy at any price at or below the bid price. With this interpretation, the market clearing price (MCP) is the one that equates supply and demand. No system optimization is involved, and it is each supplier's responsibility to schedule its own plants optimally to provide the energy sold. Settlements are made at the MCP.

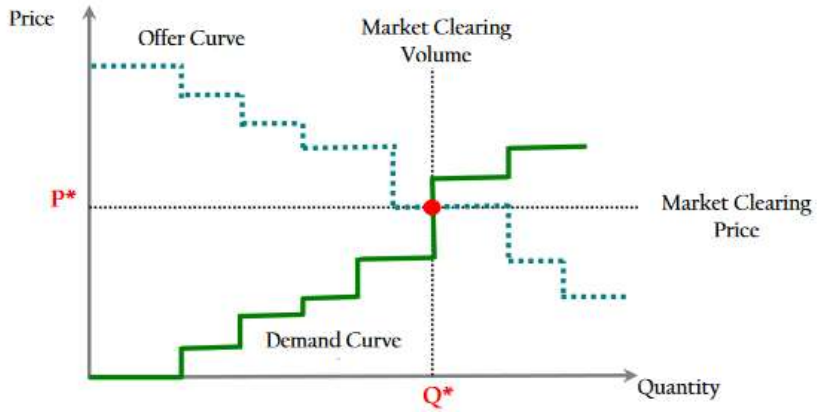


Figure 8 : Market Clearing Price (MCP) in an Exchange

Only the quantities cleared in the exchange are communicated to SO to ensure system security.

BENEFITS OF COMPETITION

Competition facilitates the most efficient means of production (NERA, 2008). Competitive market pricing provides significant benefits not found under traditional regulatory pricing. Among these benefits are the following:

- Market-based price signals are transparent and can stimulate appropriate infrastructure investment, energy conservation, and demand response
- Competition provides customers with choices—i.e., customer sovereignty. Customers can exercise their own choices with respect to long-term risks, environmental concerns, and even reliability levels

- Competitive market pricing allows sellers to tailor products and services to their customers' needs, and use demand-side solutions to avoid supply-side investment where appropriate
- By pricing at market, prices will be similar for proximate utilities
- Competition shifts risks from customers to investors
- Competition produces more efficient results because the investor, not the ratepayer, assumes the generation investment risk.
- In competitive markets, poor producers fail and are acquired or replaced by those with more skill, foresight, and industry.

WHAT WORLD HAS ACHIEVED THROUGH WHOLESALE COMPETITION?

US (PJM)

- **Downwards Trend in Power Prices** : Average annual wholesale energy price of $36.26 per megawatt hour (MWh) in 2015 was lower than the 2000 price of $42.28/MWh
- **Capacity Resources:** Gain of 17% in installed capacity, which ensures that sufficient resources are available for reliability
- **Operational Efficiency:** Improvement in generator operational efficiencies (e.g. increased thermal efficiency, reduced reactor outages) and reduced labor and non-fuel costs

ARGENTINA

- Access to electricity supply by the maximum population
- Quality of service improved greatly
- Improvement in Supply Security: Due to the increment on thermal generation capacity by Investors which in results complemented the hydropower capacity
- Financial sustainability
- Environmental sustainability
- Foster competition in the supply business

UK

- Reduction in electricity prices for end user
- Increase in the generation investment
- Active participation of demand

TURKEY

- Market transparency for new entrants both on production and retail side
- Sufficient diversity of active players
- Development in the installed capacity
- Market price decreased from 100 $/MWh to 49 $/MWh over a period of 2009 to 2017

ELECTRICITY MARKETS FROM PAKISTAN'S PERSPECTIVE

REFORM HISTORY

In 1947 when Pakistan came into being it inherited 60MW of power generation capability for a population of 31.5 Million, yielding 4.5 units per capita consumption (Introduction to WAPDA). Pakistan Water and Power Development Authority (WAPDA) was established through an Act of Parliament in 1958 as a Semi-Autonomous Body for the purpose of coordinating and giving a unified direction to the development of schemes in Water and Power Sectors, which were previously being dealt with, by the respective Electricity and Irrigation Department of the Provinces. Twelve years later, when WAPDA was created, the generation capacity had increased to 119 MW.

Power infrastructure development gained momentum after the 1970s and installed capacity of 636MW in 1970 rose to 9,094 MW in 1990-91. There were two vertically integrated public sector utilities i.e. Water and Power Development Authority (WAPDA) and Karachi Electric Supply Company (KESCO) managing the power sector of the country. Till 1980, performance of WAPDA and KESC remained satisfactory. However, constraints in the availability of capital led to an inadequate generation capacity as well as deterioration in transmission and distribution infrastructure afterwards.

Area Electricity Boards (AEBs) were established in 1982, in order to provide more autonomy and representation to provincial government, elected representatives, industrialists, agriculturalists and other interest groups in functions of the AEBs

A rapid growth was witnessed in early 1990s as big industrial and commercial houses were set up leading to sudden increase in demand for electricity. But the increase in the supply of electricity was insufficient and was unable to keep pace with the increased demand of electricity in that period which was growing consistently at 9 to 10 percent per annum. Power supply lagged behind demand, resulting in excessive shortage of electricity, especially for the industrial and commercial consumers. The overall operational inefficiencies in the power sector created the need for its restructuring.

In 1992, the Government approved WAPDAs Strategic Plan for the Privatization of the Pakistan Power Sector. This Plan sought to meet three critical goals:

- Enhance capital formation,
- Improve efficiency and rationalize prices, and
- Move over time towards full competition by providing the greatest possible role for the private sector through privatization.

WAPDA Act was amended in 1998 to permit establishment of PEPCO and unbundling of WAPDA. Power Wing of WAPDA comprising of Generation, Transmission and Distribution was restructured into public limited companies under the corporate law and were placed under the management of Pakistan Electric Power Company (PEPCO). These Entities are:-

Four Thermal Power Generation Companies i.e.

Southern Power Generation Company (GENCO-I), Central Power Generation Company (GENCO-II), Northern Power Generation Company (GENCO-III) and Lakhra Power Generation Company (GENCO-IV)

One National Transmission Company i.e.

National Transmission and Despatch Company (NTDC)

Ten Power Distribution Companies (DISCOs) i.e.

Lahore Electric Supply Company (LESCO), Faisalabad Electric Supply Company (FESCO), Islamabad Electric Supply Company (IESCO), Gujranwala Electric Power Company (GEPCO), Multan Electric Power Company (MEPCO), Hyderabad Electric Supply Company (HESCO), Peshawar Electric Supply Company (PESCO), Quetta Electric Supply Company (QESCO), Sukkur Electric Supply Company (SEPCO) & Tribal Electric Supply Company (TESCO)

The aim of above initiatives was to promote competition and improve financial, operational and management in all tiers of WAPDA to eventually offer affordable electricity to customers. It was also intended to promote commercial viability and enhance business value of the assets block of each corporate entity.

A regulatory framework was developed, and NTDC licensed in 2002 with two functions in addition to transmission and system operation functions. These functions, assigned in the license as transitory arrangements to reflect the change in sector structure and future power market, were: (i) development and implementation of competitive electricity markets, including a contract registrar; and (ii) as WAPDA could no longer be the Buyer in PPAs with new generation, procure power on behalf of the distribution companies created in the restructuring of WAPDA (DISCOs) until the wholesale competition market started commercial operation (expected by 2021) when DISCOs would contract and procure power on their own. In this way the CPPA function in NTDC License introduced a change in the power purchase and market model, where each and all DISCOs buy power through a representative that is responsible to negotiate, sign, and administer the billing and settlement of PPAs.

Consistent with the expected market development, in 2009 CPPA G was created as a power company to take over the CPPA and market development functions from NTDC as expected in 2002 NTDC License. The commercial operation of CPPA-G started in mid of 2015 when the transfer of functions were formalized and completed between NTDC and CPPA-G. The function and scope of authority of CPPA G are regulated by NEPRA Market Operator Rules.

HISTORICAL DEVELOPMENT OF PAKISTAN'S ELECTRICITY MARKET

The Water and Power Development Authority (WAPDA) of Pakistan was established through an Act of Parliament in 1958, it was an autonomous and statuary body under the administrative control of Federal Government. The Authority consisted of a Chairman and three members i.e. Water, Power and Finance.

Area Electricity Boards were established in 1982, in order to provide more autonomy and representation to the provincial governments, elected representatives, industrialists, agriculturists and other group of interests in the function of AEB. In order to reform power sector and transition from monopoly to privatization and for integration, the Government of Pakistan approved a Strategic Plan in 1994 as consequence of which the power wing of WAPDA a unbundled into separate companies for generation, transmission and distribution. This was materialized in 1998.

WAPDA was bifurcated in to two separate entities i.e. WAPDA and PEPCO. WAPDA is responsible of water and hydropower projects development and operations. Whereas, PEPCO is responsible for managing the affairs of all the ten DISCOs, four GENCOs and NTDC. These companies are administratively autonomous and operating under independent Board of Directors. On February 24, 2004, Ministry of Water and Power notified NEPRA approved Tariff for all the ten DISCOs replacing unified WAPDA Tariff.

CPPA was separated in 2015 from NTDC and formed an independent company owned by Federal Government. It is presently functioning as the Market Operator under Rule 5 of the NEPRA Market Rules 2015.

Following is the illustrative timeline of the historical development of the Power Sector of Pakistan:

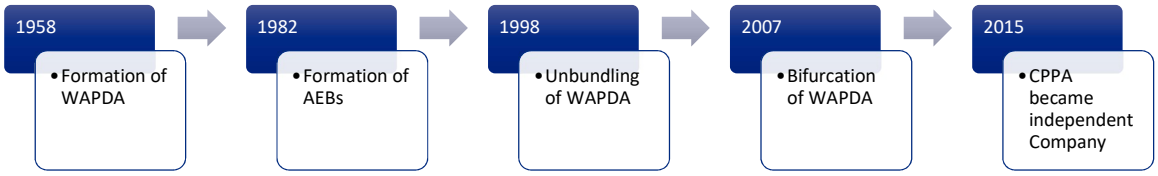


Figure 9 : Timeline of the historical development of the Power Sector of Pakistan

EXISTING STRUCTURE OF POWER SECTOR ENTITIES IN PAKISTAN

The Power sector was restructured in 1998 with the creation of PEPCO (Pakistan Electric Power Company. Prior to 1998, there were two vertically integrated utilities, i.e., KESC, which served the Karachi area and WAPDA which served the rest of the country (ICCI). Later on, WAPDA's power wing has been structured into distinct corporate entities comprising of 4 GENCOs, 10 DISCOs and one TransCo (NTDC). These 10 DISCOs are responsible for distribution to the end users. KESC was privatized and become K-Electric which now meet its overall demand with its own generation plus purchase from NTDC, IPPs and from Karachi Nuclear Power Plant. The current structure of the power sector is shown below.

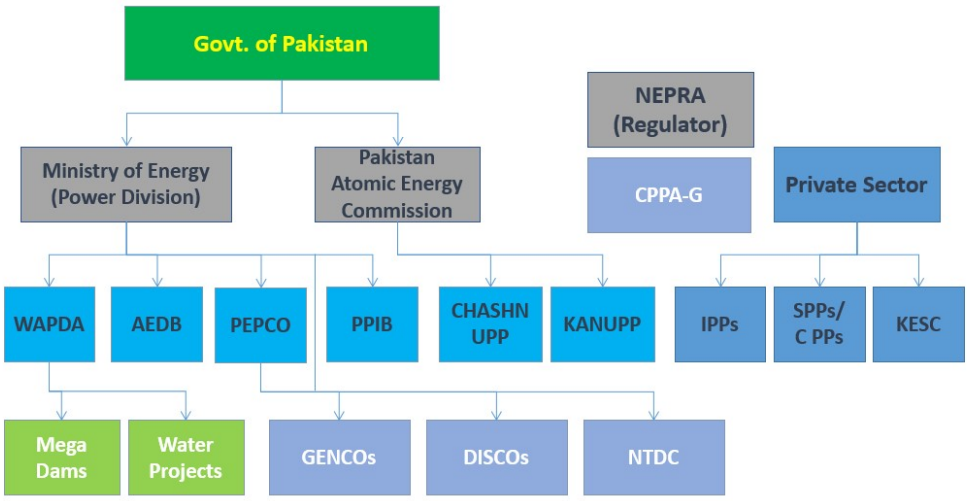


Figure 10 : Power Sector Organizational Structure

PERFORMANCE OF THE SECTOR

DEMAND AND SUPPLY ANALYSIS

After a moderate growth of around 4 percent per annum in the 1990s, the growth in the demand for electricity during the first seven years of 2000s was around 7 percent per annum (Malik, 2012). The increase in the demand however, was an indication of the expansion in the Pakistan economy. Growth in demand required substantial investment to maintain continuity of supplies. But

unfortunately, it didn't happen. Installed capacity grew at the rate of only 2 percent; that period leads to the decline in the supply of electricity (generation) in the coming years.

Electricity crisis worsens in Pakistan in 2008 as shortage of Electricity has increased up to 4000MW. The situation remained very critical up to 2013.

However in 2013 with the new government in office, serious efforts were exerted to bridge the gap of demand and supply. CPEC also played a pivotal role in these efforts. A lot of new projects were initiated which are now in different stages of development. Considering the load growth and upcoming generation projects, an indicative analysis of demand and supply is as under:

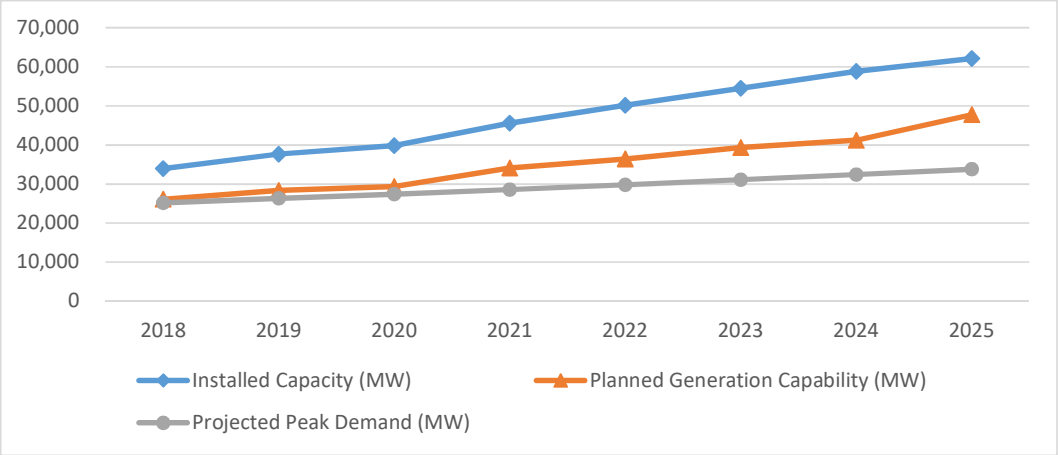


Figure 11 : Demand Supply Analysis | Source: NEPRA State of Industry Report 2017

Performance of Public Sector GENCOs

The performance of public sector thermal power plants (GENCOs) have been found to be lacking in terms of all Key Performance Indicators (KPI) for the past many years (Future, 2018). A number of power generation units have outlived their useful lives, operating at lower than their rated capacities and inferior efficiencies. These power plants have not only poor operational results, the work force which is already on the higher side on per MW basis remained idle due to their closure and non-operation; contributing towards higher cost of generation.

Performance of National Transmission and Despatch Company

With the inception of new generation projects, the NTDC transmission system is constrained (NEPRA, 2015-16). In FY 2015-16 out of a total of 35 auto transformers at 500/220 kV grid stations, 4 were loaded above 80% of their rated capacity. Out of a total of 130 auto transformers at 220/132 kV grid stations, 29 were loaded above 80% of their rated capacity. However the situation deteriorated further in FY 2017 as the NEPRA's State of industry Report states that Out of 33 transformers at 500/220 kV level, 13 transformers (39%) are loaded above 80% of their rated capacity. Similarly, out of 143 (one hundred forty three) 220/132 kV transformers, 79 transformers are overloaded, representing around 55% overloading in the system.

Resultantly number of planned and unplanned outages in the FY 2016-17 have increased as compared to the FY 2015-16 at 500 kV and 220 kV levels

PERFORMANCE OF DISTRIBUTION COMPANIES

Transmission and Distribution (T&D) losses, revenue recovery and quality of service are among the key indicators for any utility to gauge its performance (NEPRA, 2015-16).

T&D Losses: DISCOs T&D losses are higher than the NEPRA's allowed limits. Here it is pertinent to mention that notified average T&D losses target for the FY 2016-17 was 15.27%, at national level excluding KEL, whereas DISCOs reported actual T&D losses for the same period remained around 17.9% (NEPRA, NEPRA State of Industry Report, 2017). This gap of around 2.6% between the actual T&D losses and the Authority's allowed level of T&D losses has resulted in an annual gap of over Rs. 31 billion during the FY 2016-17 (including the impact of monthly FCA).Allowed and actual T&D losses for all the DISCOs and K-EL are shown in the following table for 2015-16. It may be noted that during the 2015-16, only TESCO and IESCO were able to achieve NEPRA's set loss levels, whereas all other DISCOs and K-EL failed to meet NEPRA targets. In terms of overall average losses of 15.23%, allowed to DISCOs, actual average losses have been reported by DISCOs as 17.95%, showing a gap of about 2.72% in the year 2015-16.

DISCO	Losses (%)		
	2015-16	2016-17	Inc / (Dec)
PESCO	33.76	32.60	(1.16)
TESCO	18.96	15.40	(3.56)
IESCO	09.09	9.03	(0.06)
GEPCO	10.58	10.23	(0.35)
LESCO	13.94	13.77	(0.17)
FESCO	10.24	10.57	0.33
MEPCO	16.45	16.91	0.46
HESCO	26.46	30.75	4.29
SEPCO	37.87	37.90	0.03
QESCO	23.92	23.08	(0.84)
Overall Average	17.95	17.95	0.00

Source: NEPRA State of Industry Report 2017

Recovery Ratios: The actual recovery ratios (%) of the DISCOs and K-EL for the year 2015-16 and 2016-17 are shown in the following table:

Year	PESCO	TESCO	IESCO	GEPCO	LESCO	FESCO	MEPCO	HESCO	SEPCO	QESCO	Overall DISCOs
2015-16	88.49	437.03	91.00	99.41	99.20	100.06	99.99	72.09	55.02	71.63	94.48
2016-17	89.29	82.9	91.87	95.99	99.2	97.24	96.21	93.68	109.98	43.55	92.65

Source: NEPRA State of Industry Report 2017

Reliability of Distribution Network: DISCOs are required to deliver a reliable electric power to end consumers while maintaining the required Performance Standards. Three main components of distribution system i.e. 132/11 kV power transformers, 11 kV feeders and distribution transformers are monitored for gauging the performance of DISCOs as constraints in these components would limit their ability to draw power from the Extra High Voltage system (of NTDC), leading to power supply cuts for the end consumers.

The overloading of power transformers of DISCOs in FY 2015-16, is shown in the following table. It is evident that (except for IESCO) power transformers of all the DISCOs are overloaded.

DISCO	No. of Power Transformers	No. of Over-Loaded Power Transformers (above 80%)	% age of Over-Loaded Power Transformers
PESCO	230	113	49.13
TESCO	38	13	34.21
IESCO	202	24	11.88
GEPCO	160	34	21.25
LESCO	351	127	36.18
FESCO	195	100	51.28
MEPCO	282	75	26.60
HESCO	119	59	49.58
SEPCO	118	53	44.92
QESCO	133	75	56.39
Total	1828	673	36.82

Source: NEPRA State of Industry Report 2017

The overloading in DISCOs' system coupled with other constraints on NTDC system is resulting in power supply constraints.

Overloading position of 11 kV feeders in DISCOs for the year 2016-17, is shown below. As a whole 29.00% of 11KV feeders are over-loaded above 80%. On DISCO level, PESCO and TESCO have the highest percentage (more than 50%) of overloaded feeders, followed by QESCO, SEPCO, MEPCO and LESCO (more than 30%).

DISCO	Total No. of 11KV Feeders		No. of 11KV Feeders Loaded above 80%		%Age of Over-Loaded 11KV Feeders (Above 80%)	
	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17
PESCO	907	946	396	485	43.66	51.27
TESCO	195	203	174	191	89.23	94.09
IESCO	1036	1058	72	27	6.95	2.55
GEPCO	779	805	167	88	21.44	10.93
LESCO	1580	1650	350	548	22.15	33.21
FESCO	936	998	189	159	20.19	15.93
MEPCO	1165	1241	428	433	36.74	34.89
HESCO	435	463	103	121	23.68	26.13
SEPCO	453	462	179	167	39.51	36.15
QESCO	613	628	221	233	36.05	37.10
Total	8099	8454	2279	2452	28.14	29.00

Source: NEPRA State of Industry Report 2017

Overloading of distribution transformers for the same period is shown in the following table.

DISCO	Total No. of Distribution Transformers	No. of Distribution Transformers Loaded above 80%	%Age of Over-Loaded Distribution Transformers (Above 80%)

	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17
PESCO	60365	72078	19311	21033	31.99	29.18
TESCO	15634	16612	174	191	1.11	1.15
IESCO	45438	46359	3105	2868	6.83	6.19
GEPCO	60080	61661	1548	1475	2.58	2.39
LESCO	97048	100718	41952	30350	43.23	30.13
FESCO	97761	100276	3285	1843	3.36	1.84
MEPCO	152806	156460	7105	8128	4.65	5.19
HESCO	35334	35996	8336	3340	23.59	9.28
SEPCO	35029	35875	6443	7424	18.39	20.69
QESCO	53646	55770	8743	8873	16.30	15.91
Total	653141	681805	100002	85525	15.31	12.54

Source: NEPRA State of Industry Report 2017

CIRCULAR DEBT

Circular debt is the amount of cash shortfall within the Central Power Purchasing Agency (CPPA) that it cannot pay to power supply companies (USAID, 2013). This shortfall is the result of (a) the difference between the actual cost of providing electricity in relation to revenues realized by the power distribution companies (DISCOs) from sales to customers plus subsidies; and (b) insufficient payments by the DISCOs to CPPA out of realized revenue. This revenue shortfall cascades through the entire energy supply chain, from electricity generators to fuel suppliers, refiners, and producers; resulting in a shortage of fuel supply to the public sector thermal generating companies (GENCOs), a reduction in power generated by Independent Power Producers (IPPs), and an increases in load shedding.

The primary causes of circular debt include:

- Poor governance
- Delays in tariff determination / notification
- A fuel price methodology that delays infusion of cash to the power sector
- Poor revenue collection by the DISCOs
- Delayed and incomplete payment by the Ministry of Finance (MOF) on Tariff
- Differential Subsidy (TDS) and Karachi Electric Supply Company (KESC) contract payments
- Prolonged stays on fuel price adjustments (FPAs) granted by the courts
- Transmission and distribution (T&D) losses and theft.

There also are several secondary causes to circular debt, including:

- The need to improve the thermal efficiency of the GENCOs and for NEPRA to set tariffs based on actual vs. estimated heat rates
- Inadequate budgeting of the TDS, which delays payment and increases financing costs
- Unfavourable generation mix of the GENCOs, due largely to the GOP's fuel allocation policy that diverts natural gas to other non-economic uses
- Non-commercial/non-professional approach to load shedding; non-improvement in tariff terms and conditions; impact of court decisions that have delayed payments to the DISCOs

- Late payment surcharges (LPS) paid by CPPA to the IPPs resulting from the inability of the DISCOs to fully pay CPPA; the GOP's neglect in promoting demand-side management, energy efficiency and renewable energy resources
- The need to settle payment arrears (both disputed and undisputed) in a comprehensive manner; and the need for expanded authority of CPPA to collect payments from the DISCOs through formal and enforceable power purchase agreements (PPAs).

CHAPTER-2: MARKET STRUCTURE AND PAKISTAN POWER SECTOR

MARKET ARCHITECTURE AND STRUCTURE – GLOBAL PERSPECTIVE

ELECTRICITY MARKET

An electricity market is a place where different market participants can sell and buy the energy, depending upon the market design, even capacity and reliability to protect security of supply can also be the product of electricity market. When purchase and sale between two companies in a power sector take place, it may be considered that electricity is being traded within a market, provided that ancillary services for the purpose of keeping the grid system in real time balance and within system security constraints is not considered electricity trade.

There are different market designs like gross pool, net pool, and power exchanges and hybrid designs, as a consequence of power sector structure and other conditionality. Each design corresponds to a higher or lower level of competition, and enables alternative mechanisms to trade.

MARKET PARTICIPANTS

Participants are defined as types of buyers and seller in the market. Participants may own or manage physical infrastructure in the power sector (e.g. power plants, distribution network), but this is not required in all markets. For example, a retail supplier that is not a distribution company may be buying electricity to resell to consumers without owning any electricity infrastructure. In Pakistan, currently distribution companies integrate the distribution network services with retail supply functions, and participate in buying and reselling electricity as suppliers. Following are the types of participants, and typical used globally.

SELLERS

Generation companies are the owners or operators of power plants that sell their production in the electricity market. The power plants can be differentiated into dispatchable (subject to central dispatch) and non-dispatchable that self-schedule (e.g. wind power, small run of river hydro, etc.).

Self-generation or captive generation are power plants connected to distribution network that sell surplus (or all) energy produced.

Imports from other countries sell through contractual agreements, or through regional or bilateral power trade agreements between countries that open the market to trade from other countries. The agreement can be price based (similar to a dispatchable power plant) or fixed quantities agreed in advance,

Suppliers are participants that buy in the market to resell electricity to consumers. Supplier can also be called retailers or wholesalers. In the United States, the expression used for a supplier that sells to consumers or to electricity utilities that supply consumers is Load Serving Entity (LSE).

Wholesale suppliers buy energy bulk from participants (or imports) to resell to other participants, or to export. In Pakistan, sales from one Disco to another Disco can be considered a wholesale supply activity.

Retailers buy energy wholesale, to resell to consumers at the retail level. Discos in Pakistan currently act as retailers of the consumers connected to its distribution network.

A distribution company, those having supply business, may act as supplier for captive customers connected to its distribution system and may also called as supplier of last resort for eligible customers. In these supplier's roles, the distribution company is regulated, because it is buying and reselling as in intermediary for the supply of consumers. In summary, there may be supply or power procurement regulation that apply to the distribution company because the consumer does not decide on its own or is unable to buy competitively.

Eligible customers/Bulk or Large Power Customers: are allowed to contract or buy electricity in the market and be a wholesale participants. However, in some markets participation requires the consumer to become a supplier or buy from a supplier. In Pakistan, the NEPRA Act identifies Bulk Power Consumers are as those that have 1Mw demand or above and are free to contract on their own. Therefore, a Bulk Power Consumer that exercises this right and signs a bilateral contract / PPA with generation would be a wholesale market participant.

Traders are participants that both buy and sell or resell in the electricity market, without requiring to have their own power plants or supplying consumers. A trader may buy electricity from a generator to resell to a retailer. Moreover, there are some companies providing services to medium or small participants like:

A **demand aggregator** is a company that agrees with several consumers to represent them in the market, to buy a larger volume (the aggregated demand) and obtain better prices. In the market, the aggregator may become a participant as supplier.

A **generation aggregator** is a company that agrees with several small power plants to represent in the market, to sell together the production of the group of power plants. In some markets, an aggregator is assigned to sell in the market the energy of small renewable generation.

A **broker** is a company that facilitates contracting by suppliers or consumers, through informing on the range of available options, and assist in the supplier or consumer in understanding the contract and pricing. The broker does not buy or sell, and only acts as an intermediary. For example, a supplier may ask the services of a broker to contract the purchase of electricity.

SERVICE PROVIDERS

Service providers are those entities that provide non-discriminatory and transparent services to all the market Participants, and therefore must be independent (have no commercial interest) from those that are trading in the market. Main service providers are described below.

Transmission Services Providers are responsible for providing the transmission infrastructure that enables wholesale trade. In some power markets the expression used is Transmission Network Owner (TNO). In Pakistan, NTDC in its transmission functions (build/finance, own and maintain) is a TNO. Special purpose transmission licensees as allowed in NEPRA Act are also TNOs.

System Operator (SO) is an entity that centrally administers the grid and is responsible for keeping the transmission grid in balance within system reliability and security constraints. With this goal, the

SO has the authority and is responsible for operational planning (including coordination of maintenance outages, system security studies, short and medium term demand forecasts), and administers ancillary services provided by facilities usually owned by others. Depending on the market design, the System Operator may also be responsible for centralized economic dispatch. The System Operator may be independent (not own any electricity facility) or integrated in a transmission company. However, even if within the same company, transmission and system operation are two separate and different services. In a market, the SO has the critical responsibility of administering non-discriminatory open access (connection and use) to the transmission grid. Therefore, the SO must be independent of any company that trades in the market.

Distribution Company is a company that owns a distribution network is the Distribution Network Owner (DNO) and is responsible for planning, developing and maintaining the network. The Distribution system operators (DSOs) are responsible for operating a reliable distribution system for the physical connection and delivery of electricity to consumers or other distribution companies, and to connect and physically receive energy from distributed generation. Related to connections and reliable operation, the DSO has some similarities to the SO and is responsible for administering and ensuring non-discriminatory open access to the distribution network.

Metering Services Providers cover one or more of the following: metering installation, metering system testing and maintenance, calibration, data collection/reading, data processing and transfer. Metering services providers may be combined with other activities. One or more grid/network company may be assigned metering services providers, although others may be allowed to enter (as retail competition expands) subject to qualification and registration. Some global examples are:

> In Philippines, the national transmission company, that is also the system operator, was authorized as metering services provider, including remote meter reading.
>
> In Australia, the states with full retail competition have several metering services providers. Services include provision and testing of metering systems, plus other more innovative functions such as to assist customers in monitoring and managing consumption to reduce electricity bills.

Market Operator is a centralized institution that administers one or more organized markets for participants to trade (commercial exchange of electricity of energy and where applicable capacity.) Although the functions of a market operator may vary depending on the market design, all include providing settlement services and manage a payment system combined with a security cover (collateral) system. Typical examples can be found in electricity markets or pools in North America, Latin America, the Philippines, Australia and New Zealand. In some power sectors, the market structure combines in a single entity/company the SO and the MO (such as in the USA, Canada, Australia National Electricity Market, Panama, El Salvador, Chile and Peru). In this type of structure, there is a centralized dispatch, participation is mandatory, the day ahead process schedules generation based on bids, and there is a link between short term market prices and centralized dispatch and real time operation.

In more sophisticated environments, particularly in Europe and the Nordic countries, there may be power exchanges. Power exchanges are trading platforms that administer financial markets/transactions, for companies to cover financial risk and hedge prices. Depending on the market design, transactions involve only money, and there is no exchange of electricity or result in short term contracts. There may be one or more Power Exchanges in the same country (if the power sector is big enough), or one power exchange covers more than one country (for example in some parts of Europe, or in the Nordic countries). The expression Power Exchange is widely used in Europe and Nordic countries, but may have different scope and types of markets.

Relevant to Pakistan, the expression used is Market Operator as defined in the Market Operator Rules.

POWER TRADING THROUGH CONTRACTS

In all markets there is trade through contracts or power purchase agreements (PPAs), but the design and characteristics of the contracts or power purchase agreements varies depending on the market design and the regulatory framework.

Contracts can be financial instruments, or only physical (deliver energy and/or offer available capacity), or a mix of financial and physical. Standard long term PPAs (or energy purchase agreement – EPAs) are being used currently in Pakistan are physical contracts linked to a specific power plant or group of power plants, the actual energy delivered to the grid and their available capacity.

Typically, electricity market have network codes (like Grid and Distribution) to create predictability, reliability and ensure equal (non-discriminatory) treatment to all investors and operators. Within these objectives, the contracts or PPAs refer to the approved codes and recognize that conditions and requirements in the Codes prevail above provisions in a bilateral agreement.

Some markets (but not all) require registration of these contracts. In some designs, it is only necessary to nominate the contract schedule or commitments for the next day. The general purpose of registration is for contracts/PPAs that requires balancing. (An imbalance exists when a participant injects or extracts more or less electricity than contracted.) There may be other regulatory requirements for contracts to be registered e.g. if contract prices are to be used for price setting or for security of supply consideration on available capacity committed.

MARKET DESIGN

SINGLE BUYER MODEL

The basic design for a wholesale market is the Single Buyer Market that opens the sector only to competition in the entry of new generation. This model was initially designed to allow private investors to build power plants by selling to an integrated electricity utility. This was the initial market model in Pakistan, with the introduction of independent power producers (IPPs) selling through long term PPAs to WAPDA. The main features of this model is given below and also shown in the following figure:

- Single Buyer at wholesale level
- Long term PPAs with IPPs
- IPPs sell at the connection point of a grid or network that belongs to the Single Buyer

COMPETITIVE WHOLESALE MARKET

The wholesale electricity market model opens competition at wholesale level by allowing multiple wholesalers. There is competition for the market and in the market.

Basically, the competitive wholesale market model establishes platforms, systems and mechanisms that enable trading between multiple buyers and multiple sellers as shown in figure below. The main components of this market are:

- Multiple buyers and sellers
- Mechanism to inform the MO on the agreed bilateral transactions
- Mechanism to present offers to the spot markets (quantity and price)

- A clearing mechanism to define the energy to be produced by each offer, based on minimisation of cost to meet the demand. This mechanisms defines the volumes to produce each participant each hour and the hourly price of the energy
- A real time mechanism to keep the system balance (generation= demand + losses each second)
- A metering system to know the energy produced by each offeror each hour
- A settlement system to define payments and revenues of each participant
- Reporting
- A governance and disputes resolution mechanism

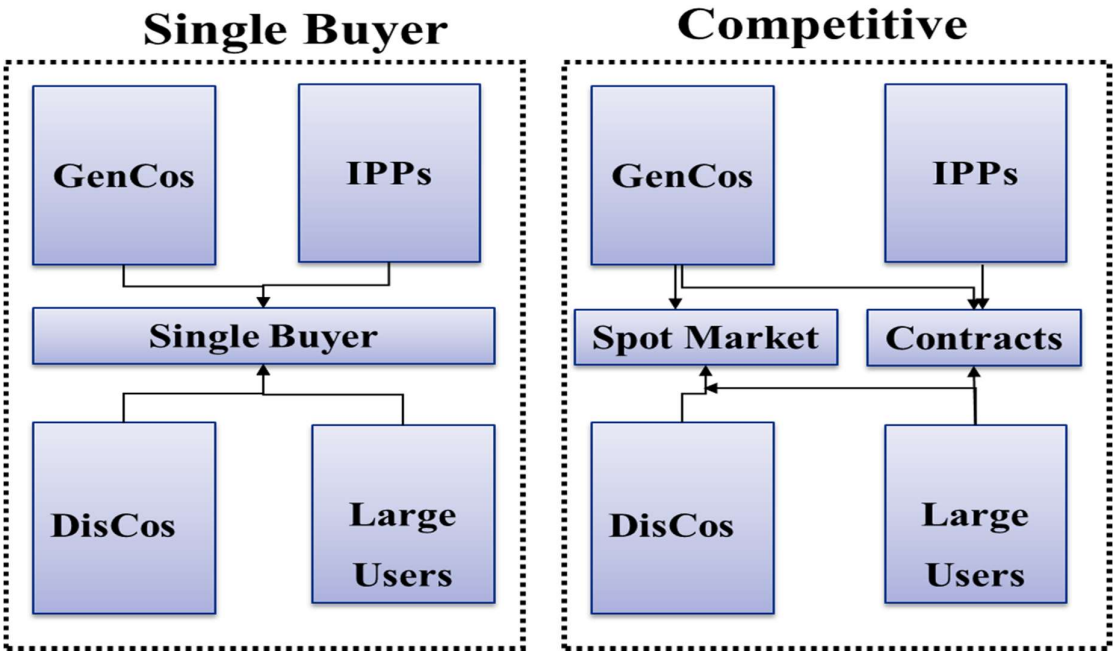


Figure 12: Single Buyer Model vs. Competitive Market

MARKET ARCHITECTURE AND STRUCTURE – PAKISTAN PERSPECTIVE (HISTORICAL AND CURRENT)

In 1958, Water and Power Development Authority (WAPDA) was created as a Semi-Autonomous Body for the purpose of coordinating and giving a unified direction to the development of schemes in Water and Power Sectors (Dr. Arshad Javaid, 2011). After that in 1998, WAPDA was bifurcated in two distinct entities i.e. WAPDA and Pakistan Electric Power Company (PEPCO). Since then WAPDA has been responsible for water and hydropower development whereas PEPCO is vested with the responsibility of GENCOs, transmission, distribution and billing. Currently, PEPCO is managing the affairs of 10 Distribution Companies (DISCOs), four Generation Companies (GENCOs) and a National Transmission and Dispatch Company (NTDC). Moreover, these companies are working under the independent Board of Directors (Chairman and some Directors are from Private Sectors).

The vision of competitive market in Pakistan was there in the documents like generation license and NTDC license, but the progress on this side of the power sector was negligible. Due to the huge gap in supply demand in 1990s, more focused of the government was to incentivize the private generators since then government had been publishing different policies to facilitate the IPPs and has contacted the long term PPAs with IPPs. During this period, to give one window facilitation, PPIB was formed and after some time to promote the renewables AEDB was established.

In 1998, under the transmission license, the function of development of wholesale market was given to NTDC , and CPPA as a department of NTDC was acting in a single buyer model. In 2015, after the ECC decision, CPPA was separated from NTDC and formed as an independent company owned by GoP. The functions transferred to CPPA were:

- Billing and Settlement
- Power Procurement on the behalf of DISCO
- Market Development

Since then CPPA, is acting as a deemed market operator. In the 9th para. of ECC decision, the mandate and timeline was given to CPPA for the development of CTBCM:

"9. Within two (02) years of the notification of Market Rules and associated operationalization of CPPA-G, CPPA-G shall prepare a comprehensive Competitive Trading Bilateral Contract Market (CTBCM) Plan for transition of the power market to a Competitive Trading Bilateral Contract Market. This plan, to be prepared in consultation with stakeholders and subsequently approved by NEPRA, will outline the actions that ought to be taken and completed at the end of each phase of the transition to a fully competitive wholesale electric power market. The actions that shall be taken within three to four (3-4) years for implementation, from the date of the approval of the CTBCM Plan, will consist of regulatory, legal, technical, commercial and financial actions that will set the groundwork for the transition to the wholesale power market by 2020."

In compliance to the above mentioned decision, CPPA has developed the CTBCM Model and transitional roadmap with the consultation of stakeholder and submitted the final proposed model to the NEPRA for its approval.

The Figure 13, as shown below depicts the physical and commercial flows of current market structure of Pakistan. On the generation side there are thermal 1994, 2002, and 2015 IPPs, Government owned GENCOs, WAPDA, 2006 renewable IPPs and some nuclear plants that are current generating most of the energy in Pakistan. CPPA, being a market operator in a single buyer model has contracted the long term PPAs with these generating companies on the behalf of 10 distribution companies (DISCOs). CPPA doing all the commercial settlement, payment and billing among these generation companies and DISCOs.

NTDC in the current role providing many function among which two of them are transmission and system operations. Being a transmission operator NTDC is providing the open access to all on non-discriminatory basis and maintaining the National Grid. NTDC as system operator, also called NPCC, is also operation the national grid, and in compliance to NEPRA Act and Grid Code performing the centralized security constrained economic dispatch SCED. For that, all generators make their generation available to NPCC for centralized dispatch.

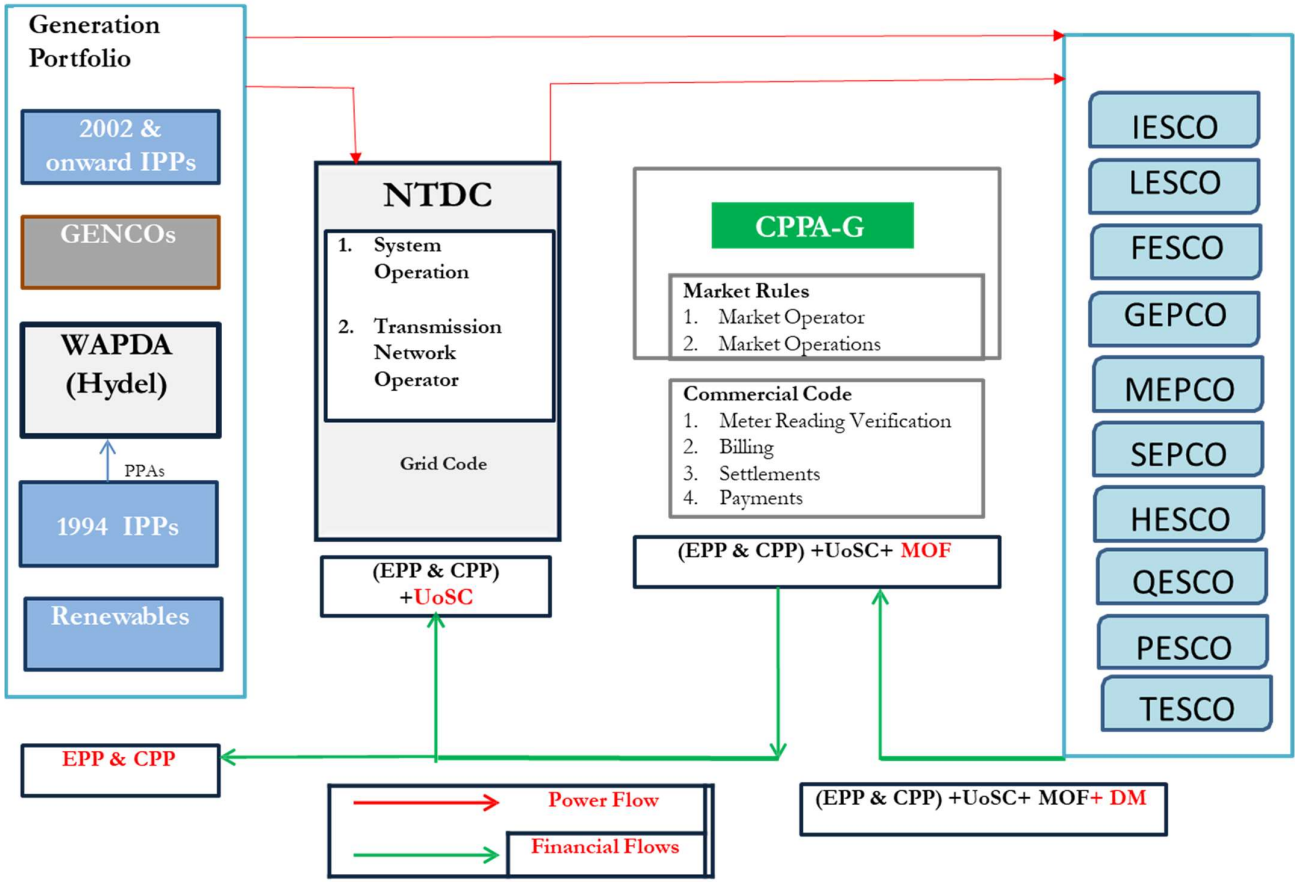


Figure 13: Physical and Commercial Flows of Current Market Structure of Pakistan

INSTITUTIONAL FRAMEWORK

In the Pakistan Power sector, there are number of private and government institutes that are playing according to their assigned roles. Let's first discuss the Government institutes. Under the Government of Pakistan (GoP) there is a joint Ministry for power and petroleum called Ministry of Energy (MoE), this change has been recently done before that there were two separate ministries for water & power and petroleum. Under the MoE (Power Division), there are many institutes like WAPDA (hydro generation company), PEPCO, AEDB and PPIB. PEPCO was formed in the result of unbundling and now has the ownership of 4 GENCOs , 10 DISCOs and NTDC. AEDB and PPIB was formed to facilitate the private investors. Though these companies have their own independent Boards. NEPRA, the regulator is an independent entity and overseeing the whole power sector through the rules, regulation and codes and different operating standards.

Most of the private involvement in the power sector is on the generation side like many thermal and renewable IPPs, captive and small power producers. Moreover, there is one private vertically integrated company called K-Electric, which is actually an exception in the power sector. K-Electric is managing the generation, transmission and distribution in the Karachi territory.

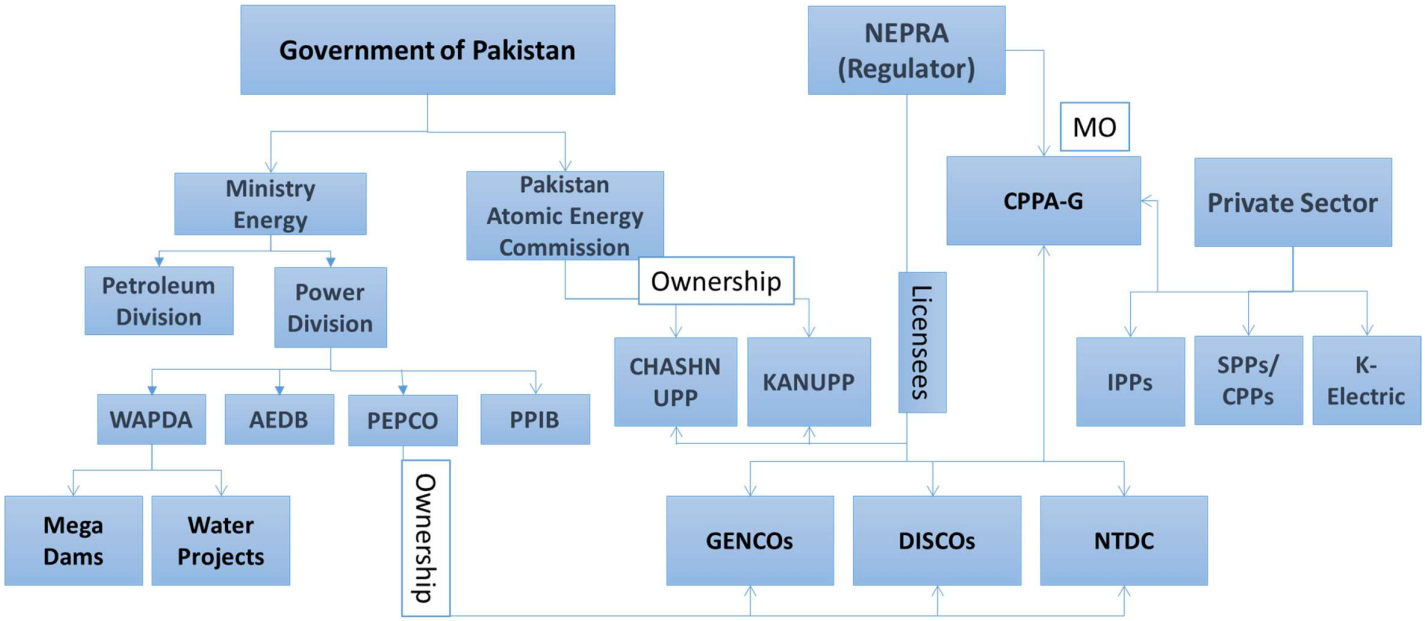


Figure 14: Physical and Commercial Flows of Current Market Structure of Pakistan

LEGAL, POLICY AND REGULATORY REQUIREMENTS

In the NEPRA Act 1997, before April 2018, Act was not providing any direct provision regarding the wholesale competitive market, but the licenses that has been given by NEPRA under the NEPRA Act talks about the future competitive market. In 2015 after the ECC Decision and operationalization of CPPA, Market Rules and Commercial Code was approved by NEPRA that directs the CPPA for the transition towards the competitive regime.

Moreover, in April 2018 some major amendments has been made in the NEPRA Act. In the amended Act there are several provisions and directions related to the introduction of competitive wholesale market, like introduction of licensing scheme and defining the roles of market operator, supplier, and trader. New amendments also talks about the market development as a part of National electricity policy.

Previously, the reason for the lack of competitive market is the protection of consumers' interests and try to balance the interest of investors, generation prices are being regulated by NEPRA through upfront tariffs or other cost plus approaches. While recently some new developments have been introduce regarding the competition for the market, like the 2017 regulation for competitive bidding tariff.

In a nutshell, the Pakistan power sector has started giving the environment for the introduction of wholesale competitive market.

CHAPTER-3: FUNDAMENTALS OF POWER SYSTEM ECONOMICS

An extract from **Fundamentals of Power System Economics Daniel Kirschen and Goran Strbac © 2004 John Wiley & Sons, Ltd ISBN: 0-470-84572-4**

WHY COMPETITION?

For most of the twentieth century, when consumers wanted to buy electrical energy, they had no choice (Daniel Kirschen, 2004). They had to buy it from the utility that held the monopoly for the supply of electricity in the area where these consumers were located. Some of these utilities were vertically integrated, which means that they generated the electrical energy, transmitted it from the power plants to the load centres and distributed it to individual consumers.

In other cases, the utility from which consumers purchased electricity was responsible only for its sale and distribution in a local area. This distribution utility in turn had to purchase electrical energy from a generation and transmission utility that had a monopoly over a wider geographical area. In some parts of the world, these utilities were regulated private companies, while in others they were public companies or government agencies. Irrespective of ownership and the level of vertical integration, geographical monopolies were the norm.

Electric utilities operating under this model made truly remarkable contributions to economic activity and quality of life. Most people living in the industrialized world have access to an electricity distribution network. For several decades, the amount of energy delivered by these networks doubled about every eight years. At the same time, advances in engineering improved the reliability of the electricity supply to the point that in many parts of the world the average consumer is deprived of electricity for less than two minutes per year.

These achievements were made possible by ceaseless technological advances. Among these, let us mention only the development and erection of transmission lines operating at over 1 000 000V and spanning thousands of kilo meters, the construction of power plants capable of generating more than 1000MW and the online control of the networks connecting these plants to the consumers through these lines. Some readers will undoubtedly feel that on the basis of this record, it may have been premature to write the first paragraph of this book in the past tense.

In the 1980s, some economists started arguing that this model had run its course. They said that the monopoly status of the electric utilities removed the incentive to operate efficiently and encouraged unnecessary investments. They also argued that the cost of the mistakes that private utilities made should not be passed on to the consumers. Public utilities, on the other hand, were often too closely linked to the government. Politics could then interfere with good economics.

For example, some public utilities were treated as cash cows, and others were prevented from setting rates at a level that reflected costs or were deprived of the capital that they needed for essential investments. These economists suggested that prices would be lower and that the economy as a whole would benefit if the supply of electricity became the object of market discipline rather than monopoly regulation or government policy. This proposal was made in the context of a general deregulation of western economies that had started in the late seventies.

Before attention turned toward electricity, this movement had already affected airlines, transportation and the supply of gas. In all these sectors, regulated market or monopolies had been deemed the most efficient mean of delivering the "products" to the consumers. It was felt that their special characteristics made them unsuitable for trading on free markets. Advocates of deregulation argued that the special characteristics of these products were not insurmountable obstacles and that they could and should be treated like all other commodities. If companies were allowed to compete freely for the provision of electricity, the efficiency gains arising from this competition would ultimately benefit the consumers. In addition, competing companies would probably choose different technologies. It was therefore less likely that the consumers would be saddled with the consequences of unwise investments.

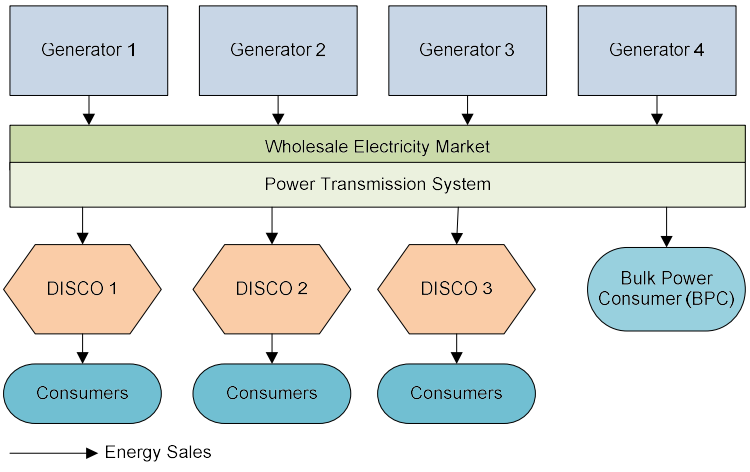
If electricity truly were a simple commodity, kilowatt-hours could be stacked on a shelf – like kilograms of flour or television sets – ready to be used as soon as the consumer turns on the light or starts the industrial process. Despite recent technological advances in electricity storage and micro-generation, this concept is not yet technically or commercially feasible. The reliable and continuous delivery of significant amounts of electrical energy still requires large generating plants connected to the consumer through transmission and distribution networks.

WHOLESALE AND RETAIL MARKETS

Energy Markets are broadly categorized in to (i) Wholesale Markets, and (ii) Retail Markets.

WHOLESALE MARKET

In this type of market, which is shown in the Figure below, no central organization is responsible for the provision of electrical energy. Instead, Discos purchase the electrical energy consumed by their customers directly from generating companies. These transactions take place in a wholesale electricity market. The largest consumers are often allowed to purchase electrical energy directly on the wholesale market. This wholesale market can take the form of a pool or of bilateral transactions. At the wholesale level, the only functions that remain centralized are the operation of the spot market, and the operation of the transmission network. At the retail level, the system remains centralized because each disco not only operates the distribution network in its area but also purchases electrical energy on behalf of the consumers located in its service territory.



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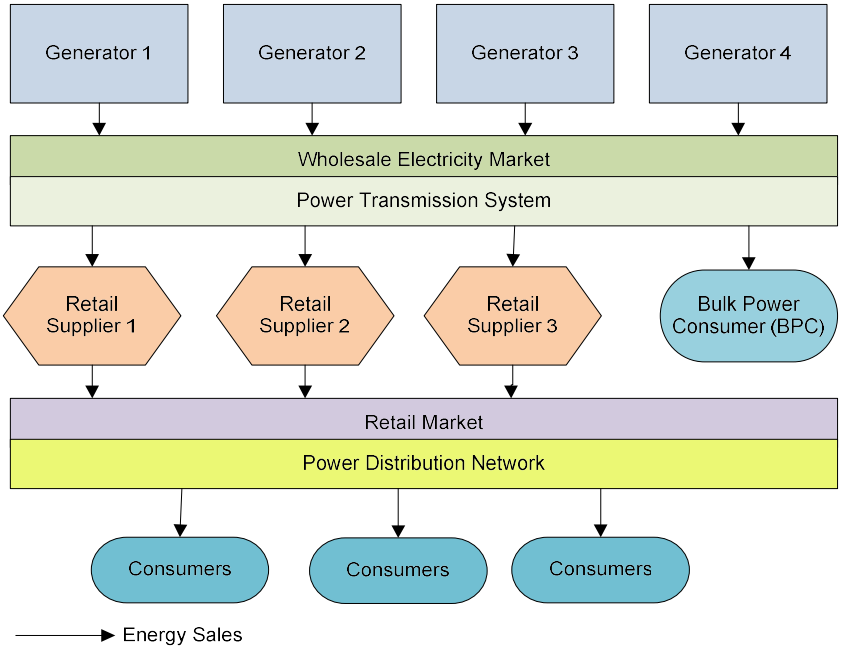
This model creates considerably more competition for the generating companies because the wholesale price is determined by the interplay of supply and demand. On the other hand, the retail

price of electrical energy must remain regulated because small consumers cannot choose a competing supplier if they feel that the price is too high. This leaves the distribution companies exposed to sudden large increases in the wholesale price of energy.

RETAIL MARKET

The following figure illustrates the ultimate form of competitive electricity market in which all consumers can choose their supplier. Because of the transaction costs, only the largest consumers choose to purchase energy directly on the wholesale market. Most small and medium consumers purchase it from retailers, who in turn buy it in the wholesale market. In this model, the "wires" activities of the distribution companies are normally separated from their retail activities because they no longer have a local monopoly for the supply of electrical energy in the area covered by their network. In this model, the only remaining monopoly functions are thus the provision and operation of the transmission and distribution networks. Once sufficiently competitive markets have been established, the retail price no longer has to be regulated because small consumers can change retailer when they are offered a better price. From an economics perspective this market is the most satisfactory because energy prices are set through market interactions. Implementing this market, however, requires considerable amounts of metering, communication and data processing. The cost of the transmission and distribution networks is still charged to all their users. This is done on a regulated basis because these networks remain monopolies.



Types of Markets on Global Scale

This section describes how different types of markets operate globally to serve different purposes. Besides the obvious need to agree on the quality, quantity and price of the goods, three other important matters must be decided when a buyer and a seller arrange a trade:

- The date of delivery of the goods
- The mode of settlement
- Any conditions that might be attached to this transaction.

How buyers and sellers settle these matters defines the type of contract that they conclude and hence the type of market in which they participate.

SPOT MARKET

In a spot market, the seller delivers the goods immediately and the buyer pays for them "on the spot". No conditions are attached to the delivery. This means that neither party can back out of the deal. A fruit and vegetable market is a good example of a spot market: you inspect the quality of the produce and tell the vendor how many cucumbers you want, she hands them to you, you pay the price indicated and the transaction is complete. If later on you decide that you would rather eat lettuce, you probably would not even think of trying to return the cucumbers and getting your money back. On the surface, the rules of such markets may appear very informal. In fact, they have behind them the weight of centuries of tradition. Modern spot markets for commodities such as oil, coffee or barley are superficially more sophisticated because the quantities traded are much larger and because traders communicate electronically. However, the principles are exactly the same.

A spot market has the advantage of immediacy. As a producer, I can sell exactly the amount that I have available. As a consumer, I can purchase exactly the amount I need. Unfortunately, prices in a spot market tend to change quickly. A sudden increase in demand (or a drop in production) sends the price soaring because the stock of goods available for immediate delivery may be limited. Similarly, a glut in production or a dip in demand depresses the price. Spot markets also react to news about the future availability of a commodity. For example, a forecast about a bumper harvest of an agricultural commodity could send its price on the spot market (the spot price) plunging if enough consumers have the ability to wait until this harvest comes to market. Changes in the spot price are essentially unpredictable because if they were predictable, the market participants would anticipate them.

Large and unpredictable variations in the price of a commodity make life harder for both suppliers and consumers of this commodity. Both are running businesses and are thus facing a variety of risks. Bad weather or a pest can ruin a harvest. The breakdown of a machine can stop production. A strike can stop the shipment of finished goods. While being in business means taking some risks, an excessive amount of risk endangers the survival of a business. Most businesses will therefore try to reduce their exposure to price risks. For example, the producer of a commodity will try to avoid being forced to sell its output at a very low price. Similarly, a consumer does not want to be obliged to buy an essential commodity at a very high price. This desire to avoid being exposed to the wild price fluctuations that are common in spot markets has led to the introduction of other types of transactions and markets. These markets are described in the following sections.

FORWARD CONTRACTS AND FORWARD MARKETS

Imagine that Imtiaz is a farmer who grows wheat. Even though it is early summer, he is very confident that he will be able to deliver 100 tons at harvest time. On the other hand, he is very concerned about price fluctuations. He would very much like to "lock in" an acceptable price now and stop worrying about having to sell at a low price when the wheat is ripe. Will he be able to find someone ready to agree to such a deal? Just like farmers are concerned about having to sell at a low price, the Rauf Flour Mills does not want to have to pay a high price for the wheat it uses to make its flour. If an acceptable price can be agreed, it is ready to sign a contract with farmer Imtiaz now for the delivery of his wheat harvest in a few months' time. This forward contract specifies the following:

- The quantity and quality of the wheat to be delivered
- The date of delivery

- The date of payment following delivery
- The penalties if either party fails to honor its commitment
- The price to be paid

On what basis can the farmer and the flour mill agree on a price for a delivery of a commodity in a few months' time when even the spot price is volatile? Both parties start by calculating their best estimate of what the spot price might be at the time of delivery. This estimate takes into account historical data about the spot price and any other information that the farmer and the flour mill might have about harvest yields, long-term weather forecasts and demand forecasts. Since a lot of that information is publicly available, the estimates of both parties at any given time are unlikely to be very different. However, the price agreed for the contract may differ from the best estimates because of differences in bargaining positions. If farmer Imtiaz is concerned about the possibility of a very low price on the spot market, he may agree to a price below his expected value of this spot market price. The difference between his expectation of the spot market price and the price agreed in the forward contract represents a premium that he is willing to pay to reduce his exposure to a downward price risk. On the other hand, if the flour mill is vulnerable to an upward price risk, farmer Imtiaz might be able to extract a price that reflects a premium above his expectations of the spot market price.

If the spot price at the time of delivery is higher than the agreed price, the forward contract represents a loss for the seller and a profit for the buyer. On the other hand, if the spot price is lower than the agreed price, the forward contract represents a loss for the buyer and a profit for the seller. These profits and losses are "paper profits" and "paper losses" because they only reflect the fact that a party could have done better and the other worse by trading on the spot market. Nevertheless, a paper loss makes a company less competitive because it means that it has bought or sold a commodity at a worse price than some of its competitors did.

Forward contracts make it possible for parties to trade at a price acceptable to both sides and hence provides a way to share the price risk. Over the years, these two parties could enter into similar forward contracts with a premium over or below the expected spot price. If their estimates of future spot prices are unbiased, in the long run the difference between the average spot price and the average forward price should be equal to the average premium. The party that gets the premium is therefore being remunerated for accepting the price risk.

Going back to our agricultural example, suppose that the Rauf Flour Mills signs every year a forward contract with farmer Imtiaz at a price that is below the expected spot price for wheat at the time of delivery. In the long run, the company should profit from accepting to shoulder this risk. In the short run, however, it may have to endure a string of large losses if the spot price moves in the wrong direction. To ride through such losses, it must have large financial reserves or demand a substantial premium. If the premium it demands is too large, farmer Imtiaz may decide that signing a forward contract with the Rauf Flour Mills is not worthwhile.

Could other Flour Mills offer him a better deal? Similarly, the Rauf Flour Mills will look for other farmers who might agree to sign forward contracts. If enough farmers and flour mills are interested in trading wheat in advance of delivery, a forward market for wheat will develop. The establishment of such a market gives all parties access to a large number of possible trading partners and helps them determine whether the price they are being offered is reasonable.

In some cases, two parties may want to negotiate all the details of a forward contract. This approach is justified if the contract is designed to cover the delivery of a large quantity of a commodity over a long period of time or if special terms need to be discussed. Since such negotiations are expensive, many forward contracts use standardized terms and conditions. This standardization makes possible

the resale of forward contracts. For example, let us suppose that the sale of a new flour mix manufactured by the Rauf Flour Mills does not meet expectations. Over the summer, the Flour Mill realizes that it will not need all the wheat for which it has signed forward contracts. Rather than wait until the contracted date of delivery to sell the excess wheat on the spot market, it can resell the forward contracts it holds to other Flour Mills. Other producers will have signed contracts during the spring. As the summer goes by, some of them may realize that they have overestimated the quantity that they will be able to produce. If they cannot deliver the quantities specified in the contracts, they will have to cover the deficit by buying wheat on the spot market. Rather than hope that the spot price will be favorable on the date of delivery, these producers could buy the forward contract from the Rauf Flour Mills to offset their anticipated deficit. The price at which forward contracts are traded will be the current market price for forward contracts with the same delivery date. Depending on the market's view of the evolution of the spot price, this resale price may be higher or lower than the price agreed by the originators of the contract.

FUTURE CONTRACTS AND FUTURE MARKETS

The existence of a secondary market where producers and consumers of the commodity can buy and sell standardized forward contracts helps these parties manage their exposure to fluctuations in the spot price. Participation in this market does not have to be limited to firms that produce or consume the commodity. Parties that cannot take physical delivery of the commodity may also want to take part in such a market. These parties are speculators who want to buy a contract for delivery at a future date, in the hope of being able to sell it later at a higher price. Similarly a speculator can sell a contract first, hoping to buy another one later at a lower price. Since these contracts are not backed by physical delivery, they are called future contracts rather than forwards.

As the date of delivery approaches, the speculators must balance their position because they cannot produce, consume or store the commodity. At this point, we may wonder why any rational person might want to engage in this type of speculation. If the markets are sufficiently competitive and all participants have access to enough information, the forward price should reflect the consensus expectation of the spot price. Hence buying low in the hope of selling high would seem more like gambling than a sound business strategy. To be successful as a speculator, therefore, one needs an advantage over other parties. This advantage is usually being less risk adverse than other market participants. Shareholders in some companies expect stable but not extraordinary returns. The management of these risk-averse companies will therefore try to limit its exposure to risks that might reduce profits significantly below expectations. On the other hand, shareholders in companies that engage in commodity speculation hope for very high returns but should not be surprised by occasional large losses. The management of these risk-loving companies will therefore feel free to take significant risks in order to secure larger profits. A risk-averse company will usually accept a price somewhat worse than it might be able to get later in exchange for the security of getting a fixed price now. A speculator, on the other hand, will demand a better price in exchange for accepting to shoulder the risk of future fluctuations. In essence, risk-averse companies remunerate speculators for their willingness to buy the risk.

As we discussed in the section on spot markets, producers and consumers of a commodity face other risks besides the price risk. They are therefore usually quite eager to pay another party to reduce their exposure to this additional risk. A speculator does not face other risks and has large financial resources that put it in a better position to offset losses against profits over a long period of time. In addition, most speculators do not limit themselves to one commodity. By diversifying into markets for different commodities, they further reduce their exposure to risk. Even though speculators make a profit from their trades, the market as a whole benefits from their activities because their presence

increases the number and diversity of market participants. Physical participants (i.e. those who produce or consume the commodity) thus find counterparties for their trades more easily. This increased liquidity helps the market discover the price of a commodity.

OPEN ELECTRICAL ENERGY MARKETS

BILATERAL TRADING

As its name implies, bilateral trading involves only two parties: a buyer and a seller. Participants thus enter into contracts without involvement, interference or facilitation from a third party. Depending on the amount of time available and the quantities to be traded, buyers and sellers will resort to different forms of bilateral trading:

Customized long-term contracts: The terms of such contracts are flexible since they are negotiated privately to meet the needs and objectives of both parties. They usually involve the sale of large amounts of power (hundreds or thousands of MW) over long periods of time (several months to several years). The large transaction costs associated with the negotiation of such contracts make them worthwhile only when the parties want to buy or sell large amounts of energy.

Trading "over the counter": These transactions involve smaller amounts of energy to be delivered according to a standard profile, that is, a standardized definition of how much energy should be delivered during different periods of the day and week. This form of trading has much lower transaction costs and is used by producers and consumers to refine their position as delivery time approaches.

Electronic trading: Participants can enter offers to buy energy and bids to sell energy directly in a computerized marketplace. All market participants can observe the quantities and prices submitted but do not know the identity of the party that submitted each bid or offer. When a party enters a new bid, the software that runs the exchange checks to see if there is a matching offer for the period of delivery of the bid. If it finds an offer whose price is greater than or equal to the price of the bid, a deal is automatically struck and the price and quantity are displayed for all participants to see. If no match is found, the new bid is added to the list of outstanding bids and will remain there until a matching offer is made or the bid is withdrawn or it lapses because the market closes for that period. A similar procedure is used each time a new offer is entered in the system. This form of trading is extremely fast and cheap. A flurry of trading activity often takes place in the minutes and seconds before the closing of the market as generators and retailers fine-tune their position ahead of the delivery period.

The essential characteristic of these three forms of bilateral trading is that the price of each transaction is set independently by the parties involved. There is thus no "official" price. While the details of negotiated long-term contracts are usually kept private, some independent reporting services usually gather information about over the-counter trading and publish summary information about prices and quantities in a form that does not reveal the identity of the parties involved. This type of market reporting and the display of the last transaction arranged through electronic trading enhance the efficiency of the market by giving all participants a clearer idea of the state and the direction of the market.

ELECTRICITY POOLS

In the early days of the introduction of competition in electrical energy trading, bilateral trading was seen as too big a departure from the existing practice. Since electrical energy is pooled as it flows

from the generators to the loads, it was felt that trading might as well be done in a centralized manner and involve all producers and consumers. Competitive electricity pools were thus created. Pools are a very unusual form of commodity trading but they have well-established roots in the operation of large power systems. In fact, some of the competitive electricity pools currently in operation were developed on the basis of collaborative pools created by monopoly utility companies with adjacent service territories. Rather than relying on repeated interactions between suppliers and consumers to reach the market equilibrium, a pool provides a mechanism for determining this equilibrium in a systematic way. While there are many possible variations, a pool essentially operates as follows:

- Generating companies submit bids to supply a certain amount of electrical energy at a certain price for the period under consideration. These bids are ranked in order of increasing price. From this ranking, a curve showing the bid price as a function of the cumulative bid quantity can be built. This curve is deemed to be the supply curve of the market.
- Similarly, the demand curve of the market can be established by asking consumers to submit offers specifying quantity and price and ranking these offers in decreasing order of price. Since the demand for electricity is highly inelastic, this step is sometimes omitted and the demand is set at a value determined using a forecast of the load. In other words, the demand curve is assumed to be a vertical line at the value of the load forecast.
- The intersection of these "constructed" supply and demand curves represents the market equilibrium. All the bids submitted at a price lower than or equal to the market clearing price are accepted and generators are instructed to produce the amount of energy corresponding to their accepted bids. Similarly, all the offers submitted at a price greater than or equal to the market clearing price are accepted and the consumers are informed of the amount of energy that they are allowed to draw from the system.
- The market clearing price represents the price of one additional megawatt-hour of energy and is therefore called the system marginal price (SMP). Generators are paid this SMP for every megawatt-hour that they produce, whereas consumers pay the SMP for every megawatt-hour that they consume, irrespective of the bids and offers that they submitted.

Paying the SMP for all the generation that was accepted may appear surprising at first glance. Why shouldn't generators that were willing to produce for less be paid only their asking price? Wouldn't this approach reduce the average price of electricity? The main reason this pay-as-bid scheme is not adopted is that it would discourage generators from submitting bids that reflect their marginal cost of production. All generators would instead try to guess what the SMP is likely to be and would bid at that level to collect the maximum revenues. At best, the SMP would therefore remain unchanged. Inevitably, some low-cost generators would occasionally overestimate the value of SMP and bid too high. These generators would then be left out of the schedule and be replaced by generators with a higher marginal cost of production. The SMP would then be somewhat higher than it ought to be. Furthermore, this substitution is economically inefficient because optimal use is not made of the available resources. In addition, generators are likely to increase their prices slightly to compensate themselves for the additional risk of losing revenue because of the uncertainty on the SMP. An attempt to reduce the price of electricity would therefore result in a price increase.

COMPARISON OF POOLS AND BILATERAL TRADING

Since both the pool and the bilateral models of electrical energy trading have been adopted for electricity markets, it is worth reviewing the perceived advantages and disadvantages of both approaches.

As mentioned above, a competitive electricity pool is often created on the basis of an existing cooperation agreement between various utilities. Its conversion to operation on a competitive basis will therefore be less of a revolution than the creation of a completely new structure. Some of the concerns that accompany the introduction of competition may be alleviated by the somewhat less radical nature of the change. In particular, the public and the government are likely to have fewer concerns about the security of the electricity supply if the same organization remains in charge. A pool provides a much more centralized form of system management. Not only does it handle all the physical electrical energy transactions but it usually also assumes the responsibility for operating the transmission system. This combination of roles avoids the multiplication of organizations but makes it more difficult to distinguish between the various functions that need to be performed in an electricity market.

Most small and medium electricity consumers have very little incentive to take an active part in an electricity market. Even when they are aggregated, the retailer that represents them has no direct means of adjusting consumption in response to changes in prices. One might therefore argue that the transaction costs could be reduced significantly if the demand is deemed to be passive and is represented by a load forecast in an electricity pool. Many economists are unhappy with this approach because they feel that direct negotiations between consumers and producers are essential if efficient prices are to be reached. Some economists dislike pools simply because they are only administered approximations of a market and not true markets.

Pools also provide a mechanism for reducing the scheduling risk faced by generators and hence, hopefully, the cost of electrical energy. When a generator sells energy on the basis of simple bids, for each market period separately, it runs the risk that for some periods it may not have sold enough energy to keep the plant on-line. At that point, it must decide whether to sell energy at a loss to keep the unit running or to shut it down and face the expense of another start-up at a later time. Either option increases the cost of producing energy with this unit and forces the generator to raise its average bid price. If this generator trades in a pool that operates on the basis of complex bids, the rules of this pool probably ensure that it recovers the start-up and no-load components of its bid. Moreover, the scheduling algorithm implemented by the pool usually tries to avoid unnecessary shutdowns. Since these factors reduce the risks faced by the generators, one would expect that they should foster lower average prices. This reduction in risk, however, comes at the price of an increase in the complexity of the pool rules. More complex rules reduce the transparency of the price setting process and increase opportunities for price manipulations. In practice, it is not clear whether complex bids and pool-based scheduling actually lower electricity prices.

THE MANAGED SPOT MARKET

For every commodity, imbalances almost always arise between the amount that a party has contracted to buy or sell and the amount that it actually needs or can produce. Spot markets provide a mechanism for handling these imbalances. If electrical energy is to be treated as a commodity, a spot market must therefore be organized. Unfortunately, as we discussed above, imbalances between generation and load must be corrected so quickly that a conventional spot market mechanism is not feasible. Instead, the system operator (SO) is given the responsibility to maintain the system in balance using what one might call a "managed spot market". This mechanism is a market because the energy that is used to achieve this balance is freely offered by the participants at a price of their own choosing. It is a spot market because it determines the price at which imbalances are settled. However, it is a managed market because the bids and offers are selected by a third party (the SO) rather than through bilateral deals.

There is also no consensus on the name to be given to this function. In addition to the term "spot market", names such as "reserve market", "balancing mechanism" and others are used.

BENEFITS FROM INCREASING COMPETITION

Competition puts a downward pressure on the profit margins of generators and suppliers and provides an incentive to reduce costs. As a result, electricity prices under competition tend to be lower.

Prices derived by competitive markets and rates derived by traditional regulation are fundamentally different, and will produce different outcomes. Over time, competitive markets are widely held to produce the most efficient results in the economy, providing the lowest costs to customers. Markets reward innovation—the search for and discovery, development, adoption, and commercialization of new products, services, organizational structures, processes, and procedures—that meets market demand.

In a competitive environment, customers have more control over what they consume and what they pay, price levels will encourage more efficient use of energy, and market prices will encourage more demand response. Economists and experienced regulators, as well as national electricity policy, favor reliance on competitive markets when workable competition is feasible.

Competition facilitates the most efficient means of production. Competitive market pricing provides significant benefits not found under traditional regulatory pricing. Among these benefits are the following:

- Market-based price signals are transparent and can stimulate appropriate infrastructure investment, energy conservation, and demand response.
- Competition provides customers with choices—i.e., customer sovereignty. Customers can exercise their own choices with respect to long-term risks environmental concerns, and even reliability levels.
- Competitive market pricing allows sellers to tailor products and services to their customers' needs, and use demand-side solutions to avoid supply-side investment where appropriate.
- By pricing at market, prices will be similar for proximate utilities.
- Competition shifts risks from customers to investors.
- Competition produces more efficient results because the investor, not the ratepayer, assumes the generation investment risk.
- In competitive markets, poor producers fail and are acquired or replaced by those with more skill, foresight, and industry.

Reliance on competitive markets is based on the principle that the generation companies with the most efficient generation and the most value for consumers should and will prevail. Efficient competition leads to generation at the lowest achievable costs in the long-term, which is a socially desirable outcome that results in an efficient use of energy resources. With competition, generation operators' incentives changed dramatically, leading to changes in microeconomic behavior. Though they may not be immediately evident in prices, benefits are clear in non-price advantages such as greater service variety and the presence of a functioning market for capacity (which promotes efficient investment decisions).

A research was conducted in USA for evaluating the benefits of competition in the electricity production sector and the results were very promising. Research has found that:

- Operating costs of generating plants in states that chose to restructure have been reduced relative to costs of generating plants in states that decided against implementing competition.
- Plant operators affected by competition reduced labor and non-fuel expenses by about 3%-5% relative to other IOUs and 6%-12% relative to cooperatives or government-owned generation.
- Similarly, divested generating plants and those subject to incentive regulation mechanisms improved their fuel efficiencies compared to their peers without high-powered incentives.
- One of the benefits introduced by competition in generation was to improve the performance of previously existing generating assets in the face of competition.
- Availability, non-fuel operating costs, and heat rates improved significantly. Availability of generating capacity has increased over time in both New England and New York.
- Equivalent availability factors increased significantly in PJM from 1994 to 1998 and have been roughly constant since then with some year-to-year variability.
- Relatively small efficiency gains—such as a two percent improvement in heat rates—can provide hundreds of millions of dollars of annual fuel savings.

CHAPTER-4: PRICING IN REGULATED AND LIBERALIZED MARKETS

PRICE REGULATIONS IN THE ELECTRICITY MARKET

In a regulated market the transmission, generation and distribution prices are regulated for the consumers irrespective that they are eligible or non-eligible consumers. In other words, in the regulated market the customer has no choice/ option for buying electricity at different price.

While in the liberalized market there are several options for the customers to freely negotiate the electricity prices in the wholesale market or in retail market depending upon the structure of the market design and the demand of the consumers.

In any type of electricity market there are natural monopolies for transmission and distribution business. So the part of price with respect to transmission and distribution or any other service provider like SO and MO in the total price structure remains regulated in both liberalized and regulated market. Only the generation price in freely negotiated between the participants at the wholesale and retail level.

In the liberalized wholesale market, the generation price is freely negotiated between the market participants (generation companies, trader, retailers, brokers, eligible consumers), depend upon the wholesale market structure. While in the retail market these prices is negotiated between the retailers and end consumers. The is shown in figure below

In Pakistan electricity market structure is single buyer and operationally the prices for all consumers are regulated. NEPRA, the regulator, is establishing the prices for all consumers and also approving the generation, transmission, distribution and end consumer tariff. The detailed factors in these tariffs will be discussed in the later section of the book.

PRICE SETTING FOR ELIGIBLE AND NON-ELIGIBLE CONSUMERS

Typically, in any market there are two types of consumers (i) eligible consumers, and (ii) non-eligible consumers.

ELIGIBLE CONSUMER

Eligible consumer is defined as a consumer that has the choice to buy electric power either from wholesale market or from any supplier. They are also called as Bulk power consumers. In Pakistan BPCs are those having the demand equal to 1MW or above.

Price setting: As explained earlier due to the natural monopoly of transmission and distribution business, the rates for transmission and distribution service is regulated and the eligible consumers are bound to pay the regulated approved rates for these services. While for the generation price of electricity they have several choices to purchase at the negotiable rates. Let's discuss these choices on my one:

Wholesale Market: In case where the eligible consumer is purchasing the electric power directly from the wholesale market, the consumer will be paying the market price of the Day- Ahead or Spot price for the consumed electric power.

The total price for eligible consumers is shown in the below equation:

$$MP * Energy\ Consumed\ +\ TC_R * MDI\ +\ DC_R * MDI$$

Where,

MP = Marginal Price

TC_R = Transmission Charges (Regulated)

MDI = Maximum Demand Index

DC_R = Distribution Charges (Regulated)

Bilateral Contract with Generating Company: In this case the Eligible Consumers, according to their demand, are selecting the generating company and directly negotiating the electricity prices and its term and conditions. On the basis of negotiation eligible consumer entered in to the bilateral contract with the generating company. So the total price in this case for eligible consumer is:

$$CP_g\ +\ TC_R * MDI\ +\ DC_R * MDI$$

Where,

CPg = Contract Price (Negotiated with Generator)

TC_R = Transmission Charges (Regulated)

MDI = Maximum Demand Index

DC_R = Distribution Charges (Regulated)

Bilateral Contract with Retailer/Supplier: Eligible consumers that are not willing to participate in the wholesale market they can choose their supplier and enter into a contract with the negotiable

fixed prices and terms and conditions. In this case the eligible consumer is not facing any risk of wholesale prices and the total price he is paying is:

$$CP_s + TC_R * MDI + DC_R * MDI$$

Where,

CPs = Contract Price (Negotiated with Supplier)

TC_R = Transmission Charges (Regulated)

MDI = Maximum Demand Index

DC_R = Distribution Charges (Regulated)

Last Resort Supplier: Eligible consumers that willing to purchase price at the regulated price then they have the choice to take this energy from the last resort supplier according to the condition specified by the regulator. In such case eligible consumer will be paying the non-eligible tariff approved by the regulator.

$$EP_R * EC + TC_R * MDI + DC_R * MDI$$

Where,

EPr = Energy Price (Agreed with Retailer)

EC = Energy Consumed

TC_R = Transmission Charges (Regulated)

MDI = Maximum Demand Index

DC_R = Distribution Charges (Regulated)

NON-ELIGIBLE CONSUMERS

Non eligible consumers is defined a person/entity purchase electricity for his own use and such person or entity have no option to purchase electricity from any retailer on his negotiated prices. The price/rate of electricity they are consuming is fully regulated and approved by the regulator. Such consumers are also called as captive consumers. In Pakistan thought there is provision for BPCs but operationally no BPC is availing this. And the main reason for this is the existing single buyer model. So currently all the consumers are actually non-eligible consumers.

Price setting: For eligible consumer the prices setting is approved by the regulator. The regulator approved the generation tariff for those who are selling electric power to last resort supplier and regulator is also determining the revenue requirement and marginal cost of the last resort supplier. And put this in the equation with the approved transmission and distribution charges and allowed this rate to the supplier to charge to the non-eligible consumers. So the total price a non-eligible consumer is paying is shown in the below equation:

$$EP_R * EC + TC_R * MDI + DC_R * MDI + LRS_R * MDI$$

Where,

EPr = Energy Price (Agreed with Retailer)

EC = Energy Consumed

TC_R = Transmission Charges (Regulated)

MDI = Maximum Demand Index

DC_R = Distribution Charges (Regulated)

LRS_R = Last Resort Supplier Charges (Regulated)

TARIFF STRUCTURE IN DIFFERENT MARKETS

In this section, the tariff structure in different market will be discussed. As mentioned in the start of this chapter that the businesses that has the natural monopoly have the regulated cost. Irrespective of market design the rates for transmission and distribution remains regulated. The regulator, when determining the tariff for transmission and distribution network, incorporate the following components:

- Operational and maintenance expenditure, such as wages and rents
- A return on capital (which is affected by capital expenditure)
- Asset depreciation costs
- Tax liabilities

The following section discusses the cost that the end consumer pays particularly in gross and net pool markets.

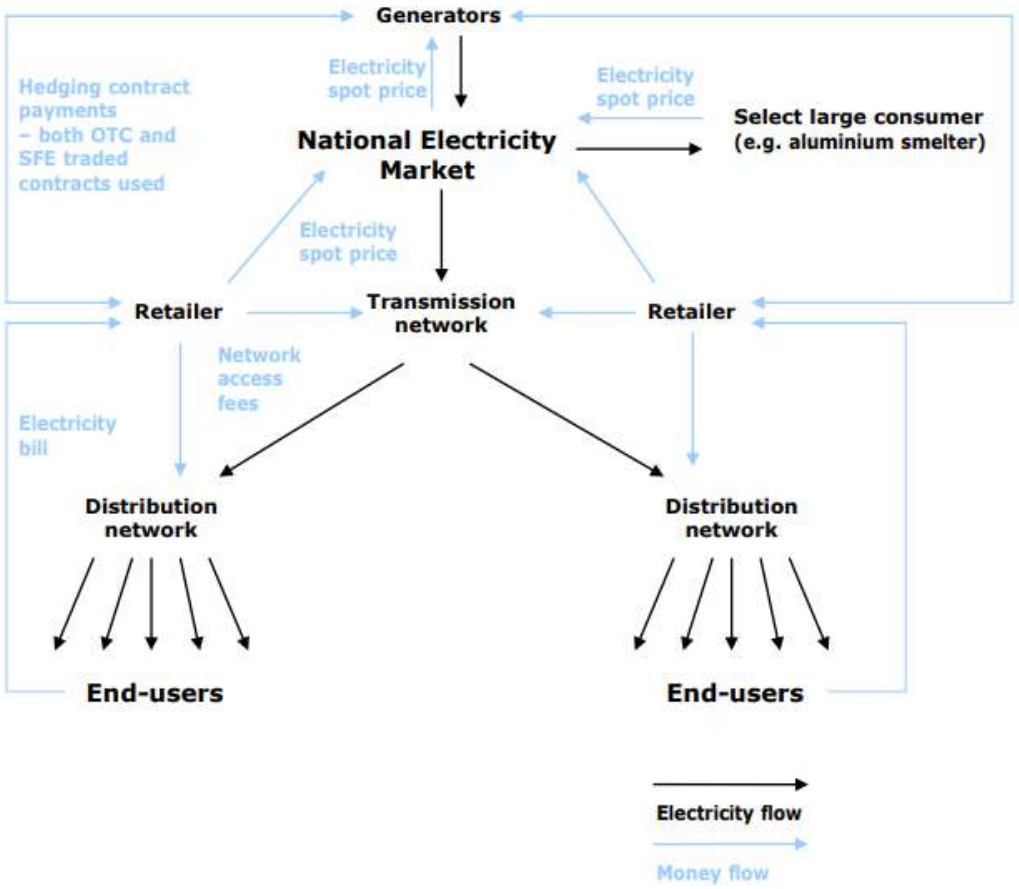
GROSS POOL

There are a number of players that are involved in getting electricity from the generating station to the end consumer.

The generators dispatch electricity, purchased by electricity retailers/suppliers from the wholesale market, to distribution points through the long-distance transmission network. The electricity then travels through the poles-and-lines distribution network directly to the end customer. While some large energy intensive companies, in other words BPCs, purchase directly from the wholesale market.

Generators and electricity retailers sell/buy directly into/from the wholesale market at the spot price, and settlement occurs through the market operator. While all transactions are undertaken at the spot price, there is significant use of financial contracts like over the counter OTC and traded derivative instruments in order to hedge against spot market price fluctuations.

The retailer and BPCs that are purchasing from the wholesale market, also pays transmission fees to the networks for use of their infrastructure. Ultimately the end-user pays for it all through their regular electricity bill. The below diagram below illustrate that money flow in a typical gross pool market.



FACTORS IMPACTING ELECTRICITY PRICE

TYPE OF CONTRACTS

The type of contract and the risk exposure of the partly greatly affect the prices of the electricity. A seller will ask a higher premium if he faces a higher risk in the market from the type of contract he is going to enter into and a buyer will be willing to pay a higher price if the contract isolates him from the market risk.

In a generation following contract, the seller is completely isolated from the market risk and the buyer faces all the risk i.e. he has to sell the amount of energy generated on the spot market if he is unable to consume it. The only risk that the seller faces is that if his power plant fails and he is unable to sell anything. In a load following contract, the buyer is completely isolated from the market risk as the fulfilment of all his energy requirement is the responsibility of the seller. If the seller is unable to generate himself, he has to buy that amount on the spot market to fulfill his obligation. In a supply contract, both the seller and the buyer face the risk of the market. If the seller is unable to supply the agreed quantity, he has to purchase it in the spot market and if the buyer is unable to consume it, he has to sell it on the spot market. As discussed earlier, the prices in the spot market are very volatile

and hence there is a risk of trading on the spot market. So the exposure of any party to the spot market means that he is taking a risk. The price of the contract and hence the price of the electricity is greatly affected by the assessment of the parties regarding the risk they are facing.

DURATION OF CONTRACTS

The duration of the contract also impacts the electricity price. Normally, producers would like to have long term contracts with the buyers and would offer better prices for such type of contracts. On the other hand, the buyer normally like to have short term contracts so that they are able to enhance their portfolio of contracts at a later stage when they have more information about their demand. The suppliers will definitely charge more for a short term contract rather than long term contract.

COMPETITION IN THE MARKET

If the market is sufficiently competitive, then the price would reflect the marginal cost of production (Stax, 2018). Otherwise, if there is not enough competition and the participants can exercise the market power, the prices would be completely different as compared to a competitive market.

MARKET RISKS

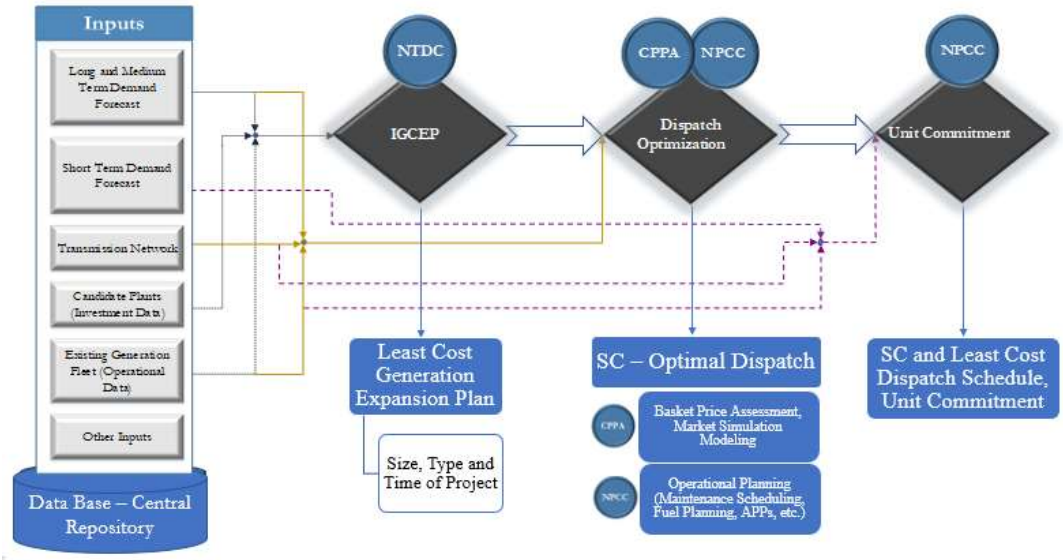
If the market is risk free or has relatively small risk, then the parties facing the market risk will demand less premium and hence prices would be low in a stable and risk free market. If the risk factor is high in a market, the risk premium demand by the parties will also be very high and hence price would tend to be higher.

PRICE SIMULATIONS

In last couple of years, Pakistan's power sector has moved from an acute deficit phase towards supply adequacy and continues to offer enormous growth potential, as well as significant development challenges. In order to meet the shortfall of last decade and to cater for energy growth that is expected to increase because of CPEC and other development and industrial projects, the country's ambitious energy targets have resulted in a rapid expansion of installed capacity and total generation over the next decade, with significant quantum of hydel generation coming in the generation mix. While projects are may be subject to delays, the forecast period is expected to witness the steady addition of new capacity.

Electricity sector is a capital extensive sector. Whether it is the expansion planning problem or an operational decision, power sector needs to be optimized at all horizons in order to come with the most economical and reliable choice. Because of huge number of variables affecting the expansion and operational decisions of power sector, robust mathematical models need to be implemented that can provide scenario-based results to the decision makers for an optimum decision.

Following figure shows the typical inputs and outputs of power sector optimization tools at different horizons and coordination between these tools for an overall optimization from expansion plan down to the operational decisions.



Power system optimization tools and their coordination

As shown in the figure above, CPPA-G's role in the power sector is assessment of basket price and market simulation results based on optimum dispatch of available resources, this report presents the results of simulation exercises performed for this purpose under different assumptions. These simulations have been done based on the information provided by different departments of the power sector, concerned agency for each input information being referred in the next parts of this report.

The modelling work is being done on a state-of-the-art optimization tool based least cost dispatch model criteria that ensures optimality of the solution. The results obtained are those of minimum cost keeping in view the contractual arrangements with power producers and constraints in transmission network for operating the power system in most secure and reliable manner. The tool used is a worldwide standard simulation package named SDDP. SDDP is a hydrothermal dispatch optimization model with representation of the transmission network and used for short, medium- and long-term operation studies. The model calculates least-cost stochastic operating policy of a hydrothermal system, taking into account operational details of hydro plants, detailed thermal plants modelling, representation of contracts, hydrological uncertainty, detailed transmission network, load variation per load level bus and many other operating constraints.

It is pertinent to mention that operation of a power system depends on a huge number of variables and thus there could be tens of hundreds of combinations for an optimal solution. Even when operating a power system very close ahead of real time, unforeseen changes in any parameter (eg. temperature, tripping of a load, availability of a generator etc.) could change the optimal operating solution. Therefore, some assumptions are made and fixed over the study period in order to analyse the results of dispatch optimization solution. The base case is done with the assumptions which are given with each source in the following sections and explicitly enlisted in Annex-A. In order to have estimations of what would happen if these assumptions have deviations, sensitivity analyses have also been carried out, with more and less optimistic different scenarios.

Basic input data for this model includes demand forecast, configuration and operation of generation resources, historic patters of hydro and renewable generation resources, fuel prices, maintenance schedules, transmission network and load per bus distribution, fuel supply contracts and , future expansion of generation fleet and transmission network.

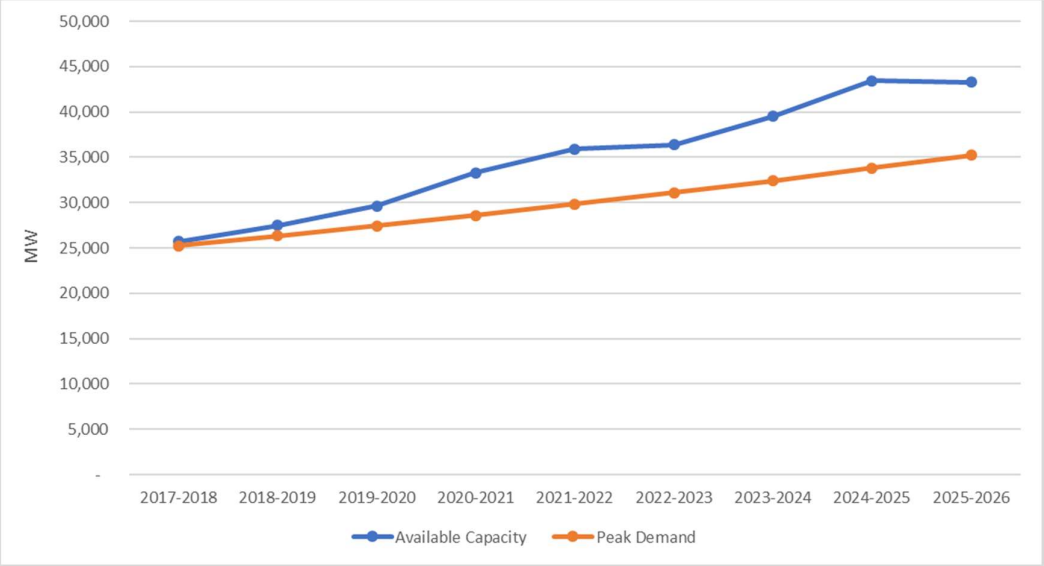
MARKET PRICE SIMULATIONS

Price simulations play a key role in increasing transparency in a competitive market. These projections are the best estimate of the spot price. With the deregulation of the electricity markets, the electricity price forecasting has become an important area of research and many tools have been developed to perform these simulations. These price forecasts are extremely important because these forecasts are used as a reference point against which the parties entering into contracts will decide their contract price. Without this estimate, it will be extremely difficult to agree on a contract price. The investment decision of the generation companies are also based on these forecasts.

Keeping in view the importance of this activity for the market, a capacity building exercise was conducted at CPPA in order to enhance this capability. The results of the exercise are reproduced here for the purpose of understanding. It is pertinent to mention here that all these results are developed for the purpose of understanding and doesn't reflect the actual underlying situation.

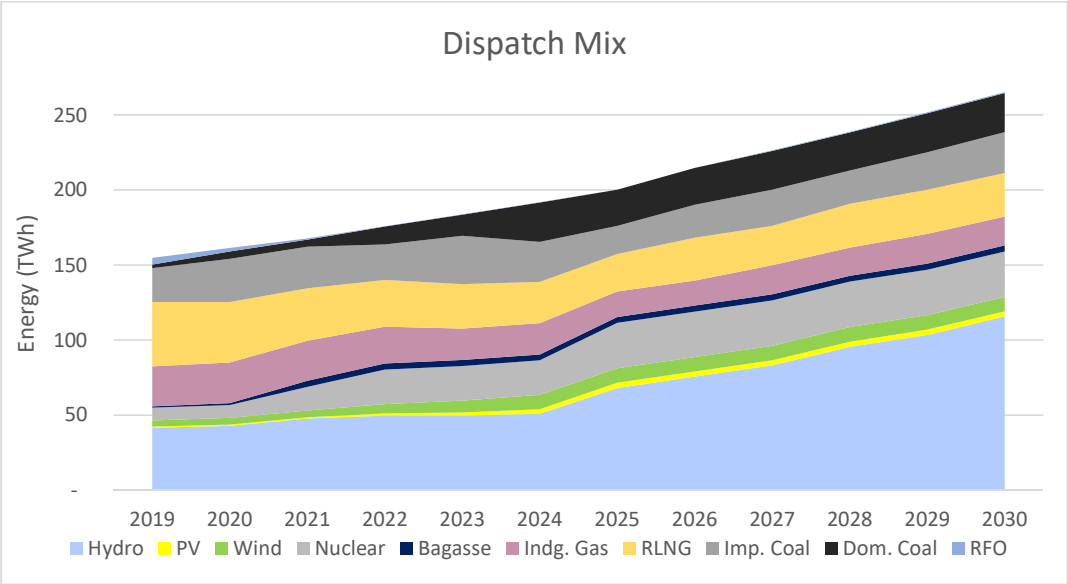
The following figure shows the projected peak demand vs. available capacity to supply that demand.

Peak versus Available Capacity



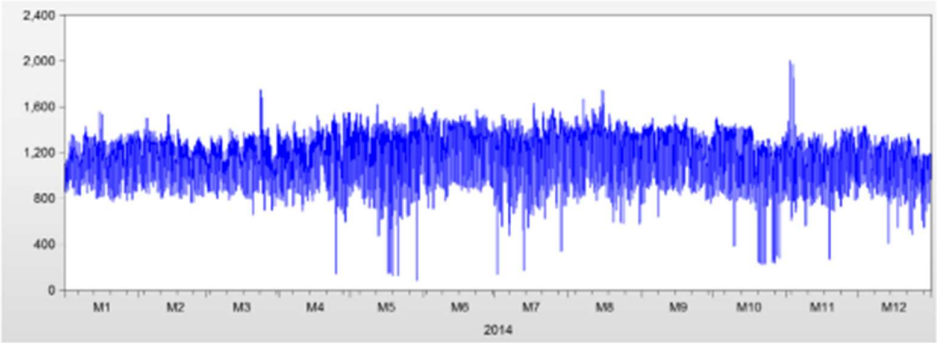
In order to meet this demand, a dispatch optimization tool was employed to calculate the energy requirements per power plant based on the least cost criteria. The results of the tool are graphically depicted in Figure below.

Energy Dispatch Mix (TWh)



Another importance simulation is the hourly price forecast. A typical hourly price forecast looks like the following figure.

Hourly Prices



From the above sampled exercises, it can be concluded that various sensitivities can be performed on these projections in order to see the impact of specific scenario on the electricity prices. The investment decision are made based on accurate price forecasts. An investment decision can be fruitful if based on accurate forecasts and it can be detrimental if the forecast turns out to be inaccurate and the investor is unable to recover its costs.

IMPACT OF RES ON MARKET DESIGN

The issue of intermittency associated with the renewable energy sources has significant impact on the design of the market. Micro-economics teaches us that equilibrium is achieved on a competitive market when supply (increasing relationship between price and quantities) is equal to demand (decreasing relationship between price and quantities) (Claude Crampes, 2018). At the equilibrium price paid by buyers, sellers cover production costs as a minimum, and even earn a profit. As supply

more or less reflects the cost of production, and as this cost is positive (nothing is free on earth), the meeting point between supply and demand should be a positive price.

However, on the electricity markets, day-ahead markets and intra-day markets, we can occasionally see that supply and demand intersect at a negative price. This is due to the surplus production from the renewables as a result of which certain producers and consumers had to announce their intent to arrange transactions at negative prices. It is mainly due to the inability to store electricity, the lack of flexibility of thermal power plants and payment methods for intermittent renewable energies.

In any industry, when the price goes below the production costs, the producers halt operations. If this interruption does not stop the product flow - which, for example, is the case for crops which are linked to natural cycles - it is stored to wait for better days, or the production surplus is simply destroyed. But storage and destruction have a cost. If we can find consumers willing to increase their consumption for payment lower than the cost of destruction (or the cost of storage, net of future expected sales), it is in the interest of the producers to pay these consumers.

When it comes to get rid of surpluses, the electricity industry experiences combined difficulties: large-scale storage is still impossible (except for pumping stations, but their reservoirs have a limited capacity), and surpluses can only be exported up to interconnection capacities and provided that the interconnected countries do not have a production surplus themselves. A willingness to pay consumers to absorb energy surpluses fed into the network could therefore be the logical conclusion of an economic calculation.

Therefore to avoid this situation, the generators tend to make forward contracts with the traders and suppliers. This avoids the disruptions of electricity prices in the day ahead markets and saves the RE generators from suffering huge financial losses.

CHAPTER-5: FUTURE PROSPECT OF WHOLESALE MARKET DEVELOPMENT IN PAKISTAN

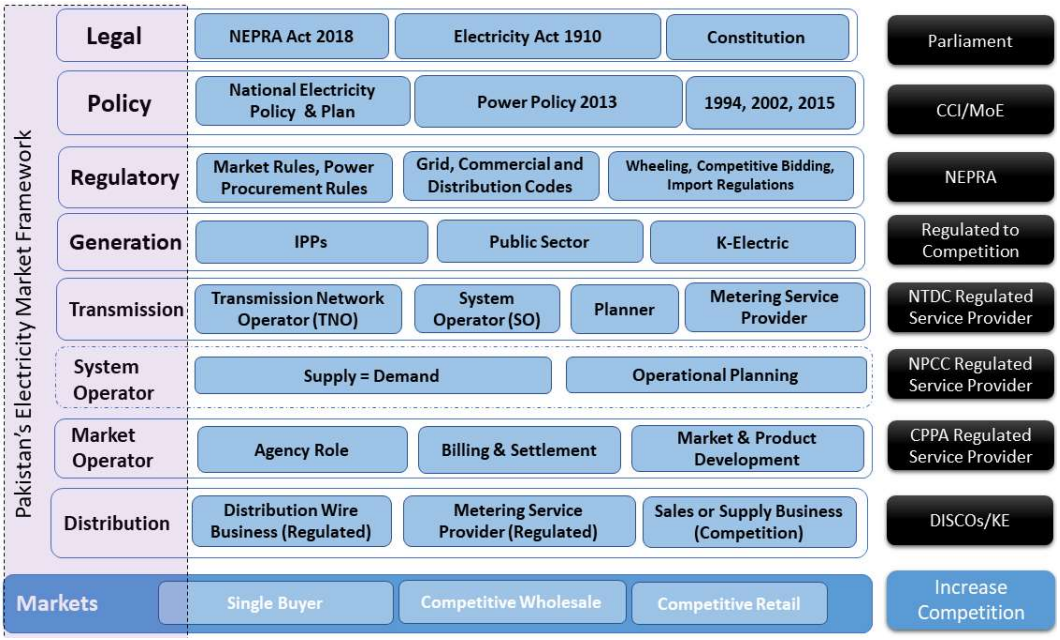
PECULIARITIES OF POWER SECTOR OF PAKISTAN

Present Electricity Market of Pakistan operate on a single buyer model where trading is only carried out through long term Power Purchase Agreements (PPAs)/Energy Purchase Agreements (EPAs). Prices of PPAs or EPAs are not negotiated, as generation prices are currently subject to NEPRA tariff determination, reflecting the technology, fuel, efficiency, etc. Therefore, commercially the main purpose of the PPA/EPA is to establish provisions on term buy and sell obligations, invoicing and payment arrangements, dispute resolution and other administrative arrangements. However, generation prices can be determined through the market if the PPA/EPA is awarded through a competitive process approved by NEPRA. The PPAs / EPAs are backed by the sovereign guarantees provided by Govt. of Pakistan.

Generators (Gencos, nuclear, WAPDA hydel and IPPs) with PPAs or energy purchase agreements (EPAs) signed or administered by CPPA G sell all energy injected / measures or estimated at market entry point (connection to NTDC grid or to DISCOs' transmission facilities). Except for hydro and renewable energy resources, PPAs have two-part pricing (energy and available capacity).

All the current PPAs are Take or Pay in terms of Capacity Payments. All the EPAs are Take or Pay in terms of Energy. A benchmark energy is specified for each agreement.

Following is a depiction of Pakistan's Electricity Market Framework.



Pakistan's Electricity Market Framework

FUTURE ENERGY MIX OF PAKISTAN

The future energy mix in Pakistan will be:

- **Renewables**: Renewables including hydro which are must run
- **Nuclear**: Nuclear plants which is also must run
- **New Coal Power Plants**: For upcoming coal based power plants, the minimum capacity factor for imported coal is 50% and for local coal is 90%. That means that 50% or 90% of energy also becomes take or pay, if we use less energy than we have to pay generator for the missed volumes.
- **New RLNG Power Plants**: A huge portion of RLNG plants will be added to the system and the minimum capacity factor is 60% because of the take or pay contracts for the RLNG. Same as point 4.3 above.

Keeping in view above, it appears that we do not have the margin to optimize the economic dispatch for energy. Almost all the energy even will be dispatched as per contracts otherwise the pool price will be higher. If we don't pay / use the contracted capacity or energy (for new plants as mentioned above), this cost will be stranded and will have to be paid by electricity consumers to honour the contracts.

CURRENT TRADING MECHANISM IN PAKISTAN – SINGLE BUYER MODEL

Imports sell through PPAs or bilateral agreements between two countries. Energy is injected at the international interconnection point, and scheduling of the exchanges will be the role of the System Operator to ensure coordination with power systems in other countries, in accordance with the Grid Code. In the future, should there be surplus in Pakistan power sector, eventually the interconnection could be used also for exports. The future market design needs to allow for imports (purchases) and exports (sales) in international interconnection, with a maximum limit to exchanges (net transfer capacity) calculated periodically by the System Operator to comply with system security constraints, as established in the Grid Code.

Small power plants connected directly to a distribution network can sell directly to the corresponding DISCO through physical PPAs (two part or energy only depending on technology). Billing, settlement and payment is directly between the two parties – the DISCO and the generator, and does not involve CPPA G. The demand of the DISCO for the CPPA G market is the demand of its consumers minus electricity injected by distribution connected generation with direct contracts with the DISCO, plus losses in the distribution network.

DISCOs can buy directly through contracts with generators, and currently some have PPAs with small distribution connected generation. Each DISCO buys from the "CPPA G market" (or the Demand Aggregator) energy and capacity, as the monthly difference between actual consumption and demand by its consumers and the energy supplied by its bilateral PPAs, plus distribution losses.

K Electric is an integrated power utility, and buys from the "CPPA G market" the difference / shortfall in energy and capacity between actual consumption by its consumers, energy injected by its own power plants and by its IPPs (IPPs with PPAs with K Electric), plus network losses, currently up to a maximum transfer capacity.

NTDC acting as metering services providers, reads/collects monthly commercial metering data. As part of the metering services providers, NTDC is also responsible for metering validating, testing and calibration. This information is provided to the System Operator, NTDC Planning and to CPPA G. At the end of each month, NPCC NTDC as System Operator sends to CPPA G as an agent and Demand Aggregator the availability and despatch data of power plants, for the verification of capacity

payment and to determine if mitigating damages apply. The metered data is also used for settlement and invoicing of DISCOs and settlement of K Electric.

At the end of each month, NPCC NTDC as System Operator send to CPPA G the information required for contracts verification (the Demand Aggregator and agent function): the availability and despatch data of power plants.

On a monthly basis as established in the PPA/EPA, each generator sends the invoice to the party that signed the agreement. It must be noted that, until PPAs/EPAs are novated, invoices for PPAs signed by WAPDA would go to WPPO and those signed by NTDC would go to NTDC. Similarly, any complaint due to late payment or incorrect payment by an IPP would be directed to WPPO or to NTDC as applicable. As neither WPPO nor NTDC have an agency agreement with NTDC but CPPA G does, it is crucial for the market development and transparency that PPAs/EPAs are transferred / assigned to CPPA G as a successor company. However, this assignment or novation needs to include provision allowing immediate assignment to CPPA G successor, when the market starts, or to the DISCOs, which are actually the buyer under the agency agreement.

The monthly energy procurement data (quantity, charges, and total cost) is sent by CPPA G to NEPRA for the determination of the monthly Fuel Price Adjustment of DISCOs, including confirmation by CPPA G and NPCC of NTDC as System Operator. Currently, this activity is not covered in the Commercial Code. NEPRA determination may identify differences or inaccuracies in the power purchase data submitted by CPPA G, or other factors that disallow certain costs if inconsistent with tariff determination or purchases in special cases such as lack of generation license.

Using the metering data provided by NTDC, the generation costs resulting from the verified invoices (in principle, with the adjustments that may result in the review and determination by NEPRA of generation allowed costs for the Fuel Price Adjustment), CPPA G calculates the monthly capacity and energy transfer price and the transmission use of system charges of NTDC, and carries out the settlement and invoice of each DISCO and of K Electric, separating the power purchase cost (energy and capacity) and the payment for the transmission system.

During the month, there are daily payments by DISCOs to CPPA G and there are daily payment instructions to generation and to NTDC by CPPA G.

Currently, generation costs are accounted monthly. Therefore, the **trading period** in the CPPA G market is monthly, and the market (pooled) price is the monthly weighted average. The billing and payment for distribution licensees is also monthly. A shorter market pricing, settlement and payment period will allow lo reduce the amount of credit cover required from each DISCO, and identify earlier when a DISCO is not complying with its payment obligation. Interest for late payment should be defined and applied for the market payment period (daily or weekly interest).

SINGLE BUYER PLUS MODEL – FIRST STEP TOWARDS TRANSITION

The Market Rules 2015 establishes the Market transition in a phased manner to a competitive regime, the Competitive Market Operation. The Single Buyer Plus (SBP), has a particular importance because it is the start of the market opening to promote more dynamic transactions and at the same time, to pave to road for the following phase, the Competitive Market Operation. To fully operationalize this SBP phase, it is still necessary to introduce some adjustments to facilitate the achievement of these targets.

The full operationalization of the SBP phase, is directly related to the new capacity procurement. Commercialization of existing capacity will have to remain as it is today, considering that this is an intermediate phase aimed to prepare the path towards the Competitive Market Operation. Also, it is

worth to consider that the SBP phase, would be aligned with the ultimate objective of having a competitive market by 2020, without postponement.

The actual implementation of the SB Plus will require:

- Adjustment of existing regulations and development of new ones
- Adapt systems and procedures to the commercial requirements of the SB Plus
- Undertake a vast capacity building plan for all stakeholders

WHEELING OF ELECTRIC POWER REGULATION

Being one of the main objectives of the SB Plus to organize the trading between Generators and BPCs, and being the wheeling of Electric Power Regulation one of the pillar regulations for this type of bilateral trading, this plan considers the wheeling as inherent part of the SBP phase.

In this regard, the objectives of both, SBP phase and of the wheeling regulations are fully aligned:

- allow BPCs and Generators to start trading at the shortest possible term;
- transition towards the ultimate objective of having a competitive market by 2020, without postponement, consistent with the high level design of the CTBCM at this under consultation run by NEPRA

The existing Wheeling regulation issued by NEPRA on June 13, 2016, establishes that the transaction will be between a generator, identified as the Wheeler and a BPC according to the conditions of a PPA freely agreed between them. In order to materialize this PPA the existing Wheeling of Electric Power Regulation provides the framework for the transportation of the involved energy. This regulation includes two main subjects:

i. The conditions under which a Generator, identified as a Wheeler, can request transportation services from NTDC and/or a Disco to bring the Input Energy from the Entry Point to the Exit Point where the Exit Energy is delivered to the BPC

ii. The mechanism to be applied to compensate differences between Entry Energy and Output Energy for whatsoever reasons related to the wheeling function or to the ability of the wheeler to produce or the BPC to consume the energy associated to the committed capacity

As this regulation was mostly designed to be used in a Single Buyer market environment, lacks from some simplifications and sophistications that could be used, even more efficiently, in a multiple sellers and multiple buyers' market environment, such as the SB Plus and later the CTBCM.

Also, now the that the NEPRA Act 2018 allows that Electric Power Suppliers can sell electricity to end customers, among them BPCs, the "merger" of this wheeling regulation into the SB Plus should reflect this new inclusion in the Act accordingly. In view of that, a few modifications have been proposed to the existing regulation to take advantage of the upcoming market development, while other parts are maintained provided that they properly cover the needs for this kind of trading.

GENERAL FRAMEWORK FOR SINGLE BUYER PHASE

1. **Use of Networks**: Today's Use of System Charges regulations and Distribution Tariffs regulations for the use of the networks necessary for the generator to inject the produced power (Input Energy) at the Entry Point and for the BPC to extract the consumed power (Output Energy) at the Exit Point, already provide the mechanisms to charge for the use of the involved distribution network and the use of NTDC network. So it is not envision to have to make significant changes to that part to the really "wheeling" part of the SB Plus plan.
2. **Deviation of Contracts**: The settlement and payments between the contracting parties will be done directly between them. The settlement and payment of deviations will be done by

the MO and through the payment mechanisms foreseen in the commercial code (CC) as amended for the Single Buyer Plus phase.

3. **Bilateral Contracts**: In the SB Plus the transactions between Generators and Retailers (the Selling Side) and BPCs (the Buying Side) will be through bilateral contracts, at prices freely agreed between the parties and according to the provisions of the NEPRA Act 2018.
4. **Deviation Settlement Mechanism (DSM):** Deviations between contracted and actual quantities will be settled according to the Deviation Settlement Mechanisms (DSM) as it will be established in the Commercial Code.
5. **Metering and Calculations**: The actual Energy Output taken by the Buying Side will be metered at the Exit Point. If the Selling Side is a single Generator, the actual Energy Input will be metered at the Entry Point.
6. **Wheeling Charges**: The Buying Side (BPC) will pay to NTDC the transmission costs, as per the NTDC tariff determination by NEPRA. The amount will be the actual consumption (MWh) measured at the Exit Point plus the distribution losses recognized in the DISCO tariff determination (fixed plus variable charges). The BPC will pay the DISCO the distribution wheeling charge a per the tariff determination per NEPRA, including the distribution losses.

DEVELOPMENT OF WHOLESALE MARKET

The current Pakistani power market model is "Single-Buyer" where CPPA procures all the power from IPP's on behalf of DISCOs. The PPAs are backed by sovereign guarantees of Government of Pakistan – apparently no risk on supplier side. There is a need to develop a wholesale market having multiple buyers and sellers with following main objectives:

1. Create the conditions for a fair allocation of risk and benefit sharing between investors/sellers and buyers/consumers
2. Level the playing field removing conflict of interest to facilitate entry of new investors and participation of private players, including Bulk Power Customers
3. Create the conditions to attract investments based on credit cover provided by market participants, without the need of the government providing sovereign guarantees
4. Pressure on the payment discipline
5. Improve efficiency arising from competition for the market (new capacity procurement) and in the market (optimization through centralized economic dispatch within system security constraints, to maximize the economic benefits of available resources and promote efficiency)
6. Enhance power sector security of supply, generation adequacy, to develop power sector sustainability in the short, medium and long term
7. Ensure accountability of all Participants and Service Providers
8. Ensure transparency and predictability
9. Open access to information

MARKET OPERATOR'S ROLE AND CAPACITY IN FACILITATING THIS INITIATIVE

MARKET OPERATOR

The main functions and responsibilities of the Market Operator are the following:

- Admission of Participants, including signing the Market Participation Agreement, and suspension and cancellation of Participants;
- As part of the admission process, registration of the Participant, including registration of settlement metering systems (to identify metered energy to be used to calculate imbalances) taking into consideration location of meters and the type of participant;
- Sign a balancing agreement with each Participant including rights, responsibilities and obligations, including obligation of the Participant to provide credit cover. Purchase and sale of imbalances will be among the Participants, and therefore not involve payment or liabilities for the Market Operator;
- Calculation of (hourly) energy imbalance prices, and determination of firm capacity daily imbalance prices;
- Calculation of energy and capacity imbalance quantities for each Participant;
- Balancing Mechanism Settlement on a weekly and monthly basis, and issuing payment instructions on behalf of Participants [and administration of market payment system].
- Calculation of monthly use of system charges and market fee;
- Administration of credit cover/collaterals for transactions in the Balancing Mechanism, transmission charges and market fee: determination of amount required, and call/use of the credit cover in case of payment not completed by market payment deadline.
- Administration of the procedure to receive complaints or observations to settlement documents, and resolve the complaint;
- Administration of a dispute resolution mechanism for settlement complaints that have not been mutually agreed and resolved.
- Implement, update and maintain a Contract Register. Participants are obliged to register with the Market Operator information of all contracts, necessary to calculate and settle imbalances. Therefore, information in the contract register will include parties, duration, connection points of sale and purchase, energy quantities and contracted capacity (payment for available capacity).
- Responsible for Information disclosure of market results, in particular made public through its website

The Market Operator usually have a Governance system to ensure transparency and accountability. The Board of the Market Operator includes members nominated by the categories of Participants and service providers to act in representation of that type of Participant but independent of any company participating in the market. The Board also includes independent members representing consumers.

The Market Operator implements panels, committees and working groups with Participants to support its functions and provide transparency. Additionally, the Market Operator carries out capacity building to level the knowledge basis, facilitate integration to the market and attract new participants and the interest and credibility by investors.

MARKET OPERATORS CAPACITY IN FACILITATING THE INITIATIVE OF COMPETITIVE MARKET DEVELOPMENT

The CPPA G have the adequate staffing, organizational structure and systems to perform the market operation functions in an efficient manner. As a matter of fact, CPPA-G has been carrying out the billing and settlement functions since its inception. Efficiency has been gradually improved by increasing the level of automation and processes improvements.

The senior management of CPPA-G is a balanced mixed of professionals who have extensive professional experience in billing, settlement, payments, power procurement, legal, regulatory, strategy, financial, project management, information technology and human resource domains.

To discharge its role as an effective Market Operator, CPPA-G has also enhanced its technical capacity by engaging consultants with vast international and or local experience in the areas of market design and development, billing and settlement, organizational restructuring, market simulations, and IT systems design and implementation.

In its efforts to liaise with similar like institutes, CPPA-G has (a) attained the full-time membership of Association of Power Exchanges (APEx), (b) built a Strategic Partnership with EXIST, the Market Operator / Power Exchange of Turkey by signing a Memorandum of Understanding (MoU), (c) built a Strategic Partnership with EPEXSPOT (the European Power Exchange) by signing a Memorandum of Understanding (MoU), and (d) signed an MoU with Lahore university of Management Sciences (LUMS) to partner in the field of research and development. These strategic partnerships have proven to be instrumental in development of competitive power market in Pakistan.

Furthermore, CPPA is being restructured to cater for the future requirements. The organizational restructuring has been divided into three phases; (a) restructuring from business perspective to align the organization with current business need (completed in mid of 2016 by adding key departments such as Market Development, ERP/IT, taxation etc.), (b) restructuring from HR perspective, for inter alignment and optimization of business processes (continuous and will be completed by mid of 2018) and (c) restructuring from a future business perspective i.e. to align the company with the proposed new electricity wholesale competitive market (plan is implemented and will be completed by mid of 2019).

PHASES OF RE-STRUCTURING AT CPPA-G

To automate and enhance the controls is another initiative that has been taken in-order to improve the efficiency and transparency. This is one of the most important elements for the establishment of an efficient competitive market. The strategy devised at CPPA-G is to (a) eliminate inefficient processes, (b) automate the back and front office processes to bring-in speed, efficiency and transparency and (c) outsource the non-core and/or work of temporary nature to stay lean and focused.

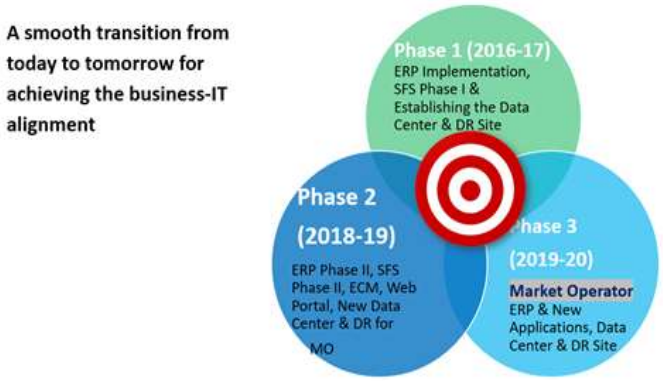
IT RELATED INFRASTRUCTURE

CPPA being conscious of its changing role in becoming the most modern, effective and efficient organization in the power sector, has assigned the highest priority to build its IT capabilities over the last couple of years. In the 2017-2020 Strategic Plan of CPPA, one of the key target of CPPA is to ensure "IT infrastructure transformation". To automate and enhance the controls is the initiative that has been taken in-order to improve the efficiency and transparency and this is one of the most important elements for the establishment of an efficient competitive market. The strategy devised at CPPA-G is to (a) eliminate inefficient processes, (b) automate the back and front office processes to bring-in speed, efficiency and transparency and (c) outsource the non-core and/or work of temporary

nature to stay lean and focused. The systems (both back and front-office) inherited from the CPPA of NTDC were manual; however, necessary checks and balances were created to ensure compliance with business rules and codes. Based on the three-pronged strategy mentioned above, CPPA has initiated different projects to automate the systems to bring-in more control and efficiency.

CPPA has not only made investment in building a state of art IT infrastructure but also attracted an able and competent team of IT professionals to take the automation initiatives to new heights in the coming years. The IT function is currently headed by an ICT professional with over 25 years of technology leadership at the top tiered national and international organizations and is supported by a team of over 24 IT professionals having advanced qualification, expertise and certifications in Data Centre Operations, Storage Management, Information/Network Security Management, IT governance and risk management, Project Management, and Software development using most modern tools and techniques.

The three phases of IT Technology Roadmap are developed and are being implemented.



Information Technology Roadmap

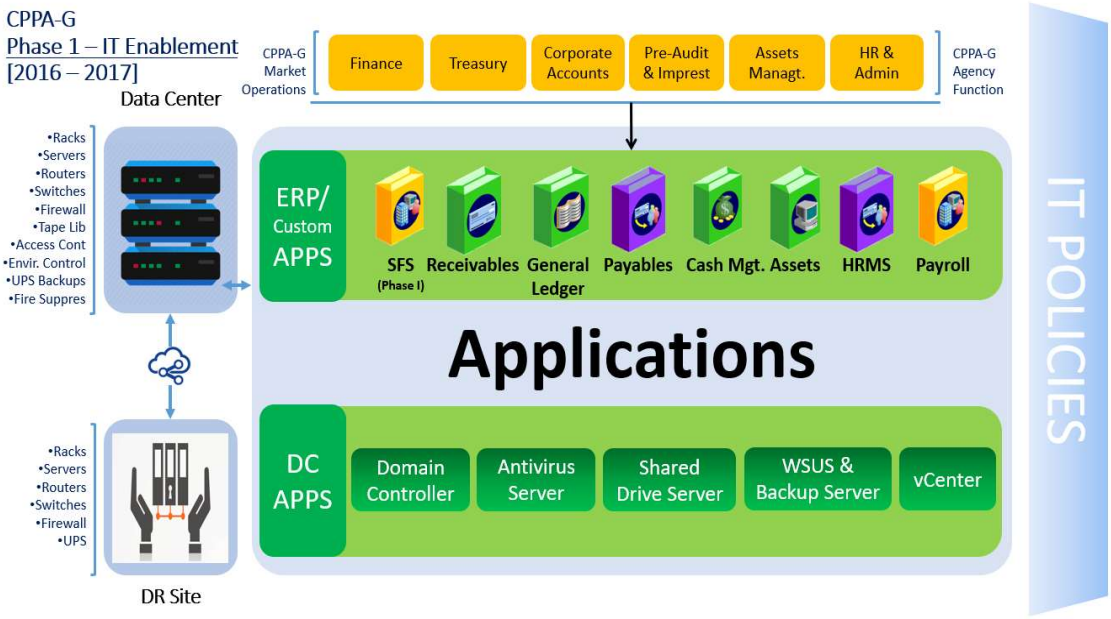
PHASE-I OF IT ENABLEMENT (2016-2017)

Under **Phase-I**, to support its current business, the CPPA has successfully established a modern data centre engineered to offer a state of the art infrastructure for continuous IT operations that supports availability, reliability and scalability for key applications and services. A backup/Disaster Recovery Centre has also been established to ensure Business Continuity and high availability and these centres are interlinked through high-bandwidth communication links. The IT infrastructure that has been established in CPPA include, (a) the creation of Data Centre including room construction, fire protection, environmental control, cooling ,cabling system, security protocol etc. (b) the installation of server and network equipment including Servers, SAN storage, core switches, routers, firewalls, racks, virtualization, distribution switches etc. (c) the LAN implementation and (d) the WAN implementation has also been completed between the head office and branch office. Furthermore, as transparency is one of the main principles in developing a competitive power market and for that information dissemination is very important. Therefore, CPPA-G revamped its website and launched it with a wealth of information for market participants. The new features on the website and market information are the key steps toward transparent market operations.

The current IT infrastructure supports both primary and DR sites that are connected through P2P fiber links. The primary site is located in NEECA building that comprises of a number of high capacity servers, tiered SAN storage of over 20 Tera Bytes, CISCO routers and switches for network

communications. Several systems have also been installed to ensure high level of network and information security through the deployment of 12 Video surveillance cameras, biometric devices on the VLAN and added protection though ASA5515X firewall as well as Intrusion Detection and Intrusion Prevention functionalities on both primary as well as secondary data centres. The data centre is providing many digital services in support of a LAN comprising of 250+ devices with a dedicated bandwidth of 30 MB link over fibre.

Many automation initiatives have been taken by the CPPA leadership to bring efficiency, effectiveness and controls in the business processes of the organization spanning over a very short period of one-year while some projects of significant capacity and complexity are in the planning stage and about to be kicked off very soon. The CPPA's ERP project resides at the heart of the automation strategy (the Phase-I of EPR implementation has been completed with implementation. The other initiatives for automation includes the implementation of System for Settlement (SFS) which is the customized application for automation of billing and settlement function of CPAA according to its current business process and has been in production since last three months after UAT, parallel runs and commissioning. This is the Phase-I of SFS that includes financials verification of power purchase invoices and integration with treasury department for payments, back feed billing process and invoices to DISCOs i.e. (automated based upon DISCO wise summary data and power purchase expense consolidated from ERP financials. Therefore, the back-office automation of CPPA comprising of Human Resource Information System (HRIS), Payroll and Benefits Management, Treasury and Financials, and has been successfully implemented through Oracle EBS R12 after vigorous test runs and the ERP is in production as of now. The customized applications have been developed based on modern software development technologies and like Oracle ADF which is a Java framework for developing enterprise applications and provides most modern visual and declarative approaches to Java EE development.



PHASE-II OF IT ENABLEMENT (2018-2019)

The **second phase of automation** comprises of infrastructure upgrade/enhancement including user computing, server computing and central storage as well as development of another customized

application using Java EE framework based on Oracle ADF for remaining business processes in support of Invoice Processing, Billing and Settlement functions of CPAA has been initiated from early this month. Additionally, a comprehensive and secured portal for data exchange between CPPA, Power Generation Companies, NTDC (metering data), NPCC (dispatch information etc.), and DISCOs has also been established based on state of the art tools like SharePoint, Oracle Middleware, and workflow engines over SSL based portals for security. This portal will also be used for information dissemination over a secured channel for stakeholders of the power sector. These two significant IT initiatives will also be completed before by June 2018. In Phase-II of SFS that will be completed in 2018, the following are planned features of the data exchange portal:

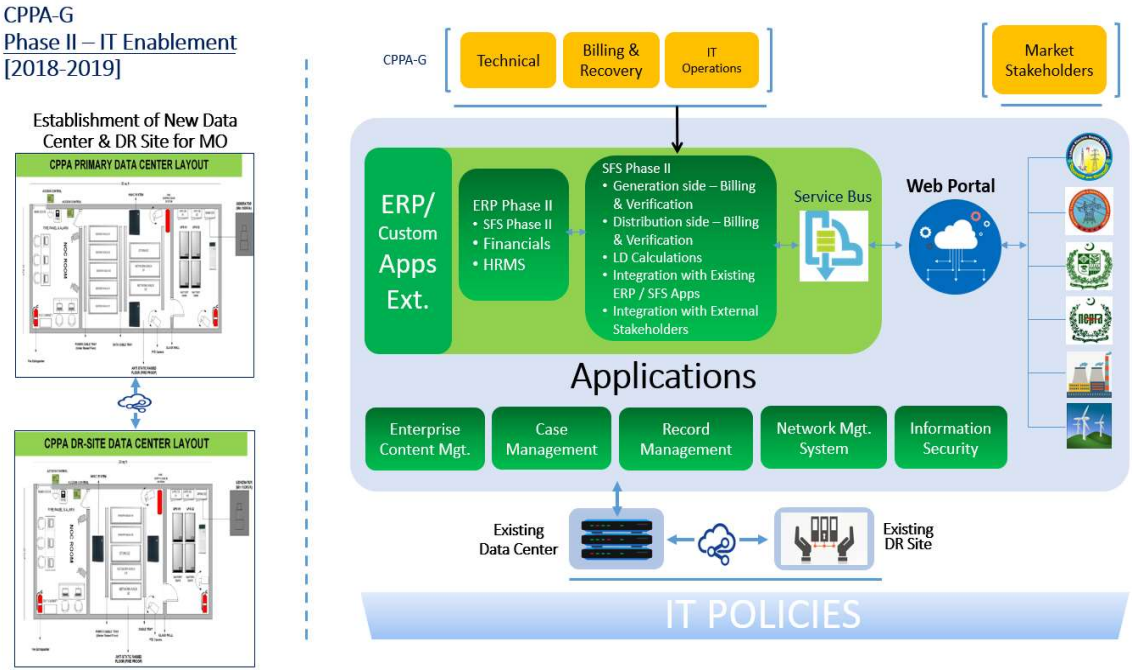
All the invoice processing activities pertaining to technical department of CPPA-G and automation of liquidity damages processes for all IPPs

CDP wise metering data entry and its integration with the invoices to DISCO process, FPA reporting and IMF reporting

Web portal for receiving and dissemination of data to the external stakeholders of power sector:

- Integration of metering data with NTDC
- Integration of dispatch instructions and relevant technical data with NPCC
- Secure logins for IPPs
- Secure logins for DISCOs and
- Secure login for NEPRA and MoE

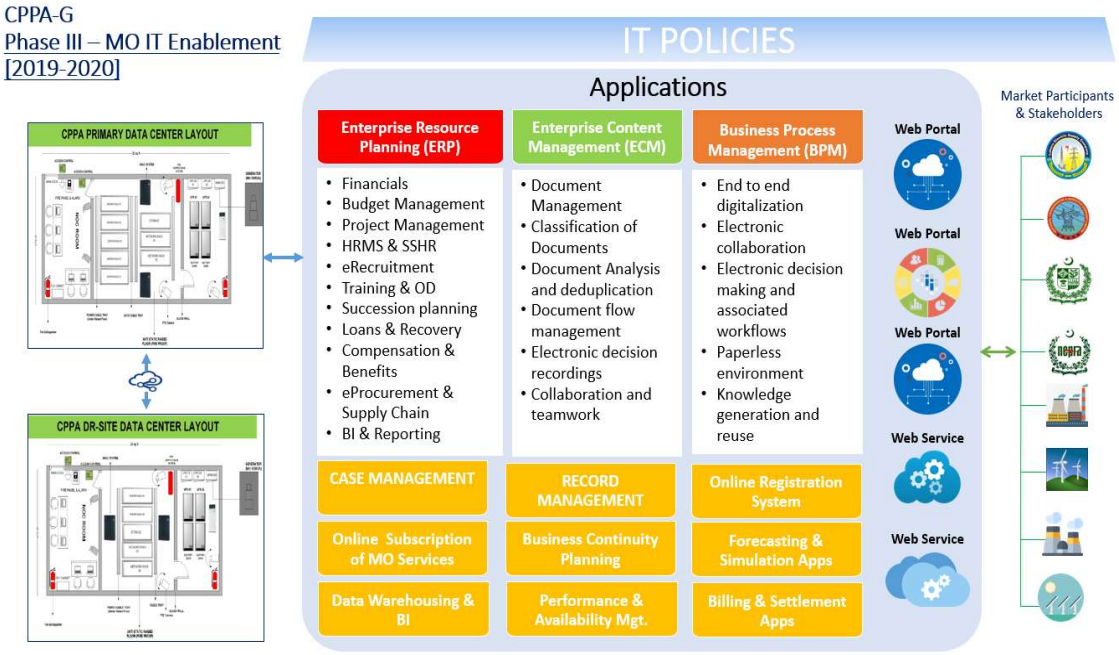
CPAA has also embarked on another revolutionary automation initiative of Enterprise Content Management (ECM). Enterprise content management, as a form of content management, combines the capture, search and networking of documents with digital archiving, document management and workflow. It specifically includes the special challenges involved in using and preserving a company's internal, often unstructured information, in all of its forms and will focus on business-to-employee (B2E) systems. The future extensions to this firm automation base are important applications like, case management, record management as well as business process management systems to realize the objective of a paperless environment. It is pertinent to mention that the documentation of AS-IS and TO-BE processes of CPAA has also been achieved during the Phase-1 of automation.



PHASE-III OF IT ENABLEMENT (2019-2020)

Under **Phase-3**, in the design of future wholesale competitive market, it has been noted to restructure CPPA to avoid conflicts (if any) that the company may have in administrating the role of a Market Operator during competitive market regime that commences in 2020. The CPPA Board, in July 2017, in principle envisaged the restructuring of CPPA, for initially an operational segregation of CPPA into Special Purpose Supplier (SPS) and the Market Operator (MO) followed by their legal incorporation to avoid the conflict of interest (if so required). A Business Processes Re-engineering exercise is therefore likely for taking care of the future role as a MO and SPS. A number meeting and consultative workshops were held. Moreover, studies of the processes, structures, capabilities, and technology roadmaps of similar international organizations is also being carried out by CPPA to plan, design, and develop a further enhancement in the IT infrastructure well versed for its new role.

To align with the above-mentioned change owing to undertaking the role of a modern MO and IT intensive business functions as a result, a matching cutting-edge information technology capability has been planned both in terms of Infrastructure as well as human resource assets to man this facility and provide the services of the highest quality. The new IT functions is envisaged to be divided into seven sub functions namely, Applications, IT Infrastructure, Solutions Architecture, Business Intelligence/ Analytics, IT governance, Project Management, and User Support groups. The new IT organization's structure, technology roadmap, human resource needs, service portfolio, support requirement, governance and policies have been comprehensively understood and planned and funding has been secured.



CPPA has secured funding from USAID for IT infrastructure and applications for MO. As per the current plan the separate IT systems for MO and SPS is likely to be established by mid of 2019, well before the commercial operations date of the wholesale competitive market i.e. mid of 2020.

CPPA Capability as The Operator of Pakistan Electricity Market

Financial Strength to Operate the Competitive Market

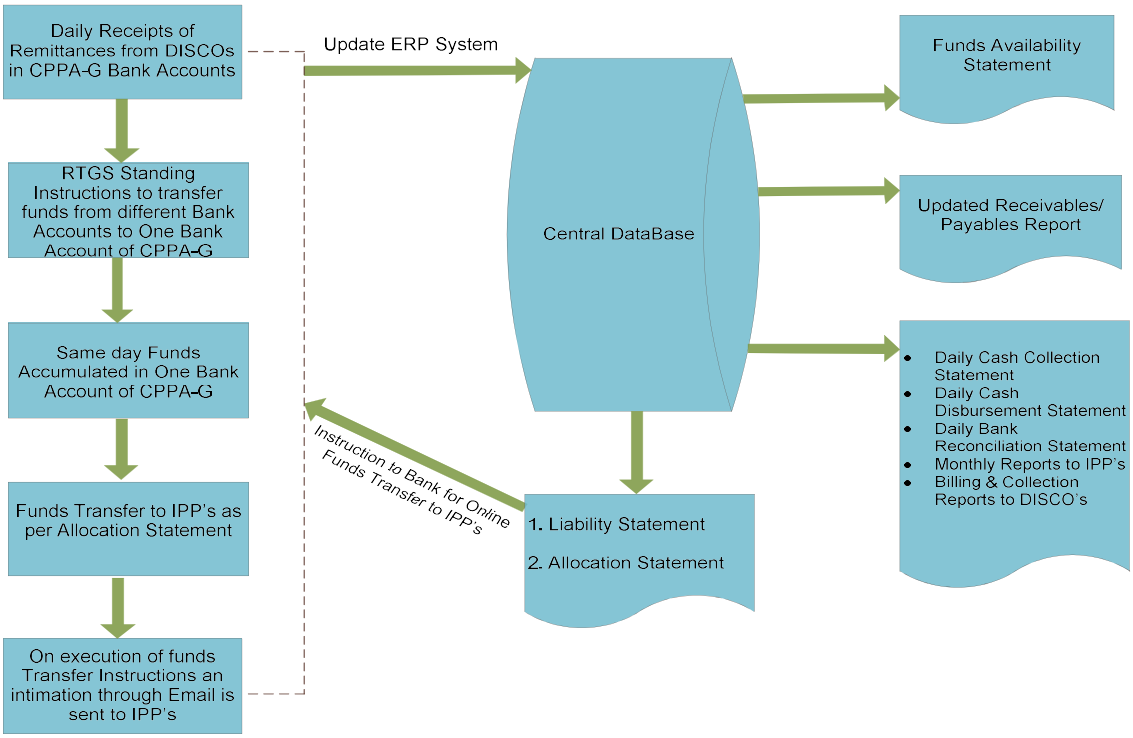
The CPPA have the financial strength to run its internal organization and systems as required to operate not only the completive market but also the present stage of the market.

Here it is pertinent to highlight that a Market Operator as a Service Provider, provides the services of market operations for which it charges the Market Fee from market participants. By getting market fee the Market Operator can provide the Market Operation services. The Market Operator cannot stand surety, give guarantees or in any other manner offer or provide security for the indebtedness or obligations of any other market participant. Under the current regime the Government of Pakistan provides sovereign guarantees to the sellers of electrical energy in-case the buyer(s) defaults.

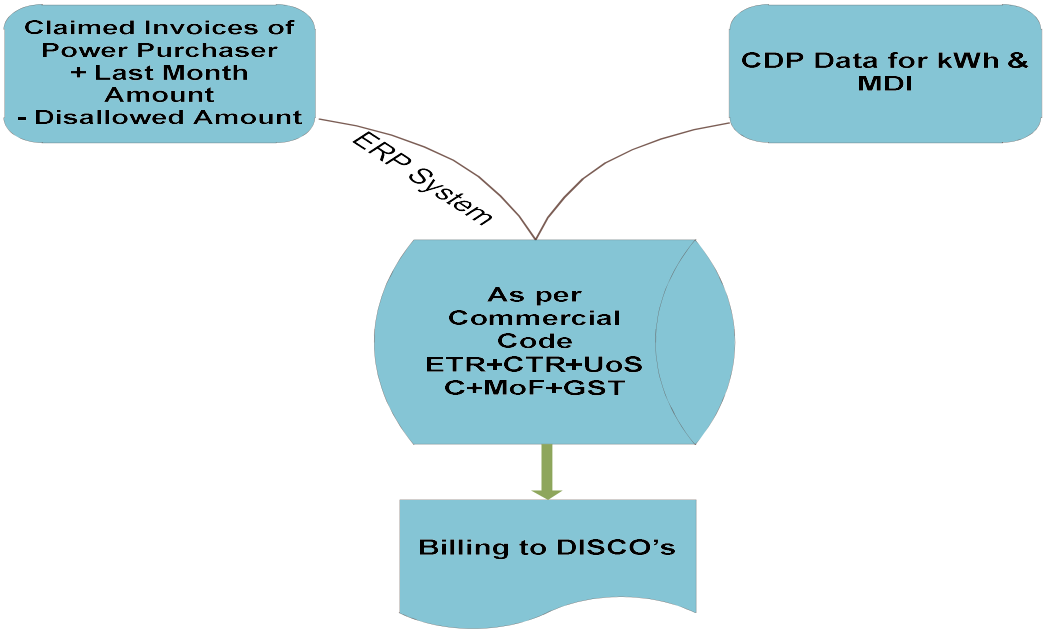
Capability for Billing, Settlement, Management of Cash Flow, Treasury Management and Other Relevant Banking Arrangement

CPPA G has been performing these functions since its inception and has over twenty years of relevant experience. CPPA at present possess required organization, workforce, standard procedures and systems to perform these functions according to the applicable rules and regulations.

Furthermore, by implementation of SFS and ERP systems, the billing, cash flow management, treasury management and banking transactions have been significantly improved and made more transparent. The following diagrams depicts the automation that has been brought into for improving these processes:



Improved Cash Flow Management



Automated Billing Process

CPPA-G has developed Oracle based billing system which takes input from the metering system and account for the cost element as per requirement of the commercial code. CPPA-G maintain 18 accounts with various banks, remittances from DISCOs are received directly in the respective bank

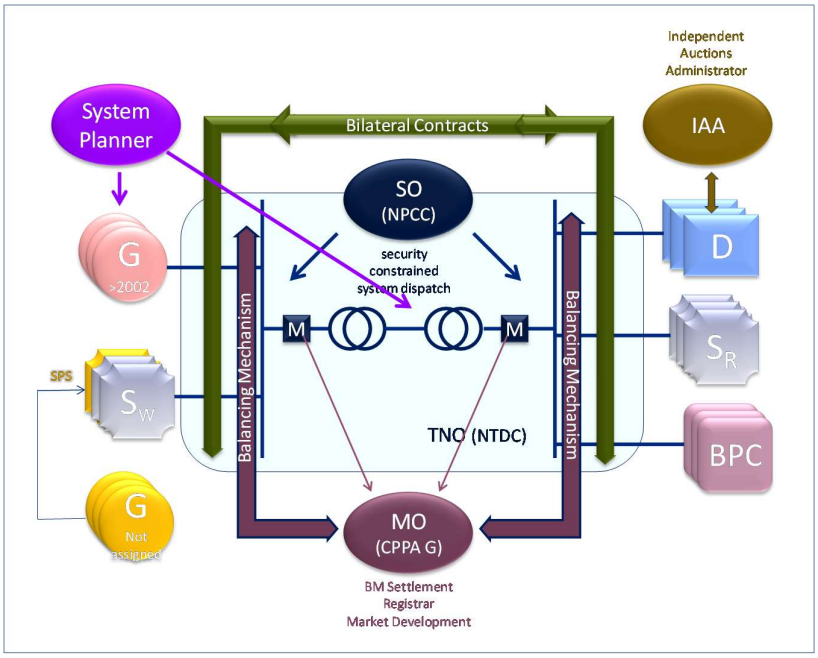
account on daily basis and a monitoring mechanism is in place to ensure that cash from DISCOs is remitted to CPPA-G designated within the prescribed time limit.

All these banks have standing instruction from CPPA-G to transfer the balance as of 09:00 am in morning to one designated bank account through RTGS (Real Time Gross Settlement System). Based on the liability statement and funds availability position an allocation statement is issued by the system which is communicated to the designated bank for funds transfer to respective IPPs/Generating Units etc. On transfer of funds to IPPs a system generated email is sent to such IPPs on real time basis.

The process of integration with market participants with regard to billing and settlement thereto has been envisaged. The same is covered under Phase-II of IT transformation.

WHOLESALE MARKET MODEL AND ROADMAP PROPOSED FOR PAKISTAN

GENERAL STRUCTURE



ROADMAP FOR IMPLEMENTATION

Detailed Tasks for Each Group of Actions

The implementation of CTBCM requires certain actions to be performed by different entities. A complete roadmap has been developed which includes seventeen group actions and a number of sub actions. The proposed roadmap has been designed to avoid that any action lagging behind does not delay the start of the commercial operation of the market despite all other actions having been completed successfully.

Considering that the timing of the approval of the CTBCM depends on NEPRA review process, which is not controllable, the roadmap starts the preparatory actions as from the approval of the power market conceptual design policy. The actions can be differentiated into the following groups and the following stakeholders that should lead the execution of these actions:

#	GROUPS OF ACTIONS	STAKEHOLDERS SHOULD BE INVOLVED	ACTIONS AND RESPONSIBLE
1	Policy on market development, White Paper describing the market conceptual design	NEPRA; CPPA G (draft); MOE approval and processing with other institutions.	• CPPA G submits the conceptual market design to NEPRA for approval. • CPPA G prepares initial draft of the policy (the draft White Paper), including rationale, based on the market design approved by NEPRA and submits to MOE. • MOE sends the draft White Paper for consultation • Additionally, CPPA G will include a notice in its website requesting comments • Explanatory workshops by CPPA G prior to and/or at the start of the consultation process. • CPPA G consolidates relevant comments and feedback and addresses, as relevant, in a final draft of conceptual market design policy. The comments received and the response will be published in CPPA G's website. • MOE will finalize policy on market development (White Paper) and approve • MOE and CPPA G make public approved policy in their websites.
2	Amendment/additions to legal framework	CPPA G; MOE	• MOE prepares additional text/modifications be proposed for NEPRA Act amendment, based on approved policy • MOE will manage the standard process for consultation and the proposed modification/addition to be sent for discussion and enactment in the National Assembly. • NEPRA Act modification approval
3	Modifications to adapt or replace energy policies	MOE	• MOE reviews and adapts various power policies (generation, transmission, among others to be determined)
4	Modifications (review and additions) to power sector regulatory framework	NEPRA.	• Except for pre existing PPAs/EPAs, Generation tariffs for captive customers and pass through to regulated electricity retail tariffs of DISCOs result of competitive procurement or competitive balancing market. • Regulations to pass through of power procurement costs including balancing, ancillary services, balancing mechanisms costs, fuel adjustments, etc.) to the regulated tariffs for each DISCOs the and KE • Bulk Power Consumers can freely negotiate contract conditions and prices with generators or suppliers. • Review and amend Market Operator Rules to harmonize with the conceptual market design and the functions assigned to the Market Operator, and types of Market Participants. • Regulations / guidelines for the monitoring of: competitive process for new capacity procurement of DISCOs, etc..

5	Contracts: assignment of pre-existing PPAs/EPAs among DISCOs; K Electric as distribution / retail supplier and other distribution licensees	MOE and CPPA G, IPPs and Gencos, DISCOs, K Electric	• Development of implementation strategy • Guidelines for implementation, guarantees adaptation, assignment distribution factors, etc. • formation of the task forces that will have to do the actual legal work • assignments to DISCOs and KE
6	Separation of CPPA G into Market Operator and Special Wholesale Supplier Functions	CPPA G	• Creation of the Market Operator Business Unit as a service provider in the wholesale market • Creation of the Special Purpose (wholesaler) Supplier Business Unit, the SPS Business Unit, as the administrator of the power purchase from existing PPAs/EPAs on behalf of Distribution Companies. • Establishing functional and accounting separation of both units. • Preparations to separate into two companies prior to commercial start of the market
7	Creation of a Special Purpose (wholesale) Supplier to be the purchaser of any PPA/EPA that has yet not been assigned	CPPA G; DISCOs	• Following actions in 6, review and sign new agency agreement between SPS and each DISCO • Until actions in 5 fully completed, purchaser on behalf of DISCOs in pre existing PPAs/EPAs • Draft back to back contract to resell energy and capacity, and sign with each DISCO • Implement / upgrade generation Invoice verification services (transferred from current CPPA G function)
8	Creation of the Independent Auction Administrator (IAA and provide credit cover/guarantees to low performing DISCOs)	MOE (PPIB); DISCOs	• Organization and standard auction procedures, templates and bidding documents • Provide the required credit cover / guarantees to low performing DISCOs
9.1	Codes: New Market Commercial Code	CPPA G draft and consultation, NEPRA review and approval.	• New Market Commercial Code • CPPA G drafts Market Admission Agreement and publishes in website • New Market Commercial Code published in website after approval
9.2	Codes: Update Grid Code	NTDC draft with the Grid Code Review Panel., NEPRA review and approval.	• Review the Grid Code to incorporate market design relevant issues, including revise and update the Metering Code of the Grid Code • Grid Code and amendments published in NTDC website
10	Organizational: Strengthening of CPPA G as Market Operator	CPPA G	• TBD

11	Strengthening of System Operator, enforce rights and obligations	NTDC NPCC; NTDC as TNO.	• Ensure systems, software, data base and data exchanges for implementation of demand forecasting, dispatch and balancing in accordance to market design and full implementation of Grid Code, • System Operator website launched, and publishes operational planning, demand forecasts, availability, and results of system operation. • System Operator implements arrangements to monitor Transmission Users compliance with Grid Code • NPCC staffing and capacity building
12	Strengthening DISCOs credit worthiness and readiness as market participants	DISCOs, MOE in representation of the owner of DISCOs, the Special Purpose (wholesale) Supplier	• Capacity building to determine demand forecast, and for the management of contract (bilateral) portfolio. • Assessment of wholesale payment history, financial situation and efficiency (losses and collection) of each DISCO. Measures for financial strengthening as necessary, and identify worst performing and financially very weak DISCOs that would be unable to provide credit cover guarantee on their own.
13	Open access to transmission services: formalize transmission services rights and obligations	NTDC.	• NTDC drafts standard (template) transmission connection agreement and sends to NEPRA for comments/review; • NTDC agrees details for Schedules of the agreement with each power plant (currently, data has mostly already been agreed in signed PPAs/EPAs) and signs connection agreements with each power plant, and distribution substation to NTDC grid; and any other connected to NTDC grid.
14	NTDC Least cost expansion plan and adequate revenue meters	NTDC, CPPA G (as observer of meter testing)	• NTDC/NPCC finalizes least cost expansion plan draft and consultation, and submit for approval. NEPRA review and approval. • NTDC provides information on Revenue Metering System for CPPA G / Market Operator to develop and maintain the Revenue Metering System Register; • NTDC tests existing Revenue meters (CDP) • Together with MO and NEPRA as observer, establish arrangements to adjust meter readings for the calculation of balancing.
15	Measures for Market payment culture: credit cover mechanisms and payment system	CPPA G/Market Operator' DISCOs and MOE, IAA	• MO establishes the market payment system • MO develops methodology and formula to determine market credit cover (collateral). • DISCOs together with MOE (in representation of the government as owner of the DISCOs) establish for financially bad performing DISCOs (inefficient demands) a payment security cover for contracts and market payments of those DISCOs, where the guarantee/security cover scheme would be organized through and provided by the IAA.
16	Readiness for commercial operation of electricity market:	Lead by CPPA G, includes all market participants; CPPA G	• Testing all Revenue Meters, dispatch software and market data management system • Capacity building of participants and services providers

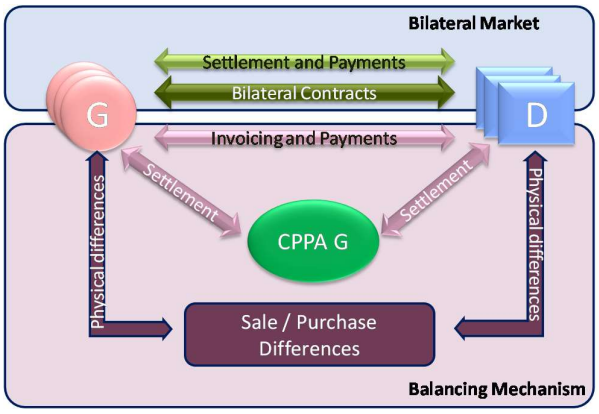
		reporting of readiness tests and results to MOE and NEPRA	• Required credit cover in the market and testing of credit or guarantee systems • Pilot shadow market, to test live systems, mechanisms, information exchange and procedures. • Collect comments and feedback from Participants. • Develop required improvement or correction. • Inform the MOE and NEPRA test results and whether readiness has been achieved
17	Declaration of date to start commercial operation of the market	MOE	

FEATURES OF PROPOSED WHOLESALE MARKET MODEL

TRANSACTIONS

The target market will have the following commercial structure:

- A bilateral contract market, in which sellers (Generators and Wholesale Suppliers) will sell directly to the buyers (Distributors, as Retailer Supplier, other Retail Suppliers, Bulk Supply Customers) through bilateral contracts
- There will be a Balancing Mechanism to settle deviations between contracted amounts and actual amounts
- Settlement and payment of bilateral transactions will be done bilaterally between sellers and buyers
- Settlement of contract deviations in the Balancing Mechanisms will be done by and through the Market Operator, and payment by Participants



PRODUCTS

Two separate products will be traded in the market: energy to supply electricity consumption; and "firm capacity" to provide sufficient and adequate capacity for medium and long term security of supply through capacity obligations to Demand Participants.

Demand Participants will have the obligation to cover in advance with contracts their participation in the system peak demand. The proportion of the buyer's demand to be covered by contracts for different future time horizons will be determined by the NEPRA

CONTRACTS

Demand Participants (DISCO; K Electric; Suppliers and BPCs) will sign contracts directly with Generators and/or Traders to cover their energy needs and capacity obligations. A BPC can buy from a Supplier that will then assume the obligation of contracting for the BPC.

At the CTBCM start, there will be two types of contracts: pre-existing PPAs/EPAs and new contracts signed under the new market framework: the Supply Contracts.

All existing contracts that have assignment clauses will be assigned to all DISCOs, with all their rights and obligations unchanged (e.g. guarantees, available capacity and net energy supply pass through). Other PPAs will be invited to be novated and adhere to the CTBCM.

New contract as from the start of the CTBCM will be Bilateral Supply Contracts with supply obligations but not obligation to produce (for the seller side) and obligation to pay for the contracted quantities, but not to take / consume. Seller and Buyers will settle differences in quantities between actual and committed contractual quantities in the Balancing Mechanism.

BALANCING MECHANISMS

The market will include balancing mechanisms centrally administered by the Market Operator, covering both energy and capacity, for the following sales or purchases:

Energy Balancing:

- For Demand Participants (including exports), differences between actual energy (metered plus allowed transmission losses) and contracted. Generators/power plants that are taking energy from the grid for own consumption during maintenance or test periods will be considered as a demand and will pay the energy taken through the Balancing Mechanism.
- Transmission losses above the level allowed by NEPRA in transmission tariff determination, will be bought by the transmission company at balancing prices.
- For Generators, and Wholesalers (including imports) difference between scheduled energy and actual (metered) in connection point. As noted in the first section, there may be constraints on implementing balancing mechanism for generation depending on signed existing PPAs/EPAs. However, design of future contracts, Supply Contract, will incorporate the Balancing Mechanism by referring to mandatory compliance with Market Rules / Commercial Code.

Capacity Balancing:

- For Demand Participants, differences between contracted firm capacity and actual peak demand.
- For Generators, difference between committed/contracted generation and actual available generation. The capacity balancing mechanism creates a market based price and payment by the generator for liquidated damages due to unavailability.

The imbalances will result due to actual demand, generation availability, actual import/export exchanges, and the System Operator generation scheduling, least cost economic dispatch within system security constraints and real time operation, in accordance to the Grid Code.

The Participant will sign a Balancing Agreement with the Market Operator, including the balancing mechanism obligations, rights, responsibilities and obligations of the Market Operator and of the Participant.

The Participant will have to provide the credit cover to guarantee the payment that may arise from its participation in the Balancing Mechanism (the credit Cover will also guarantee payment of transmission charges and market fee).

Purchase and sale of imbalances will be among the Participants, and therefore will not involve payment by or liabilities for the Market Operator. However, it will be the Market Operator responsibility to ensure that each and all Participants provide sufficient credit cover for imbalances and execute them in cases of non-payment.

The System Operator will provide the Market Operator with the information on actual energy and available capacity.

SETTLEMENTS

For the bilateral contracts, the settlement, invoicing and payment will be done directly between the parties in the contracts, e. g. the Generator and Traders on one side and DISCOs, Suppliers and BPC and any other buyers.

For the Balancing Mechanisms, the settlement procedures and payment system will be initially, weekly (provisional) and monthly (final). At the end of each week (possibly each day in the case of remote reading of settlement meters), metering services providers will submit to the Market Operator metered energy. The System Operator will send to the Market Operator daily information on available capacity. With this information and the information about the bilateral contracts available in the Contract Register, the Market Operator will calculate the imbalances of each Participant:

- The Market Operator will calculate imbalance energy and capacity quantity and prices (to be defined as part of the market detailed implementation).
- The provisional weekly settlement document will include energy and capacity imbalances and will be informed to all Participants.
- The monthly settlement will conciliate the weekly settlement, including payments made by or received in the weekly provisional settlement for imbalances, and including additionally monthly transmission use of system charges and market fee. The monthly settlement will also include any adjustment resulting from resolving complaints and disputes to previous settlements. The settlement document sent to each Participant will include all the detailed data required for the Participant to review and verify the settlement.
- The Market Operator will administer the payment system and monitor compliance with market payment obligations (which do not include payments in contracts, which will be made bilaterally).

SECURITY COVER / GUARANTEES

The market will include mechanism to address non-payment risk. The "bi-lateralization" of existing contracts will not include any change in the guarantee that are part of the existing PPA. For new market based bilateral contracts to be entered into between the parties as from the CTBCM start: the Supply Contracts, there will not be any more sovereign guarantees granted by the GOP. Instead, each Supply Contract will include credit cover.

Government owned low performance DISCOs that have a history of low collections and low payment to CPPA G/NTDC CPPA and that cannot provide the credit cover, can be eligible to receive the required credit cover through the IAA, through guarantees or credit mechanisms that can be called in case of non or later payment.

The Generator can call the default of a PPA/EPA/contract in case of non-payment. In such situation, the Generator will be able to continue to sell through the Balancing Mechanism until signing another contract, and the DISCO that defaulted in the contract will result buying in the balancing mechanism. Participants must also provide credit cover for the exposure to imbalances settled through the Balancing Mechanism, transmission charges and market fee, as applicable.

NEW MARKET CONTRACTS

The market based contracts, Supply Contracts, that will come in force as from the CTBCM will be agreements to protect against price risks, setting a price for agreed in advance hourly volumes of energy and capacity. The settlement of imbalances will be made in the Balancing Mechanism. This design will enable to optimize the dispatch of the generation resources without being affected by contractual obligations (e.g. take-or-pay obligations in PPAs or contracts), which would lead to higher production costs.

As a consequence of these type of contract, Generators (or Traders) are responsible for producing the agreed hourly volumes or buying the difference as imbalance. The buyer is responsible for paying the agreed volumes at contractual price but can sell any surplus in the Balancing Mechanism. In summary, the buyer and the seller agree in the Supply Contract to a price for fixed quantities, independent on actual energy generated or demand consumption. Differences between agreed volumes and actual volumes are settled in the Balancing Mechanism.

However, when the market is not liquid (when there is not enough generation capacity to meet the demand) the financial agreement becomes a physical obligation. In this circumstances, the balancing price will become high to reflect cost of not supplied energy and the generator that is not available to deliver will have to buy in the Balancing Mechanisms to meet the contract obligations. This creates incentives for generation to be available in periods with inadequate reserves and risk of shortages.

CAPACITY OBLIGATIONS & NEW GENERATION CAPACITY PROCUREMENT

All Demand Participants (DISCOs as retailers, BPC, Suppliers, Traders) must have sufficient capacity and adequate energy contracted (and/or own generation) in advance, to cover a certain portion of the forecasted demand for different horizons (to be established through regulation). For example (to be defined during the Detailed Market Design),

Distribution companies, as Suppliers: will have to have the following percentages of their forecasted peak demand contracted in advance: [100%] of the forecasted peak demand for the next [3] years; [90%] for years [4 and 5]; [75%] years [6 to 8]; etc.

KE as Supplier: [95/97%] of the forecasted peak demand to be purchased in the market for next [5] years be covered by own generation and contracts. Power procurement by KE in the CTBCM will be through Supply Contracts directly with Generators or Traders to cover their contribution to security of supply or through the Balancing Mechanisms. KE will register as Market Participant and participate in the Balancing Mechanism as Supplier and Trader, depending on the direction of the

deviations regarding the contracted amounts. Alternatively, KE may contract with a Trader in the market and designate it as responsible for its imbalances.

Bulk Power Consumers: contribution to security of supply will be through informing the forecasted peak capacity it expects to purchase in the market through bilateral contract or purchasing capacity from the market for the next [5] year. A BPC or a group of BPCs can delegate to a retailer its power purchase obligations, subject to signing a retail supply contract.

OBLIGATIONS TO OPERATE IN THE NEW MARKET

In the CTBCM all Participants must contribute to the secure and reliable supply in the power system by planning and committing to the coverage of the demand.

All Network Services Providers must contribute by ensuring grid / network upgrade and expansion sufficiently in advance.

The Capacity Obligations for Demand Participants will require to contract (and/or own generation) enough capacity and energy to supply their forecasted demand and participation in peak system demand (including operational reserves). The goal is to ensure sufficient available capacity but avoid over contracting that would increase unnecessarily generation costs. As described before, the Balancing Mechanism will settle deviations between contracts and actual. This requirement is consistent with obligations in the distribution license.

DEMAND PROJECTIONS, AGGREGATION AND GAP

Each DISCO will prepare its demand forecast. Before the end of each year and for next 10 years will inform NEPRA the annual and monthly demand forecast for its captive customers, power already procured through contracts and plans for new procurement (power acquisition program). NEPRA will review and approve the forecasts, in consultation with NTDC as Planner and the System Operator. The System Operator will consolidate the approved forecasts, and produce the System Demand Projection.

In case KE plans to purchase capacity and energy in the CTBCM through Bilateral Supply Contracts, will have to inform same information as the rest of the DISCOs and other buyers. Each year the System Operator IAA will determined for each DISCO the gap between already contracted capacity and capacity obligations, and the total gap.

Based on procurement regulations to be issued by NEPRA and the gap informed by the IAA NEPRA will decide what is the Gap to be covered with new contracts for the different horizons that the procurement regulation will establish. The resulting Gap, will be passed to the Independent Auctions Administrator (IAA), which will prepare a consolidated power acquisition plan covering the additional capacity requirements for each DISCO for each future scenarios and and submit for NEPRA approval. The IAA will be open to include in this consolidated plan, capacity requirements from other Demand Participants.

CENTRALIZED PURCHASER SERVICE

The procurement of the power acquisition plan approved by NEPRA will be done by IAA through centralized competitive auction for the aggregated capacity gap, using a standardized template commercial supply contract consistent with the CTBCM (financial contracts with supply obligations). The competitive procurement may result in one or more contracts awarded to generators/power

plants. Each awarded Generator will sign with each DISCO a Bilateral Supply Contract for a part of the total energy and capacity awarded in the auction, proportionally to the DISCO requirement to cover its gap approved by NEPRA. For the sake of clarity, the IAA will not sign the PPAs, which will be signed directly by the purchasers, i.e. the DISCOs. If KE participates in the auction, it would also sign bilateral contracts with the awarded Generators.

The competitive process will follow NEPRA regulations as applicable and approvals for the resulting prices of the awarded contracts to qualify as competitive generation tariffs.

FUTURE MARKET DEVELOPMENT

It is important to remark that this sections deals only with additional reforms that could be introduce in the market in the future. None of them are applicable at the start-up of the CTBCM, however it shows that the CTBCM can naturally evolve towards more competitive electricity markets with very simple measures, most of them to be decided through regulations.

In the future and depending on security of supply developments, the Capacity Obligations (level of contracting in advance) may be reduced by NEPRA, after consultation and hearing with stakeholders. The threshold for Bulk Power Consumers will be lowered to expand the retail market open to competition. The Capacity Obligations of a DISCO for of its captive consumers demand will reduce accordingly. That will promote the retail supply business to increase.

As more Supply Contracts are signed, the Balancing Mechanism will evolve towards an increasing spot market and operate similarly to markets with net pools. However, it must be noted that in USA net pools include capacity obligations. In the EU market development evolve towards financial price hedging instruments that are different to Supply Contracts, and future markets with standardized products. Such level of sophistication will not be possible under current PPA/EPA arrangements.

Additionally, at some point on time, it will possible to implement a medium and short term power procurement platform administered by the Market Operator, enabling the trading between multiple buyers and multiple sellers for competitive short term procurement to complement commitments arising from contractual agreements.

SYSTEM EXPANSION

The System Expansion Planning will be executed according to the Grid Code, within the following principles:

1. Each DISCO and Suppliers prepare and inform their demand forecast for the next 10 years, including assumptions and historical actual energy and capacity demand. KE c also sends it demand forecast and projections of energy and capacity required, if any, at connection points with NTDC grid.
2. The System Operator aggregates and consolidates into system demand forecast, incorporating also consideration on historical trends and macro projections
3. The consolidated demand forecast is sent to the Planner
4. The Planner, taking into consideration what is established in the Grid Code, the policies issued by the GoP, applicable regulation, etc. prepares an indicative generation expansion plan integrated with the transmission expansion plan. There will be consultations with stakeholders on assumptions used and with Grid Code Review Panel.
5. The Planner submits the plan for NEPRA review and approval. NEPRA may carry out consultations as part of the review for decision making.

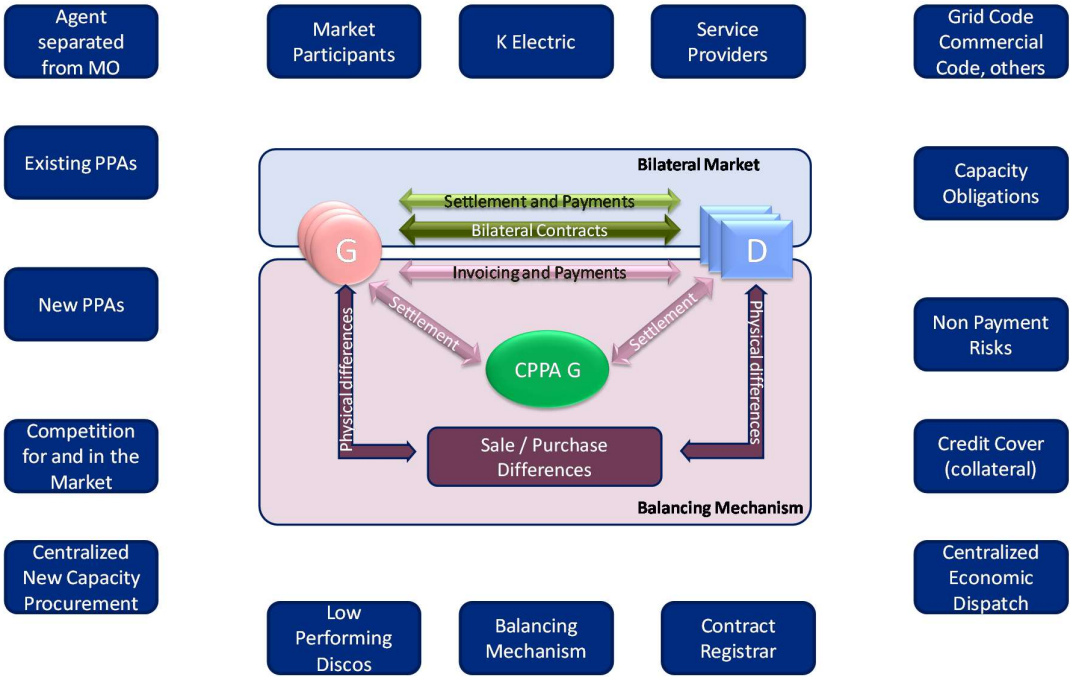
6. Once the plan is approved, the Planner publishes it in its website.

LEGAL AND REGULATORY FRAMEWORK

The current legal and regulatory framework will require adjustments to make them fully consistent with the CTBCM design. The following documents will need to be created or adjusted for that purpose:

- A GOP policy for the creation of the CTBCM and start of its commercial operation.
- The Market Rules to adapt the functions of the Market Operator and reflect the types of Participants and Services providers
- The Commercial code
- The Grid Code

Additionally, other GOP policies for the power sector would need to be reviewed to reflect the market structure and institutional arrangements. Similarly, NEPRA regulatory framework on power procurement and generation pricing would need to be reviewed.



Target Market - General Interactions

NEPRA ACT AS AMENDED 2018

The NEPRA Act (as amended 2018), provides legal framework to establish competitive wholesale and retail markets in Pakistan, while introducing changes such as de-licensing of generation companies over a period to providing legal basis for formation of new licensed entities such as Market Operator, Traders, Suppliers and so on. The NEPRA Act (as amended 2018) contains several provisions related to the introduction of a competitive electricity market in Pakistan.

The new entities introduced under the law are as follows:

- Market Operator Licensee: Responsible for the organization and administration of trade in electricity and payment settlements among generators, licensees and consumers

- System Operator Licensee: Responsible for administering the grid systems and dispatch
- Power Supplier Licensee: Responsible for sale of electric power to end consumers
- Distribution Licensee: Responsible for the network and wiring aspects of electric power
- Power Trader Licensee: Responsible for trading of electric power
- Provincial Grid Company: Grid companies owned by Provincial Governments

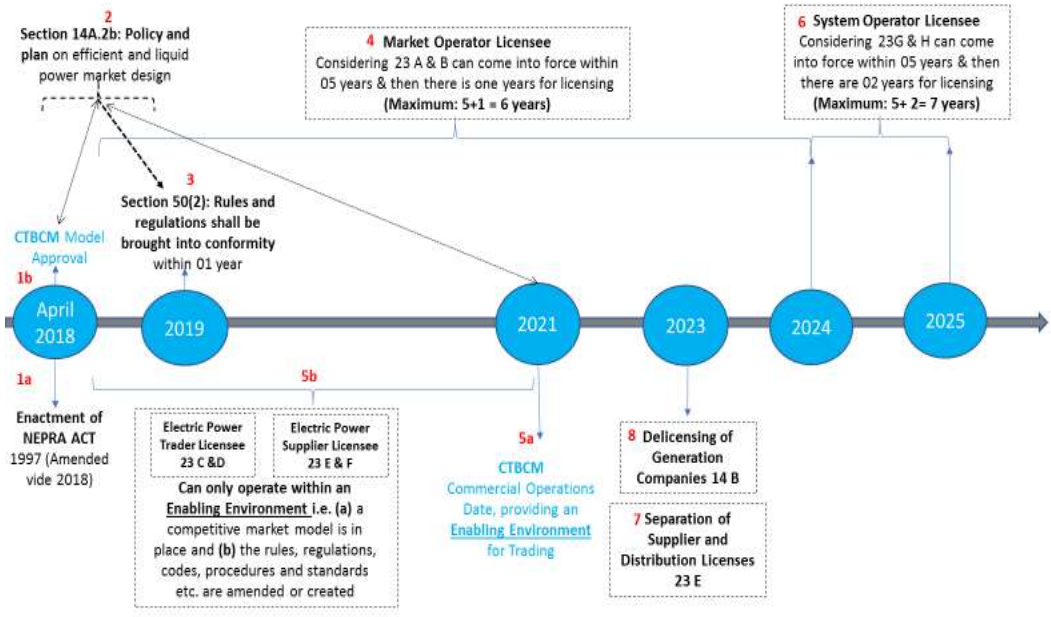
The introduction of a competitive market most of all means a re-distribution of the market risks that each participant to it shall share. It is important to remark that introduction of a competitive environment in the power sector does not mean "deregulation", rather "re-regulations" that means:

To change the legal and the regulatory frameworks in-order to let players trade among them by observing certain rules (e.g. market rules; codes, etc.) without regulatory intervention w.r.t. dictating them what and how to do this trading. Typically, this for generation and retail end of the supply chain.

At the same time, in segments of the sector in which the natural set up corresponds to monopolistic or oligopolistic structures, it means to have regulatory regimes establishing rules that established what and how to do (e.g. system operations, market operations, regulated consumer end tariffs, charges for the use of the transmission systems, etc.). Typically, this is for the wire business and related functions.

Market development, monitoring, surveillance, investigations, capacity building and so on. A key role that the Regulator and Market Operator must play with close coordination and collaboration.

It would be pertinent to highlight some key timelines as given in the Act w.r.t development of institutional framework, alignment of existing rules and regulations, development of National Electricity Policy viz a viz market design and other important items necessary for development of a trading environment where traders, suppliers, generators, and other markets participants can trade. This is illustrated in the following figure:



Amended NEPRA Act - Important Timelines and Sequencing

In above figure, apart from important timelines given in the Act for various items, the wholesale market model i.e. CTBCM is also discussed, as NEPRA has initiated it's approval process and without an approved and operational wholesale market model competitive trading can't not take place, as the model creates an environment for trading that don't exist today. The logical sequencing numbers from 1 to 8 and associated items as given in the above figure are discussed in the table below:

#	Title	Remarks
1	**Enactment of NEPRA ACT** 1997 (Amended vide 2018)	NEPRA Act amended, also creates the legal basis for creation of competitive market
1.a	CTBCM Model Approval	CPPA submitted CTBCM Model to NEPRA in March 2018 and NEPRA has published CTBCM on its website inviting comments which is part of its approval process. The Act provides the legal basis to establish CTBCM.
2	**Section 14A.2b: Policy and plan** on efficient and liquid power market design	Federal Government shall prepare a National Electricity Policy to be approved by CCI and National Electricity Plan that shall also include policy directions and plan to have efficient and liquid power market design. The CTBCM model will inform the Policy and the Plan formation and vice versa
3	**Section 50(2): Rules and regulations shall be brought into conformity** within 01 year	The Section 50, Sub-section 2 of NEPRA Act states to rules that will be prescribed and regulations that will be specified shall be brought into conformity with the Amended NEPRA Act within one year from enactment. It is important to mention here that development of National Electricity Policy and Plan will be instrumental to complete this task. Here it is important to mention that completing items 2 and 3 in one-year time will be an uphill task that will require tremendous collective efforts. Therefore, developing and sharing a comprehensive plan of activities to complete these multi-dimensional tasks may prove instrumental for their timely completion
4	**Market Operator Licensee** Considering 23 A & B can come into force within 05 years & then there is one years for licensing **(Maximum: 5+1 = 6 years)**	The Clauses 23 A,B, G & H are ineffective for a period of 05 years or an earlier period as notified by Federal Government. When Clause 23 will become effective, one additional year will be provided for licensing of Market Operator as per 23A. So, technically there can be maximum 5+1 six years until the Market Operator will be licensed. However, it will be imperative that before the Commercial Operations of CTBCM, the Market Operator is given a licensed
5a	**CTBCM** Commercial Operations Date, providing an **Enabling Environment** for Trading	The proposed Commercial Operations Date of CTBCM is mid of 2020, however, it may go forward by six months, based on the timings of the approval given by NEPRA, providing enough time for completion of the planned activities to create the wholesale competitive market. The Market Operator should be a licensed entity as envisaged in the Act, before the wholesale market starts
5b	Electric Power Trader and Suppliers Licenses	**Can only operate within an Enabling Environment i.e. (a)** a competitive market model (CTBCM) is in place and **(b)** the rules, regulations, codes, procedures and standards etc. are amended or created

6	System Operator Licensee Considering 23G & H can come into force within 05 years & then there are 02 years for licensing (Maximum: 5+ 2= 7 years)	The licensing scheme of the SO is not having any impact on the CTBCM Model. The important thing regarding SO that influence the wholesale market is the performance of SO. So the strengthening of SO with respect to SOPs, tools/technology and human resources is the basis to run the efficient wholesale market.
7	**Separation of Supplier and Distribution Licenses 23 E**	The creation of CTBCM by 2020 will initiate the competitive market operations and will provide Bulk Power Consumers (BPCs) the choice to purchase electricity from difference sellers, and hence the retail competition will commence for the BPCs. Progressively moving forward, as the threshold for BPCs will be decreased from 1MW to below and number of such consumers will increase over time, at that time say around 2022 onwards, the need to split the supplier and distribution license will gain importance
8	**De-licensing of Generation Companies 14 B**	The de-licensing of Generation companies is irrelevant to the CTBCM Model. Because in the case when Generation Company wants to participate in the wholesale market then there will be some rules and codes regarding their registration to become a wholesale market participant, which actually fulfills the requirement of CTBCM.

Following is a simplified sequencing diagram that illustrates the major steps and events presented in the above table in a sequential and simplified manner.

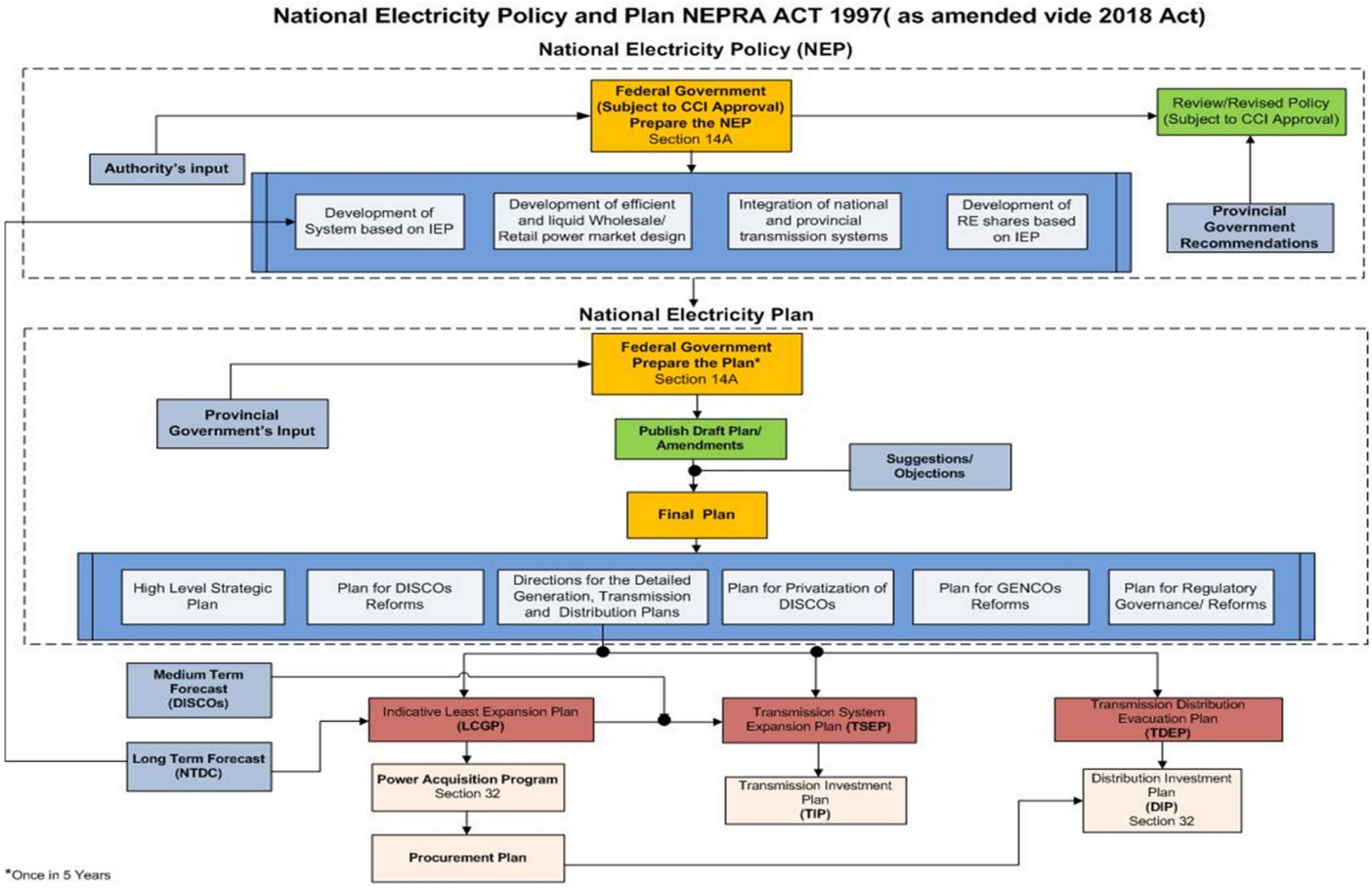
Simplified Sequencing Diagram

NATIONAL ELECTRICITY POLICY AND PLAN

In the NEPRA Act amendments, new chapter regarding the National Electricity Policy and Plan (NEP) has been introduced which is a noteworthy initiative to streamline the whole power sector. For the growth and development of power sector it is essential to set some goals and objectives under the policy framework for the power sector and create the plan according to the directions of the policy to achieve the targets.

According to the Section 14A (1&2), Federal Government (FG) will prepare the National Electricity Policy once in 5 years, according to the targets of the policy. While developing the policy framework they can take assistance from the Authority. The policy framework should cover inter alia the following main points:

- The target for energy mix for the power sector on the basis of optimal utilization of resources
- Targets for the development of the proficient and liquid power marker design
- Integration of national and provincial transmission systems
- Target for the development of the sustainable renewable energy market with a gradual increase in share



- Other important aspects regarding the development, reform, improvement and sustainability of power sector as a whole.

The following diagram presents the whole paradigm of policy and plan. This diagram contain three layers, (a) National Electricity Policy, (b) National Electricity Plan and (c) other detailed plans that will be formed under National Electricity Plan and as defined in the Grid code.

MARKET OPERATION AND MARKET DEVELOPMENT IN THE NEP

The National Electricity Policy would prescribe the directions towards implantation of the electricity market in Pakistan and its operations. The transition of the electricity sector from its current state of Single Buyer Plus to competitive power markets, within the timelines and the framework and guidelines of the Government is aimed in the NEP. The development of such competitive markets

shall be based on efficiency, liquidity and shall also take into account the following aspects for smooth transition:

- providing level playing field by removing conflict of interests (if any) and protecting the existing contractual rights of the parties;
- ensuring accountability of market players;
- ensuring proper mechanisms are in place to settle imbalances resulting from trade;
- ensuring open access to information, and undertaking other transparency measures; and
- standardization of products traded in the market to enhance liquidity, by: catering for significant demand growth and lack of timely payment culture; fair allocation of risks; and analysis of the market players keeping in view the fuel mix, and capturing its effects.

PORTFOLIO OF MARKET CONTRACTS

GENERAL CONSIDERATIONS

Contracts are the instruments to manage risks. In an electricity market, the first environment for the buying and selling of electricity is the Contract Market. The purpose of the Contract Market is for a company participating in the market to be able to manage its risks and share risks among those that can best manage each risk. Risks to be managed by a generator include ensuring a steady or predictable cash flow; and for a demand reducing volatility and stabilize power purchase price and ensuring security of supply.

Contracting energy is the market instrument to manage and share energy risks. Different contracts designs allow different allocation of risks. However, in a market with multiple buyers and multiple sellers the contracted energy (the energy market product) may be different to actual consumption or requirements of the demand/buyer, or actual energy generated by the generation/seller. Therefore, the market includes a trading environment to clear energy differences (imbalances) between the physical and the market energy product, to ensure that each Participant extracting energy from the grid pays for all that energy (through contracts and balancing) but not more, and that each Participant injecting energy to the grid is paid for all that energy but not more.

Regarding capacity, the Contract Market is the environment to cover the capacity obligations of demand participants. The characteristics of the contracted capacity is similar in all contract designs presented in this document, except on how the capacity quantity is defined. However, for each demand participant the contracted capacity may result different to its capacity obligation, and for each participant that is or represents generation the capacity committed in contracts may be different to its available capacity. Therefore, the market includes a trading environment to clear capacity differences (imbalances), to ensure that each demand Participant buys its capacity obligation and each generation complies with its contracted capacity commitment.

Considering that the interest of a Participant is to manage the risk of price volatility and manage imbalances, the contract market needs to allow and enable sufficient flexibility on how Participants agree to trade bilaterally (agree quantities and prices, and conditions). Therefore, the contract designs should be tailored to reflect the needs and conditions of different load profiles (the buyers in the contract market) and of different generation technologies (the sellers in the contract market).

There are different types of contracts. The variety of designs allows each Participant to choose the preferred contract design(s) and contract portfolio to optimize the needs, conditionality and interests of the Participant.

Contracted Products: In all designs of the market contracts:

- It is possible to buy or sell energy only, capacity only, or two products (energy and capacity);
- Contracted energy can be defined as fixed quantities (with hourly profiles), or with formula to calculate the hourly quantities, or as a percentage of energy in commercial settlement metering systems. (The energy balancing period assumed in this document is one hour.)
- Contracted capacity can be defined as fixed quantities (annual or monthly), or a formula to calculate the capacity quantities, or a percentage of available generation capacity, or a percentage of the demand capacity obligation that a demand participant is required to cover with contracts or buy shortfall in the capacity balancing mechanism. Price of energy and of capacity will depend on risk assigned to each party and associated costs.
- A Buyer in the contract market may result with differences between contracted quantities (energy and capacity) and actual demand or capacity obligation (e.g. in the case of suppliers, energy taken from the grid to sell to its customers or capacity obligation of the demand it represents or covers).
- As the competitive electricity market in Pakistan will be based on a centralized economic dispatch within system security constraints, a generator selling energy in contract(s) may result not being dispatched, for economic reasons or due to system constraints. The situation is different for renewable generation that has priority dispatch, but that cannot control energy generated as this is variable depending on weather conditions (outside the control of the generation company).

Therefore, to ensure that all are paid and pay as required, it is necessary to quantify / measure the imbalance between what a Participant has contracted (and has to pay or to be paid) and the actual demand or generation.

In electricity markets where contracts can be two part (energy and capacity), imbalances or imbalances may arise with the contracted energy or the contracted capacity. Therefore, mechanisms are implemented to clear the differences, such as the Balancing Mechanism for Energy (BME) and the Balancing Mechanism for Capacity (BMC) described in this report.

To calculate and settle imbalances, each Participant is obliged to submit the information on any new contract or a modification to an existing contract to the Market Operator, to be included in the Contract Register. The Market Operator will administer the Contract Register to verify that all requirements have been complied, prior to approving the registration. Only contracts that have valid registration in the Contract Register will be considered in the calculation of imbalances, and using the information submitted by the parties for the registration.

Additionally, there is a need to calculate and allocate the quantity and costs of energy transmission losses**.** Energy transmission losses is calculated as the difference between the energy generated and imported injected to the grid at the Commercial Delivery Points (where the commercial revenue meters are installed) and the energy extracted (bought by the demand participating in the market or for exports), also at Commercial Delivery Points (CDP). The standard practice is for the demand to pay for transmission losses, for all the actual losses or the capped losses that the regulator sets for the transmission company. This document describes options for the pricing and allocation of transmission losses.

This section describes different type of contracts that could be useful for the electricity market in Pakistan once the CTBCM starts commercial operation. It is important to note that each design represents a different allocation and sharing of risks. Therefore, taking into consideration the cost of risk management, may result in different prices. When or whether a type of contract will be required or be used by a Participant is the result of Participants' requirements and decisions in the future.

Note: For simplicity, examples in this document refer mostly to DISCOs. However, the same assessment and conclusions can be extended to include Bulk Power Consumers or Suppliers (demand).

TYPES OF CONTRACTS IN THE PROPOSED COMPETITIVE MARKET

GENERATION FOLLOWING CONTRACT

In a Generation Following contract design, the Seller sells the energy generated injected to the grid (at its CDP) and the Buyer buys at its CDP all or share of the energy injected by the Seller. The concept in this type of contract is that the market energy product follows the physical energy of the generation. The Seller's energy payment from the contract is based on what the seller has generated and the contract price.

This design is appropriate for non-controllable generation: renewable generation that cannot be dispatched (such as solar, wind, small hydro run of river) and selling only energy. In principle, it can have similarities with current EPA design in Pakistan.

If a Generation Following Contract includes obligations regarding available capacity in addition to the contracted energy, the design of the existing PPAs in Pakistan (pre-CTBCM) can be assimilated to this type of market contract design.

In summary, this type of contract can be very useful to accommodate existing EPAs/PPAs in the CTBCM to become multiple contracts between a generator and different buyers.

Contracted Energy in a Generation Following Contract: If the Generator has a single Generation Following Contract selling all its energy, the contract is between the Generator and one Buyer, and the Buyer purchases 100% of the energy injected by the Seller, and the Seller cannot sell in contracts its production to any other Buyer. This is partly similar to a PPA or EPA that establishes exclusivity, for example in a Single Buyer market.

The current practice in Pakistan is different to a Single Buyer, as each PPA or EPA has been signed by CPPA G (or NTDC CPPA) in representation of DISCOs and, therefore, contracted energy is bought and should be paid by each and all DISCOs based on energy actually delivered to that DISCO (a resulting of system dispatch and real time operation).

In the electricity market, the Generation Following Contract also allows a Generator to sell to several Buyers, each with a bilateral contract, by establishing in the contract that contracted energy is a share (a percentage) of the energy injected by the Generator on an hourly basis. With such a design, the Generator may have several contracts, each one defining the percentage of the energy generated/injected by the Generator allocated to Buyer, subject to that the total sold is not greater than 100% (the Generator cannot sell in this contract design more than energy generated).

The percentage / share can be defined in the contract provisions as a number, or as a formula to calculate the percentage. If the contract is long term (duration several years), eventually the contract can establish that the percentage or the formula for its calculation will be reviewed after a number of years (e.g. every 2-5 years) and modified through a methodology established in the contract or mutually agreed.

The role of the Market Operator in administering the Contract Market will include, among others, the verification that the total percentage sold by a Generator in this contract design is not greater than 100%. Any Generation Following new contract or modification will be rejected by the Market

Operator if the total energy sold in this type of contracts (based on the information in the Contract Register) adds a percentage greater than 100%.

For the Generator (the seller), a Generation Following Contracts ensures that it will not have a negative energy imbalance, and protects from having to buy in the Balancing Mechanism for Energy (BME). The seller never has a negative energy imbalances in this type of contract as the product sold is based on actual generation. If a Generator is selling only with Generation Following contracts and the total of the percentages sold in those contracts is less than 100%, the remaining non-contracted energy will be sold in the Balancing Mechanism for Energy. If instead the total is 100%, all energy would be sold in contracts and the Generator would not have any trading in the balancing mechanism for energy.

For a demand (the Buyer), a Generation Following Contract establishes the price but exposes to quantity imbalances and prices in the Balancing Mechanism for Energy. Each hour, the contracted energy is the percentage of the actual energy generated by the seller established in the contract, independent of the Buyer's consumption during the same period. However, under the centralized economic dispatch for generation, the energy generated by a Generator does not follow the profile of the consumption of each buyer or of the total power system (generation may increase when demand decreases, an/or decrease when demand increases), the Buyer will result with imbalances between the contracted energy (i.e. the percentage of the energy actually generated/injected by the seller) and the actual consumption of the Buyer measured at the corresponding (one or more) commercial delivery points (CDPs) with the commercial settlement metering system. Therefore, the BME applies to the Buyer that may have imbalances between contracted energy and actual consumption (buys or sells in the BME).

This contract design allocates the demand energy risk (quantity and demand profile) to the buyer. However, it must be said, that in principle the Buyer has good knowledge of its forecasted demand and may have mechanisms to control or manage demand.

The seller (generation) faces no demand risk. However, the contract assigns to the Generator the availability and dispatch risk. If the contract is designed and agreed to sell only energy, the revenues of the Generator will depend on its actual production. The Buyers will only buy and pay the Generator if energy is actually injected. Energy contract price tends to correspond to generation variable cost (for thermal in a two part contract) or the energized fixed costs for a renewable generation.

Note: In non-competitive electricity markets, some purchase agreements may include a provision on take-or-pay of energy. This provision is usually interpreted as priority dispatch to ensure energy generated (typically, on annual basis) is not less that this volume, and minimize the risk of payment for the shortfall between actual and take or pay energy. In general, energy take-or-pay provisions are discouraged as contrary to competition and least cost use of generation resources, and may not be allowed to be explicitly included in new contracts in competitive electricity markets. In the market, for the transition and administration of pre-existing purchase agreements, the take or pay can be considered in the economic dispatch with zero variable cost (it has to be paid even if not generated) and therefore would be included as energy generated in the Generation Following design.

Contracted Capacity in Generation Following Contracts

A Generator (or the Supplier that represents generation) can sign one or more Generation Following contract with a Buyer that represents or is a demand:

- Each contract will define the contracted capacity as a share of actual available generation capacity. The issues and constraints regarding percentages are similar as those described for

energy. The Generator (the seller) cannot sell more than 100% of its available generation capacity.

- As the Generator sells actual available capacity without a commitment, the security of supply risk would be partly transferred to the Buyer. However, eventually the contract could establish a commitment to an annual or monthly minimum availability, and paying the buyer a compensation should actual availability be less that the minimum established as commitment in the contract.
- If the contract is capacity only, the share could be freely agreed between the parties. However, if the contract includes energy and capacity, for consistency and simplicity of implementation the same percentage defined for energy would apply to the contracted capacity of the total available capacity of the Generator.

Note: For pre-existing PPAs with take-or-pay energy quantities in Pakistan, it could be said that the minimum annual guaranteed energy can or has been converted into a capacity payment (take or pay) with availability obligations for the Generator and penalties if this availability is not achieved (similar to Liquidated Damages if not met), while the energy still is "generation following" (a percentage of the actually generated energy). However, the cost of the take-or-pay provisions has not been incorporated into the capacity price.

LOAD FOLLOWING CONTRACTS

In a "Load Following" contract, the Buyer contracts with the Seller:

- A share (a percentage) of the Buyer's energy actually taken from the grid (as measured based on the settlement metering systems at the corresponding CDPs of the Buyer). The Seller is paid based on actual measured energy of the Buyer, independent on actual energy generated by the Seller
- A capacity obligation. The Seller is paid based on actual capacity obligation. The Seller is paid based on actual capacity obligation independent on actual capacity availability of the Seller

This type of contracts could be appropriate for Bulk Power Consumers that want to be fully covered by contract pricing and avoid the cost or risk of imbalances. There does not seem to be any similar design currently in Pakistan.

Energy in Load Following Contracts

The energy contracted is defined as a share (percentage) of the energy taken from the grid by the Seller at its CDPs (totaling energy metered at all its CDPs, if more than one CDP). As described before, the contracted energy must be defined for each energy balancing period (e.g. an hourly basis). The share is established in the contract as a fixed number, or a formula to calculate the percentage. The Buyer is a DISCO or K Electric, or a Bulk Power Consumer (BPC) or a Supplier reselling to demand.

As all generation is subject to centralized economic dispatch or must run for non-controllable renewable generation, the generation of the Seller will not follow the demand shape of the Buyer(s) and there will be differences / imbalances between what the seller is generating and what the Buyer is taking from the grid.

If the Buyer agrees a Load Following contract with a single generator, the share could be 100%. If the share is less than 100%, the remaining non-contracted energy taken from the grid will be bought in the BME.

If the Buyer buys from more than one generator, each with a Load Following contract, the percentage in each contract defines how the load profiles of the Buyer is distributed among the contracts. If the aggregated percentage of contracted energy is less than 100%, the remaining non-contracted demand will be bought in the BME.

Capacity in Load Following Contract

The contract may include a capacity payment that can be designed replicating the demand capacity coverage required as capacity obligations of the Buyer. The share can be defined with the same percentage as for energy or a different one, but subject that the energy schedule will be capped by the contracted capacity. For example, if the energy contracted is 50% of energy but only 40% of peak demand requirement, the energy contract schedule will be reduced to the resulting contracted capacity if the energy percentage allocation results greater.

Other considerations on capacity balancing and settlement are similar as to the Generation Following contracts. The capacity imbalance for the Generator (the Seller) will be calculated as available capacity minus total capacity sold in contracts.

CAPACITY AND ASSOCIATED ENERGY CONTRACTS

This contract has also a "load following" design but the energy is linked to covering the capacity requirements (capacity obligation) of the Buyer. Therefore, it is appropriate for any demand Participant, in particular a DISCO that wants to fully cover its capacity obligation via a contract with a Generator (or Supplier) that also commits to energy sale and energy pricing. In this design, the Buyer (as a demand) benefits from complying partly or fully with its capacity obligation and at the same time stabilizing energy purchase price.

The main component of the contract is the capacity obligation assumed by the Generator. The Generator commits to a capacity availability (that may be profiled during the months or weeks of the year, for the generator to consider and manage maintenance outages plans or other outages). The Buyer buys and pays for capacity in the contract only the available capacity of the Seller up to the contracted quantity. The Generator must pay a compensation to the Buyer in case of failing to provide the committed available capacity during a period where there are shortages and load shedding that affects the Buyer (or the consumers to whom the Buyer resells energy). The purpose is to promote adequate maintenance and availability of generation to avoid maintenance outages in periods with lower reserves and optimize generation maintenance outages when expected reserves are high.

The contracted energy is shaped with the demand profile of the Buyer. As in the previous design, the actual energy generated (the physical generation) is disconnected from the contracted quantity, and the contract becomes a risk management of security of supply and financial instrument to set energy and capacity prices in advance.

FINANCIAL CONTRACT WITH FIXED QUANTITIES

This contract is designed to share risks between the two parties in the contract.

Energy: The contract commits to an energy schedule in advance (energy quantities defined for each balancing period, for example one hour).

- Each balancing period, the generator sells to the Buyer the energy quantity defined by the contract for this period, at the energy contract price. This is independent on whether the Seller (the generator or Supplier aggregating different generation) generates/injects more or less than the contracted energy quantity (or does not generate) during that period. If the generator is

generating more than the contracted energy, the difference is sold in the BME at the price during this period. If it produces less, then the generator has to buy the difference in the BME.

- Each balancing period, the Buyer buys the contracted energy for this period at the contract energy price. This is independent on whether the energy taken by the Buyer at its CDP(s) is greater or less than the contracted energy. If the Buyer takes from the grid (totaling settlement metering systems in its one or more CDPs) more than the contracted amount, the difference is bought in the BME at the price for that period. If instead it is less, the Buyer sells the surplus in the BME.

This contract design totally disconnects contracted quantities from physical quantities generated and demanded. Therefore, contractual agreements can be made to set prices and manage risks, while maintaining an economic dispatch that ensures efficient use of energy resources (generators are dispatched according to their efficiency, i.e. position in the merit order list, regardless the contracts the generators have committed with the buyers).

Note: In practice, it is expected that a Buyer may have more than one contract and the energy imbalance is calculated as the difference between total contracted energy and actual metered energy taken from the grid.

Capacity: The contract can also include the buying and selling of capacity. The general considerations on capacity product in the market applies. The contracted capacity can be defined as a number or a formula. In principle, there is no relationship between the contracted capacity and the energy volumes contracted.

For the Buyer the contracted capacity serves to cover capacity obligations of demand participants, while for the Seller commits available generation capacity. Therefore, the contract must identify the power plants included to deliver the capacity commitment.

Results for a Generator (the Seller)

Energy: The generator benefits of the contract in ensuring a cash flow (contracted energy at contracted energy price) independent on whether or not it generates. However, the contracted quantities become a "demand" for the generator that must be bought in the BME if not covered by its own generation. If, instead, actual generation is greater than contracted energy the surplus is sold in the BME, and the generator's revenue will be the contract payments plus the sale of non-contracted energy in the BME. The main risk for the generator is not being available to cover the energy contract quantity at the time when reserves in the market are low and therefore BME prices are high.

In summary:

- Generator energy revenues: contracted energy at contract price plus sales in Balancing Mechanism if actual generation is greater than contracted energy.
- Generator energy results: (energy revenues, as defined in the previous bullet), minus variable generation costs for energy actually generated, minus purchases in the BME if energy generated is less that its contracted demand).
- Similar to the previous design, this type of contact promotes efficient availability and variable costs of generation, as such efficiency maximizes its results and profitability.

If the generator is available, it will be dispatched unless it is not economical (according to the economic dispatch), in which case there is generation available in the BME cheaper than its own variable costs and therefore purchasing the shortfall to cover the contracted energy will be at a lower cost than its own variable generation cost. On the other hand, generating more than contracted would be a result of the dispatch and therefore the balancing energy price will be the same or greater than the generator's variable costs, resulting the selling in the BM in an extra profit for the generator

(although this extra profit maybe marginal, always acts as an incentive to be available and dispatched when the prices in the BME are increasing, what means that all cheaper available generators are already dispatched).

If the contract includes also the selling of capacity, the Generation (Seller) will receive also a capacity payment subject to availability. The design of the capacity quantity, conditions and settlement principle would be similar as for other contract designs described previously.

Results for a Demand (the Buyer)

The Buyer benefits from covering its capacity obligations and from having predictable and smooth energy purchase costs. The capacity obligation of the Buyer is partially or totally contractually transferred to the seller (the generator) as an availability or committed generation capacity obligation.

For an hour (an energy balancing period), if the actual energy extracted from the grid by the Buyer (measures with the settlement metering system at its CDPs) is greater than contracted quantity, the Buyer will buy the shortfall (the uncontracted energy) in the BME. Therefore, the Buyer pays if not fully contracted:

- Contracted energy at contract energy prices; plus
- Non-contracted energy at price in the BME.

If instead the metered energy is less than the contracted quantity, the Buyer sells the surplus in the BME at the BME price for this period (the Buyer is over contracted in energy for that period). In that case the Buyer pays all the contracted energy at contract energy contract prices, but is compensated by selling the surplus contracted energy in the BME at its price.

In summary, the energy purchase cost of a demand Participant results as follows:

- Energy purchase cost in contracts; plus
- Revenues from sales of surplus energy (when energy contracted is greater than the actual energy extracted from the grid by the Buyer) in the BME; minus
- Purchases in the BME when contracted energy is less than actual energy extracted from the grid metered at CDPs.

A similar result applies for the contracted capacity. The shortfall or surplus compared to the capacity obligations will be cleared through the BMC, at its price for the month (the capacity balancing period).

CAPACITY ONLY CONTRACTS

This design is an option to allow a Demand Participant that has contracted energy-only generation (for example with renewable energy) to purchase separately the capacity required to comply with its capacity obligations.

Similar to the description of previous types of contracts, the contract can be designed as a share (a percentage) of the capacity available of a Generator or a percentage of the capacity required by the Demand Participant to cover its capacity obligations. The contract can follow the design of availability commitment including payment by the Seller of a compensation when the generator does not meet the committed availability, in particular if actual availability is less than contracted during shortage periods when load shedding is called.

Alternatively, this type of contract could be agreed between two generators to cover possible shortfall in capacity committed in contracts (similar to secondary trading). For example, if a Generator that has committed 100 MW available capacity and needs to carry out an unplanned maintenance, the Generator could contract the capacity from another generator that has a surplus uncontracted

capacity to avoid the imbalance in the BMC and the compensation payment for unavailability, of applicable depending on contract conditions.

If a Generator 1 contracts capacity from another Generator 2, for the purpose of capacity balancing and contractual obligations, it is considered as if the contracted capacity of Generator 2 "belongs" to Generator 1.

The capacity balance calculation for each Generator would be: actual availability of the Generator, plus capacity bough in contracts from another Generator, minus total capacity sold in contracts (including capacity contracts selling to another generator).

CONTRACT PORTFOLIO AND CONCLUSIONS

In practice, competitive electricity markets are characterized by buyers and sellers managing risks through a portfolio of tools, mainly portfolios of different contracts plus, in more advanced and sophisticated markets, financial instruments, future markets, etc.

The balancing mechanisms are the market instrument that allow diversification of buyers and sellers, contract design and portfolio in a power sector that protects efficient use of resources through a centralized economic dispatch.

It is reasonable to envisage that initially the market in Pakistan will start with generators or demand participants adopting one or two types of contract design. However, as experience develops and there is a better understanding of risks and benefits of each contract design, the participants will move to a portfolio of a mix of different types of contracts tailored to their needs or specific characteristics.

The examples shown previously for each contract design corresponds to results, imbalances and revenues if the parties use only one contract design. However, a similar assessment can be done for a portfolio of different types of contracts (any possible combination, e.g. a Generation Following Contract and one of more Financial Contracts with Fixed Quantities).

The allocation of imbalance risk varies depending on contract design. For example, for energy:

- If a DISCO or Bulk Power Consumer procures with Load Following Contracts covering all (100 %) of its energy, the demand will have no energy imbalance.
- If all contracts are designed as generation following, the only energy imbalances that will exist are for the demand, as percentage / share established in the contract(s) is different to total actual energy required. The transactions in the balancing mechanism for energy would be among demand participants only.

BALANCING MECHANISMS FOR ENERGY AND CAPACITY

CAPACITY OBLIGATIONS AND CAPACITY BALANCING MECHANISM

In addition to energy, the electricity market will include the trading of **firm (reliable) capacity**, designed under the following principles:

- Long term reliability of supply should be achieved at efficient price;
- A market based mechanism: quantity sold and prices are the result of competition;
- The mechanism should provide incentives for timely new generation investments, and as necessary adequate generation mix, and adequate reserves (generation technical and fuel availability) to ensure supply during peak demand and unexpected extraordinary circumstances;

- Ensure adequate firm capacity for critical situations (e.g. dry periods/low hydrology, high demand during summer);
- Provide stability and predictability to attract sufficient interested investors and competition.

Each and all Demand Participants (e.g. Participants that are retailer suppliers or selling wholesale to DISCOs) have the obligation to contribute with a share of the required firm capacity to ensure reliable supply (with adequate operational reserves as defined in the Grid Code). The capacity obligation would be determined as the Demand Participant share (or its participation) in the generation required to supply the system peak plus operational reserves. A Demand Participant can cover its capacity obligation through firm capacity it owns or contracts, and the balancing capacity market administered by the Market Operator.

Generators can sell firm capacity through contracts and the un-contracted available capacity in the balancing capacity mechanism.

- Firm capacity for thermal generation will be calculated based on historical availability; and for new power plants without a history of actual availability, based on typical availability for similar technologies and dependable capacity through tests monitored by the System Operator.
- For hydro, firm capacity will be determined simulating dispatch under dry conditions, and assessing maximum capacity it can deliver constantly during the peak period, or as the average capacity during the peak period. The determination of firm energy or firm capacity of a hydro power plants is usually carried out with simulation and optimization models, which are also for medium term planning The detailed design of the Capacity Balancing Mechanism will cover the following:
- The definition of firm capacity (maximum a Participant can sell in contracts and offer in the market), and capacity obligation (the demand obligation to buy or provide);
- Daily or weekly determination of capacity imbalances;
- Offers and administration of the market, price and settlement;
- Monitoring compliance by generators and penalties to the generator or compensation payments by the generator if the committed capacity is not available.

ENERGY BALANCING MECHANISM

When parties contract bilaterally using a network shared with others, the market needs an energy balancing mechanism. The development of the electricity market in Pakistan has been advancing at retail level, with some BPCs already contracting directly with generation connected to the distribution network. Practical implementation may face challenges, as the energy generated will not be able to follow exactly the consumption of the BPCs that are parties in the contract, nor the BPCs will be able to adjust consumption to follow the generation pattern of the seller in the PPA. Moreover, network constraints may limit energy generated or supply. In summary imbalances will exist and correct pricing of those imbalances is critical to be fair to the generator and the BPC and to avoid creating distortions or additional costs to the distribution licensee that are transferred to captive customers (consumers that do not qualify as BPCs).

Proposed competitive wholesale electricity market the Market Operator will administer mechanisms for short term trading that complement and clear differences arising from contractual agreements. The competitive electricity market will have platforms, systems and mechanisms that enable contracting between multiple buyers and multiple sellers and trading of imbalances. The centrally administered balancing markets are designed to achieve the following objectives:

- Enhances competition and transparency, by creating reference competitive energy prices that can be used in the negotiation and design of bilateral contracts;
- Facilitate contracting and allow different contract designs, by clearing difference between actual/ forecasted demand (or exports) or available generation (or imports), and energy committed in medium to long term contracts (including import and export contracts);
- Provides price signals on lack of adequate reserves or surplus generation.

An efficient, transparent and competitive energy balancing mechanism will clear the differences between contractual agreements (quantities) and actual energy injected or extracted to the grid/market. As the Participants agree bilaterally contracts, these commercial arrangements cannot impose conditions that affect the reliability and quality of the system or that affect the competition to generate or the economic dispatch of the system. The energy balancing mechanism allows a free contract market environment where Participants agree long and medium term buying/selling agreements, harmonized with the realities of maintaining a balanced and reliable system (that imposes system security constraints) and the centralized economic dispatch to optimize use of available generation resources and promote efficiency among generators competing for dispatch. The energy balancing mechanism will ensure that (i) All energy injected to the grid is paid either through PPAs/EPAs/bilateral contracts, or through the balancing mechanism; and (ii) All energy taken from the grid is paid either through PPAs/EPAs/bilateral contracts or through the Balancing mechanism.

CHAPTER-6: INSTITUTIONAL FRAMEWORK IN COMPETITIVE REGIME

ROLES OF THE IMPORTANT MARKET FUNCTIONS

An electricity market is an arrangement to transfer electrical energy from producers to consumers. The whole supply chain of electricity involves many players with distinct functions. This section describes the roles of the important functions of an electricity market.

MARKET OPERATOR

The Market Operator implements panels, committees and working groups with Participants to support its functions and provide transparency. Additionally, the Market Operator carries out capacity building to level the knowledge basis, facilitate integration to the market and attract new participants and the interest and credibility by investors. In Pakistan, CPPA is the entity in the role of Market Operator.

The main functions and responsibilities of the Market Operator mainly comprise the following:

- Admission of Participants, including signing the Market Participation Agreement, and suspension and cancellation of Participants;
- As part of the admission process, registration of the Participant, including registration of settlement metering systems (to identify metered energy to be used to calculate imbalances) taking into consideration location of meters and the type of participant;
- Sign a balancing agreement with each Participant including rights, responsibilities and obligations, including obligation of the Participant to provide credit cover. Purchase and sale of imbalances will be among the Participants, and therefore not involve payment or liabilities for the Market Operator;
- Calculation of (hourly) energy imbalance prices, and determination of firm capacity daily imbalance prices;
- Calculation of energy and capacity imbalance quantities for each Participant;
- Balancing Mechanism Settlement on a weekly and monthly basis, and issuing payment instructions on behalf of Participants [and administration of market payment system].
- Calculation of monthly use of system charges and market fee;
- Administration of credit cover/collaterals for transactions in the Balancing Mechanism, transmission charges and market fee: determination of amount required, and call/use of the credit cover in case of payment not completed by market payment deadline.
- Administration of the procedure to receive complaints or observations to settlement documents, and resolve the complaint;
- Administration of a dispute resolution mechanism for settlement complaints that have not been mutually agreed and resolved.
- Implement, update and maintain a Contract Register. Participants are obliged to register with the Market Operator information of all contracts, necessary to calculate and settle imbalances.

Therefore, information in the contract register will include parties, duration, connection points of sale and purchase, energy quantities and contracted capacity (payment for available capacity).

- Responsible for Information disclosure of market results, in particular made public through its website

The Market Operator has a governance system to ensure transparency and accountability. The Board of the Market Operator includes members nominated by the categories of Participants and Service Providers to act in representation of that type of Participant but independent of any company participating in the market. The Board also includes independent members representing consumers.

SYSTEM OPERATOR

The System Operator provides non-discriminatory and transparent system operation, planning and dispatch services to all Participants (and transmission users). Therefore, the System Operator is an independent body from any Participant, and does not trade electricity (buy to resell).

The System Operator (SO) is responsible for a reliable operational planning and coordination of maintenance outages, economic generation scheduling and dispatch, and keeping the system in balance within security and reliability constraints. The economic dispatch is carried out in accordance to the Grid Code. The SO manages open access to the transmission grid and therefore is independent of commercial interests of existing and potentially new Participants that trade in the market. The role of SO remain the same regardless of the type of market.

NPCC of NTDC is the System Operator in the power sector of Pakistan. NTDC license requires functional separation of the Transmission Network Operator (TNO) business from the System Operator. The implementation of this License requirement is important for the transparency and credibility of the market.

SYSTEM PLANNER

The Planner ensures adequate economic transmission development plan. In Pakistan, the Planning function is assigned in NTDC license to the transmission business and is governed by the Grid Code. NTDC as the TNO is responsible for the execution of the Transmission Expansion Plan, which will be mandatory in contents and timing, except for transmission investment tendered and for special purpose transmission licensees.

In the competitive market regime, it is expected that the Planner will develop a 10 year least cost transmission expansion plan together with an indicative least cost generation expansion plan including power plants under construction and with signed PPAs, and information provided by Discos, K Electric and BPCs and international interconnections. The planning procedures and standards will be in accordance to the Grid Code, guaranteeing predictability and transparency. The transmission plan for first three-to-five years will be considered mandatory and for the last five years indicative. The Planner will produce annual updates of both expansion plans informing congestion and impact on dispatch costs and supply, any delays in investment, impact on system security constraints and measure to address delays and constraints/congestion, and inform locations best suited for new generation, and all reports and related documents required in the Grid Code.

METERING SERVICES PROVIDERS

The metering services are provided by the network companies. NTDC as transmission licensee for revenue meters at the Commercial Delivery Points (CDP) of Participants with the transmission grid

and the Discos (eventually also K Electric) for revenue meter at Commercial Delivery Points of Participants with its distribution network.

In accordance to the Grid Code, NTDC responsibilities as metering services provider are to provide the revenue meters at each CDP, read/collect commercial metering data as well as validating, testing and calibration. This information is provided to the System Operator, to the Planner and to the Market Operator. The MO will make this information available for Participants that require it for its contracts, in particular to the Special Purpose Supplier the availability and dispatch data of power plants.

TRANSMISSION SERVICES PROVIDERS

A Transmission Service Provider is responsible for providing the transmission infrastructure that enables wholesale trade. In the competitive market of Pakistan, NTDC will be a Transmission Services Provider or Transmission Network Operator (TNOs). NTDC is the main TNO and must ensure that special purpose transmission licensees adequately design, build and maintain their transmission facilities.

NTDC will ensure adequate economic transmission. For that purpose, NTDC will be responsible for the implementation of the system expansion plan approved by NEPRA, which will be mandatory. It will be also in charge of the operation and maintenance of its assets in accordance to the Gid Code and the Performance Standard Rules.

MARKET PARTICIPANTS

Market Participants or Participants are the licensees and Bulk Power Consumers that have registered with the Market Operator as Participant. The types of Participants in the electricity market are as following:

GENERATORS

Generators play the role of a Participant in a competitive electricity market. All generation licensed in accordance with NEPRA Act will be Participants, subject to registering with the Market Operator and complying with admission requirements.

Strategic large power plants such as large Hydro with multiple purposes that are prioritized above electricity generation, will be commercialized in the CTBCM similar to other power plants. In these cases, the generation company will have bilateral contracts with Demand Participants (initially Discos and possibly KE) as bilateral contracts.

RETAIL SUPPLIERS

Retail Suppliers (or Suppliers) are the companies that sell electricity to the end consumers. In the scenario of power sector of the country, Retail Suppliers include Discos and K Electric, but also may be independent retailers in the future to evolve into other competitive areas such as demand aggregation or retail competition. However, it must be said that the implementation of such type of retailers may take some time until the business of competitive independent retailers develops.

A Retail Supplier can enter into sales contract with several Bulk Power Consumers (BPCs), and procure power to resell to each of them. In this way, with a larger volume and mix in consumer portfolio, the Retail Supplier may obtain better contract prices and conditions and commercial conditions, enabling the development of competition to sell to BPCs.

Distribution licensees in special areas, such as new real estate or industrial development, can become market participants as Retail Suppliers or purchase from another Retailer to supply its own end customers in that area and do not participate directly in the market. Eventually, for Discos the distribution network services business could be separated from the retail supplier business (e.g. unbundled as a subsidiary).

WHOLESALE TRADERS

Wholesale Traders (or Wholesaler) are the companies that sell to other Participants and also can export or import. A Wholesaler can enter into an agreement with one or several generators and sell the aggregated generation in the market through bilateral contracts. Depending on the design of the agreement, the generators contracted by the Wholesaler may be also Participants or not, but the Wholesaler will have to be a Participant.

In cases of imports and exports, the foreign seller or buyer, cannot be a Participant, provided that it is not a company registered according to the Pakistani law. Therefore, export/import trading has to be done through a Wholesaler that is a company registered in Pakistan and a Participant that has a contract with a foreign company to buy or sell at the interconnection with the foreign power system.

Imports: The Wholesaler has an import contract with the foreign company (subject to required permits) and sells the imported power to the market through bilateral contract with Discos, Retailers or other Wholesalers.

Exports: The Wholesaler purchases through bilateral contracts in the market in Pakistan the power to be exported and resells it to the foreign company through an export contract (subject to required permits)

A similar arrangement can be used for cases in which the generation is produced by a company that has a special regime that cannot be assimilated to the market and become a participant (e.g. Neelum Jehlum in AJK). The commercialization of its production, will be done through a Wholesaler registered as a Participant in the market.

SPECIAL PURPOSE (WHOLESALE) SUPPLIER (SPS)

The SPS (government owned company licensed as Wholesale Supplier) will register with the Market Operator to be a Participant, subject to meeting all conditions to be a Participant. The SPS will have the following functions:

1. During the transition be the purchaser of PPAs/EPAs that have not been assigned yet or cannot be assigned to the Discos. The SPS, as part of this responsibility, will verify invoices sent by Generators for those PPAs/EPAs and pay.
2. The SPS will have back-to-back power supply (market) bilateral contracts with all the Discos to resell the energy and capacity bought. A share of the energy bought by the SPS from each PPAs from which it is the purchaser, will be assigned to each Disco, which will later become the quantity in the bilateral contract between the generator and the Disco.
3. Assist the Discos in carrying out the verification on the invoices to each Disco by the generators for the bilateral contracts. The Disco will decide when to terminate this verification services.

The SPS will not be allowed to sign any new contracts for any Disco.

BULK POWER CONSUMERS (BPCS)

Bulk Power Consumers (BPCs) as those who are free to contract on their own, as per the NEPRA Act. Therefore, a Bulk Power Consumer that signs a bilateral contract with a Generator or Retail Suppliers will be a Participant and will be subject to all requirements for Demand Participants, such as capacity obligations, provide credit cover, etc.

DISTRIBUTION COMPANIES

Subject to admission and registration with the Market Operator, Discos and K Electric licensees will be Participant in the CTBCM as Supply Retailers buying energy and capacity in the market and participating in the balancing mechanism, to resell them to its end customers. Each and all Discos will be registered as Participants with the Market Operator as Retail Supplier. Simultaneously the Disco will be a Distribution Service Provider, however the Disco as a service provider the Disco will not be Participant in the wholesale market, only the Disco as a Retail Supplier will be a Participant.

K-ELECTRIC

K-Electric (KE) as an integrated power utility will participate in the market as a Retailer, when buying from the market, or as a Wholesaler, in the event of selling to it. Therefore KE will have to register as a Participant with the Market Operator as a Supplier (Retailer and Wholesaler) and comply with all the obligations required for the registration and participation in the market.

As CPPA G function evolves to become a Market Operator, the purchase of power by KE from the CPPA G will not be possible any longer provided that selling and buying in the CTBCM will be only between generators and discos or retailers. At the market start the present agreement between KE for 650 MW (decreasing up to 500 MW) and 5 years duration, will have either to cease or to be replaced by one or more Power Supply Contracts with Generators or Wholesalers with available capacity. For the sake of clarity, all Gencos and IPPs having PPAs with WPPO, NTDC and CPPA G will not be eligible for the supply to KE.

CHAPTER-7: ROADMAP FOR IMPLEMENTATION OF CTBCM

DEVELOPMENT OF THE PROPOSED ELECTRICITY MARKET

The development of the proposed electricity market will involve (i) a preparatory stage; (ii) an initial test/pilot stage; (iii) a transitional stage as necessary (during this stage. some of the mechanisms or requirements of the market design would still not be in force); and finally (iv) the commercial start of the full design of the electricity market.

The proposed roadmap has been designed to avoid that any action lagging behind does not delay the start of the commercial operation of the market despite all other actions having been completed successfully.

The actions and commercial arrangements required to transform the sector up to the start of the CTCBM will involve different stakeholders. For the sake of clarity, consistency and coordination, actions have been grouped assigning to different stakeholders the lead in the implementation. A tentative timetable has been included as well.

The roadmap has been designed to avoid that any action lagging behind does not delay the start of the commercial operation of the market despite all other actions having been completed successfully. As the timing of the approval of the amendments to NEPRA Act to incorporate a section on market development will depend on decisions in the National Assembly, which are not controllable, the roadmap starts the preparatory actions with CPPA G submitting for NEPRA approval the conceptual market design and then MOE consultation of the market development policy based on the approved design. The last group of actions is intended to test and correct previous actions, if and as necessary.

MARKET IMPLEMENTATION AND MONITORING GROUP (MIMG)

Close monitoring and coordination of the roadmap implementation will be needed, with reporting by each responsible party through monthly progress report describing actions completed, actions underway, any barrier or situation identified that is causing or may cause delays, and measures taken or under development to address barriers and delays.

A Market Implementation and Monitoring Group (MIMG) has been formed, with representatives of all involved stakeholders and lead by [MOE] and with an executive committee formed by CPPA G and NEPRA - Market Development. This group will be the responsible for monitoring the implementation of roadmap based on progress reports by responsible stakeholders and its members. It will also have the role of proposing correction measures to address causes of delays and difficulties identified in implementing the roadmap.

The procedures and process for the operation of the proposed Market Monitoring Implementation Group will be defined as part of the market detailed design.

GROUPS OF ACTIONS: DETAIL DESCRIPTION

LEGAL AND REGULATORY FRAMEWORK

The current legal and regulatory framework will require adjustments to make the framework fully consistent with the CTBCM design.

- GoP market development policy for the creation of the CTBCM and start of its commercial operation.
- Market Operator Rules to adapt the functions of the Market Operator and reflect the types of Participants and Services Providers
- Market Commercial Code
- Grid Code

Additionally, other GoP policies for the power sector would need to be reviewed to reflect the market structure and institutional arrangements. Similarly, NEPRA regulatory framework on power procurement and generation pricing may need to be reviewed and adapted.

Considering that the timing of the approval of the CTBCM by the NEPRA, which are not controllable, the roadmap starts the preparatory actions as from the government approval of the market development policy with the market conceptual design and rationale. The strategy is for the conceptual market design (the target market defined for the CTBCM) will include a comprehensive consultation process, capacity building and high-level approval to provide sufficient predictability and consensus for all responsible parties to be mandated to start the corresponding actions in the roadmap.

MARKET CONCEPTUAL DESIGN AND MARKET DEVELOPMENT POLICY

The development and implementation of power market reform requires a policy decision on the general market conceptual design. The government presents in the policy document the goals and the issues to be addressed through power market reform and the proposed concepts, mechanisms, participants and electricity trading arrangements for the electricity competitive wholesale electricity market.

The market development policy would holistically cover the following:

- Rationale and issues identified to be addressed;
- Objectives to be achieved through the market and address issues identified;
- General principles to achieve objectives
- Market products to be traded: purpose and scope;
- Contract Market for medium and long term trading and short term market mechanisms
- Management of pre-existing PPAs/EPAs and of stranded costs, when and if applicable;
- Market Structure: Types of market participants and opening the market for consumers to decide how and from whom to buy electricity (participation by Bulk Power Consumers).
- Mechanisms for least cost security of supply and reliable network services: centralized system planning, capacity obligations and auctions for new contracts of distribution companies;
- Regional exchanges (imports and exports)
- Indicative timetable, transitional and preparatory arrangements.

Based on the approved market conceptual design, MOE will prepare the market development policy with CPPA G support. As may be required by standard processes in the Government, MOE will carry out consultation of the draft policy with relevant stakeholders and provincial authorities. One or more explanatory workshops will be organized prior to and/or at the start of the consultation process.

The relevant comments and feedback received will be consolidated by MOE with the support of CPPA G in groups by issue and assessed to take into consideration, if applicable, in reviewing the market development policy to address comment received, but ensuring full consistency with the market conceptual design approved by NEPRA. The relevant comments received and the response will be published and made publicly available in CPPA G's website.

MOE will finalize and approve the market development market development, which will be made public in both MOE and in CPPA G websites.

REVIEW OF LEGAL AND POLICY FRAMEWORK

MOE reviews existing energy policies and prepares draft amendments / revisions or new policies, as required to harmonize with approved market development policy and CTBCM approved design.

The start of the competitive wholesale electricity market will introduce (i) competition for generation: competition to enter the market, competition for supply and contracts (with distribution licensees and with Bulk Power Consumers), and (ii) competition for dispatch. Market based power supply contracts will be directly with consumers or those that supply (sell electricity) to consumers. This represents a significant difference to the practice in Pakistan during the last years of negotiating new generation investment and PPAs/EPAs with the government, and signed by NTDC or CPPA G on behalf of DISCOs.

Existing Generation Policies will need to be reviewed accordingly, or replaced by new generation policies adapted to the market development policy. The market conceptual design will include a product (capacity) and mechanisms (capacity obligations for demand, generation availability commitment, and auctions or tenders for contracts that enable financing of new generation) to protect generation adequacy for security of supply within least cost concept. Therefore, the least cost expansion plan (responsibility of NTDC) with a (i) mandatory transmission expansion plan and (ii) an indicative generation expansion plan is a critical component of the market design.

Currently, there are policies on power generation, transmission and others referring to expansion and investment plans, which guided the sector under the current arrangements. These will need to be reviewed as described above and new ones may be added. In particular, the MOE may introduce a policy on generation mix and target quota of renewable generation, to guide the development of the least cost system expansion plan.

NEPRA: REVIEW AND ADAPT REGULATORY FRAMEWORK

The approved market conceptual design and market development policy will require modifications (review and additions) to NEPRA sector regulatory framework including as applicable NEPRA rules, regulations, guidelines and procedures.

A comprehensive regulatory framework has been developed and implemented by NEPRA and licensees based on current NEPRA Act, energy policies and licensing arrangements. The existing regulatory framework envisages the development of competitive market arrangements, with considerations on possible second tier supply and Bulk Power Consumers, bilateral contracts and

balancing mechanism, and pooling arrangements. However, the regulatory framework will require modifications to ensure full consistency for the implementation of the approved market.

Some indicative examples are listed below:

- The lack of a competitive market is the reason that, to protect consumers' interests and try to balance the interest of investors, generation prices are being regulated by NEPRA through upfront tariffs or other cost plus approaches. As new contracts of DISCOs will be the result of a competitive procurement process (tender or auction), generation tariffs will become the result of competition. NEPRA has already the regulations on competitive bid tariff to replace regulated upfront tariffs. Existing regulatory framework will need to be reviewed / completed or new regulations issued to regulate or set guidelines for the competitive procurement process for new contracts of DISCOs, and to establish the standards and requirements for new power procurement costs be passed through to regulated retail electricity tariffs.
- The balancing mechanism costs resulting from competition for dispatch (least cost security constrained) and availability of generation will also be part of DISCOs power procurement costs, and the regulatory framework will need to reflect this in regulated electricity tariffs.
- Currently, all generators must sell at the generation regulated tariff determined by NEPRA and a Bulk Power Consumer in principle cannot agree its own prices. The regulatory framework should not create barriers to the freedom of Bulk Power Consumers to negotiate contract conditions and prices with generators or suppliers.
- Under current CPPA/ CPPA G model where most generation has been procured through purchase agreements that have not been signed by the DISCOs, the practice has been to transfer to regulated electricity tariffs of all DISCOs the same generation (power procurement) cost based on an average monthly cost of licensed generation dispatched by NPCC and PPAs/EPAs signed by NTDC or CPPA G on behalf of DISCOs or by WAPDA. On the other hand, there is another reference generation cost transferred to electricity consumers as K Electric has a different generation/ power procurement cost, based on its own generation, IPPs with PPAs signed directly with K E, and purchases through interconnection with NTDC grid at CPPA / CPPA G transfer price.
- The conceptual design of the competitive market model is based on bilateral contracts and balancing mechanism, which implies DISCOs may have different power purchase costs. However, the conceptual design envisages during the initial stages of the new market, DISCOs will have similar transfer prices provided that they will share the same existing contracts with similar allocation as today, and for new generation prices will arise from the proposed centralized competitive procurement of new contracts. The regulatory framework for generation component of regulated tariffs of a distribution licensee and the monthly fuel cost adjustment, will need to be reviewed.
- Review and amend as necessary Market Operator Rules to harmonize with the conceptual market design and the functions assigned to the Market Operator.

While the work to regulate generation prices/tariffs will decrease and phase out with the development of competitive electricity markets, NEPRA's monitoring role will need to be strengthened to ensure that effective competition is in place. In particular, NEPRA should develop regulations / guidelines for the monitoring of competitive process for new contracts of DISCOs, the monitoring of dispatch and balancing mechanism, and the monitoring of the retail/suppliers and wholesale market.

Additionally, this group of actions will cover strengthening NEPRA market development and monitoring role. NEPRA would implement power market department including the market monitoring function, in particular for competitive auctions and retail supply market.

ASSIGN PRE-EXISTING CONTRACTS

The regulatory framework establishes the principles of least cost / best price contracting by distribution licensees, allowing for different design of contracts. NEPRA licensing rules for distribution licensees require to procure power at *"best effective prices"*, and include provisions on "power acquisition contracts" that allow hedging arrangements and on compliance with international competitive bidding practices for purchase of power.

The conceptual market design is based on a Contract Market with bilateral contracts as the main electricity trading.

This group of actions corresponds to the assignment of pre-existing PPAs/EPAs among DISCOs, consistently with the wholesale market design and that those agreements were signed on behalf of DISCOs, meaning therefore that DISCOs are the "owners" of the contracted energy and capacity. Until a pre-existing PPA or EPA is assigned among DISCOs, the Purchaser will be as a transition the Special Purpose Supplier (SPS).

The implementation of these actions will primarily be by legal teams lead by the CPPA G in coordination with the MOE and the involvement of NTDC, IPPs, Gencos, and DISCOs.

An initial legal assessment indicates that for 2002 and onwards policies PPAs which have assignment clauses, unilateral assignments are possible if certain conditions are met, in particular the following main three conditions:

1. that the GOP without interruption guarantees the performance of the succeeding entity or entities on the same terms and conditions as the Guarantee (this refers to the government guarantee in the Implementation Agreement between the government and the investor);
2. all or any part of the Power Purchaser's rights and obligations under this Agreement are assigned pursuant to law
3. that the assignees are one or more entities, each of which has the appropriate legal capacity to carry out and perform such rights and obligations assigned to or assumed by it.

One immediate consequence of this, is that the guarantees established in the Implementation Agreements of each to be assigned PPA cannot be changed and will have to remain as it is, unless during the assignment individual negotiation processes the IPPs individually agree to modify the guarantees in their PPAs and adopt the new credit covers that will be offered to new generation to be bilaterally contracted in the market.

Another consequence is that in the CTBCM there will be PPAs/EPAs that are still in the process of being assigned and the SPS will be created and responsible to administer in DISCOs behalf those pre-existing PPAs and EPAs during the assignment transition.

A detailed implementation strategy will be developed to standardize the assignment approach and facilitate the assignment process. The implementation roadmap for the assignment of existing PPAs/EPAs would cover the following:

- Strategy and standard approach for the assignment.
- Establish proportional factor for assignment among DISCOs. This factor will be based on the current distribution among DISCOs, in consultation with the DISCOs and as necessary depending on applicable regulations final approval of NEPRA
- Timelines for the assignment including detailed schedule.
- Assignment of PPAs and EPAs signed by CPPA G to DISCOs, to become effective as bilateral contracts when the competitive wholesale electricity market starts;

- Assignment of PPAs and EPAs signed by NTDC to DISCOs, to become effective as bilateral contracts when the competitive wholesale electricity market starts;
- Draft templates for different types of supply contracts in the market to be implemented as from the moment the CTBCM starts

The start of the CTBCM will however not depend on having all the pre-existing PPAs/EPAs assigned to DISCOs. All PPAs not assigned at the time of launching the CTBCM (no later than 2020) will be assigned to the Special Purpose (Wholesale) Supplier (SPS) that will provide the administration services and act as Purchaser on behalf of DISCOs for the preexisting PPAs/EPAs that have yet not completed the assignment to DISCOs.

Therefore, to start the market and for the transition until all pre-existing PPAs/EPAs are assigned to DISCOs, the actions will be to create the SPS to take over their administration until the administration is completed:

- Prepare amendment to Power Purchase Agency Agreement (PPPA) and sign between the SPS and each DISCO, to eliminate the new power purchase / new contracts on behalf of DISCOs after the CTBCM starts.
- Assignment of 1994 PPAs to the SPS, unless the IPP accepts to negotiate a contract novation
- Assignment to SPS of other existing PPAs/EPAs that have still not completed the assignment to DISCOs.

However, the assignment process will start at the earliest once the new market model and roadmap for implementation has been approved. Both NTDC and CPPA G as per the assignment clause in the existing 2002 and onward policy PPAs, can initiate immediately the assignment process of these PPAs/EPAs to the DISCOs as successor purchasers.

In summary: the actions are mainly the following:

- Establish and approve (CPPA G and MOE) a strategy for the assignment of pre-existing PPAs/EPAs to DISCOs, the assignment to become effective as bilateral contracts when the commercial operation of the CTBCM starts.
- CPPA G drafts template bilateral power supply contract /PPA to be used in the assignment, ensuring full consistency with the market conceptual design approved.
- CPPA G in coordination with NTDC and DISCOs, based on demand projections for DISCOs and current practices on generation allocation among DISCOs, determine proportionality factor (share) to assign pre-existing PPAs and EPAs among DISCOs.
- CPPA G: Create and operationalize the legal working group for the assignment process and negotiations with generation companies.
- Establish timetable for assignment, starting as soon as the market development policy is approved. The process should take into consideration that credit cover will be provided in all contracts assigned to each DISCO. Discussions with relevant IPPs should start urgently, to identify concerns and issues.
- Assignment the pre-existing PPAs and EPAs among DISCOs, and signing of bilateral agreement between the generator and each DISCO, to become commercially effective as bilateral contracts when the commercial operation of the CTBCM starts.
- Create a government owned not for profit Special Purpose Supplier as purchaser on behalf of DISCOs (agent) of pre-existing PPA/EPAs that have still not completed assignment to DISCOs. This is described further in the next group of actions

SEPARATION OF CPPA G FUNCTIONS

This Group of Actions will manage the CPPA G organization to implement the Market Operator meeting the market structural requirements to ensure independence of the Market Operator from commercial interest of Participants and ensure a smooth transition for pre-existing agreements.

One of the most important requirements of a competitive wholesale electricity markets (as is the case of the CTBCM) is to avoid any kind of conflict of interest of the Market Operator, as is the institution responsible for centrally administering market mechanisms for Participants to buy and sell electricity. The Market Operator must be completely independent of any commercial interest of Participants and not be involved in buying electricity in contracts to resell. The current power procurement and generation invoice verification process carried out by the CPPA G (being a party in or administering the PPAs/EPAs on behalf of DISCOs) cannot be carried out by a Market Operator that administer centrally wholesale electricity market.

Currently the CPPA G covers more than one function. Its role as agent of DISCOs and purchaser in PPAs/EPAs cannot continue in the Market Operator of the competitive wholesale electricity market (the CTBCM) due to this clear conflict of interest. Therefore, to ensure that the market operator function is independent from any commercial interest (or contract trading with Market Participants), the CPPA G needs to be separated into its different functions:

- The Market Operator as a service provider administering centrally the competitive wholesale electricity market
- The Agent of DISCOs as the administrator of the power purchase from existing PPAs/ESAs on behalf of DISCOs, which will be the Special Purpose (wholesaler) Supplier, the SPS that will register and become a Market Participant.

The proposed approach is to carry this separation in two stages:

- First, functional separation, by creating two business units within the CPPA G, each unit with its own management, staff and accounting separation; and
- Second, as per the wholesale market model and roadmap for implementation approved, legal separation into two companies prior to the start of the CTBCM.

This action shall be carried out by CPPA G upon Board approval. The activities for the organization of the two functions (agency function and market operator function) into two separate business units could include the following:

- Detail the scope of work and the Organizational Structure for each of the two business units. Both business units will report to the existing CPPA G CEO, who will report to the CPPA G Board of Director
- Prepare and submit for approval of the CPPA G board, the revised Organizational Chart of each business units
- Designate two Deputy CEOs to lead each business units
- As currently CPPA G activities related to MO functions and SPS already are segregated, the staffing assignment will be by sections performing these two separated functions
- Set up digital interface to exchange data between NTDC (NPCC) systems and CPPA G ERP system
- Implementation of CPPA G ERP System with separation of "business units" corresponding to the accounting and functional separation of the two activities, in preparation for and until legal separation. Details related to the CPPA G separation will be further elaborated during the detail market design

- Centralized corporate functions, such as HR, IT, Accounting, etc. will have to prepare a plan to be approved by the CEO to split these functions having in mind the legal separation that will take place at a later stage. During the transition these centralized services will remain in single units reporting to the CEO
- Test the operation of the separate to clearly identify staffing needs and adequacy of systems and data bases

The next group of actions correspond to the legal creation of separate companies, which may share some administration services through contractual service agreements between the two. The actions for the new companies are described next.

CREATION OF THE MARKET OPERATOR

For the separation and implementation of the Market Operator the preparatory activities include the following:

- Creation of the Market Operator company
- Implement systems for budget and accounting, and petitions of market operator fee;
- Staffing, capacity building and systems for new activities of the Market Operator under the conceptual market design (contract register, metering system register, settlement software, etc.);
- Start and finalize admission of Participants, to collect required information;
- Establish systems for information exchange with the Metering Service Provider (NTDC and as applicable DISCOs) and the System Operator (NPCC)
- Implement the contract register (each contract of Participant, including quantities and terms to determine imbalances);
- Implement the metering systems register, and the formula to calculate energy and capacity at the market point to buy and sell, and calculate imbalances.
- Systems for calculation of transmission use of system charges;
- Systems to administer for balancing mechanisms (calculation of imbalance quantities and prices);
- Procure or adapt software systems for market settlement (balancing, transmission charges, market operator fee) (including template settlement document), in accordance to the market design and Market Commercial Code;
- Develop and implement internal audit and quality control mechanisms;
- Market Operator develops template settlement document, and templates.
- Market Operator drafts Market Participation Agreement, and initiates process of information collection and signing agreement with each participant in the competitive market.
- Implement a centralized market data base for all systems to share the same information. The market systems will keep track of each input or modification of data, calculation of invoices, payment received and paid, etc.) to ensure auditable track record.
- Implementation of payment system and procedures including bank accounts and methodology
- Develop market credit cover methodology and formula (to be included in the Market Commercial Code and with details in a market standard operating procedure, to calculate periodically market credit cover for each Participant.
- Implementation of a "market services department" in charge of admission of Market Participants receiving required information and signing Market Participation Agreement, and

administration of complaints (except those related to settlement), relationship with NEPRA and market development;

- Management of monitoring Participants' compliance, in particular payment compliance, to decide and implement suspension or termination of Participant;
- Design and implement the governance system for adequate representation of the Market Participants and for accountability and transparency including access to information, reporting and other accountability measures;
- Design and launch website of the Market Operator.
- Market Operator draft indicative template for each type of supply contract in the market, including obligation to comply with Commercial Code and Grid Code, and participation in balancing mechanism, and generation availability provisions and price hedging provisions in accordance with market conceptual design and (draft) new Commercial Code. Templates are made available for public and participant information in the website.

CREATION OF THE SPECIAL PURPOSE (WHOLESALE) SUPPLIER

This group of actions corresponds to the creation of the SPS as a separate company. The SPS will be a Participant to act as purchaser on behalf of DISCOs (agent) for the pre-existing PPAs and EPAs that have not completed the assignment to DISCOs. This will be considered the SPS contract portfolio.

The SPS will draft and sign back-to-back power supply contracts with each DISCO, proportionally to the distribution factor, for the total capacity and energy in the SPS portfolio. This portfolio will change each time a PPA or EPA is assigned to the DISCOs or ends. For consistently with it the back to back PPAs will be adjusted. The SPS is not allowed to sign new contracts or modify / extend existing PPAs and EPAs in its portfolio

The SPS will be a government owned company licensed as wholesale supplier (trader), registered as a Market Participant with the Market Operator providing the required credit covers for its exposure to market payments, as the SPS will be designed to sell all energy and capacity of its contract portfolio, it is expected the SPS would not have balancing mechanisms exposure and therefore credit cover would only be required for the market operator fee, as may be applicable.

The creation of the SPS will start with a transition of establishing SPS Business Unit in CPPA G, with accounting and functional separation, reporting to the CPPA G CEO, until the legal separation creates the SPS Company prior to the start of the CTBCM. The SPS will become an independent entity with its own governance. (To be further elaborated during the detail market design)

The SPS shall be based on the following principles and scope:

- Accountability and reporting obligations on the invoice verification and payment to its portfolio of pre-existing PPAs/EPAs.
- The Special Purpose (wholesale) Supplier may also provide the DISCOs with generation Invoice verification services, assisting the DISCOs in carrying out the verification on the invoices sent by the generators for the contracts/PPAs/EPAs assigned to the DISCO. The DISCO will decide whether to do it by its own or use the SPS. This administration involves verification of invoices sent by generators and identifying liquidated damages to invoice the generator by DISCOs.
- The Special Purpose Supplier is not allowed to sign new contracts for any DISCO.

Specific Preparatory Activities for the commercial start of the SPS Company:

- Management and staff training/capacity building;
- Establish the SPS Code of Practice
- Draft standard operational procedures as required
- Amend the power purchase agency agreement (PPAA) and sign the new PPAA with each DISCO, termination the PPAA signed by CPPA G.
- Draft template and sign power supply contract with each DISCOs Design and implement the reporting system and website for the SPS.
- If and as needed, preparation of service agreements with the Market Operator o share services or systems and data bases.

CREATION OF THE INDEPENDENT AUCTION ADMINISTRATOR (IAA)

The Independent Auction Administrator (IAA) will be a government owned company responsible for competitive auctions for new capacity procurement / new contracts of DISCOs, aggregating needs of and acting as a broker for DISCOs, and administration guarantee support scheme for financially weak low performing DISCOs.

Each DISCO or a group of DISCOs will have the right to organize an auction to procure new contracts, provided that the DISCO or DISCOs demonstrate the benefits of separate auctions and the competitive process fully complies with the regulatory framework and is approved by NEPRA.

Centralized Auctions: The IAA will be a transitory service provider, until all the DISCOs transition to contracting on their own. Additionally, the IAA will manage the calculations and the mechanism to ensure that each and all DISCOs have contracted in advance the quantities required to comply with each DISCO's capacity obligations.

Working together with the DISCOs that will provide demand projections and in coordination with the Market Operator to access the contact register, the IAA will calculate demand coverage gap, i.e. the forecasted demand that is not covered with contracts. Demand forecast by each DISCO will be incompliance with procedures and requirements in the Grid Code and in the Distribution Code. The gap assessment will determine the need for new capacity procurement, if any, for DISCOs to meet their capacity obligations to ensure the security of supply, based on which the IAA will prepare the indicative power acquisition plan for the DISCOs, taking into consideration transmission available capacity and constraints, the Transmission Expansion Plan and the Indicative Generation Expansion Plan prepared by NTDC as Planner.

The gap calculation, the acquisition plan and the design of the auction and its procedures will need to comply with any regulatory requirement (NEPRA regulations or guidelines) to qualify as a competitive price and therefore allowed to pass through to regulated consumers retail tariffs. Therefore, the IAA will be responsible for the regulatory approval of:

- the template market based power supply / PPA / EPA for the auctions, consistent with the wholesale market contract requirements
- the standard bidding documents in compliance with regulation for competitive tariffs to ensure that costs of awarded contracts will be considered allowed costs to be recovered in regulated retail electricity tariffs of each DISCO.
- coordination as applicable with relevant agencies (e.g. for renewable auctions, with AEDB) and of the documentation for the centralized auctions for procurement of new contracts

The IAA will administer the competitive auctions for the aggregated demand needs of DISCOs. The IAA may assign the actual administration of the auction to a relevant agency, but retaining keeping the overall coordination, qualification requirements and review of bids and results;

Once the contracts are awarded in the auction and the regulatory compliance is granted by NEPRA, the IAA will assist for each DISCO to sign the respective contract/PPA with each awarded generator. The IAA is not allowed to sign PPAs on behalf of DISCOs.

Security Cover and Guarantees for Contracts: In addition to auction administrator, the IAA will be responsible of administering the GoP guarantee support for one or more financially weak low performing government owned DISCOs. The scope of activities would include the following:

- Identify DISCOs that will be considered noncredit worthy and requiring the scheme of guarantees provided by the government through the administration of the IAA. Should later the DISCO be privatized in the future, this scheme would no longer apply and all private bidders will be required to commit to provide the credit cover for the contracts (and market) of the DISCO.
- Preparation and test/trail implementation of data exchange (e.g. web based) and system/software for the consolidation and review of each DISCO demand and contract coverage to identify gap for each DISCO and total

CODES IN THE ELECTRICITY MARKET

This group of actions corresponds to the development of the Market Commercial Code and to the update of the Grid Code to harmonize with the approved market conceptual design.

MARKET COMMERCIAL CODE

Market Commercial Code will set the objectives, principles, rules, procedures, rights and obligations that govern the Market Operator, Participants and as applicable services providers, as established in the detailed market design. The Market Commercial Code will cover the details and requirements of settlement process including the market balancing pricing and trading, the market settlement period and process to enable prior verification and comments by Participants (Preliminary Settlement document and final). It will also include provisions and procedures for metering system registration, the metering register and calculation of energy and capacity for each Participant, capacity obligations, balancing mechanisms; contract information and contract register; market operation fee; market credit cover, and others as required and described in the conceptual market design. For capacity and consensus building, CPPA G may organize workshops and prepare explanatory brochures.

- Draft the code, while providing capacity building through workshops and brochures. Consultation through website and open discussion forms.
- Once CPPA G (through the Market Operator Business Unit) finalizes the draft Market Commercial Code, the CPPA G will submit to NEPRA for review and approval.
- The Market Commercial Code will be complemented e market standard operation procedures covering detailed processes and formulas, and standard forms (e.g. template Market Participation Agreement).
- The Code and the market procedures will be made public in the Market Operator website (until website implemented, in the CPPA G website). However, the Market Operator website could be implemented while the Market Operator is still a Business Unit in CPPA.

GRID CODE

The Grid Code will have to be updated in order to incorporate and take into consideration matters in the market design relevant to the Grid Code (mainly operational planning and dispatch, generation availability commitment, and demand control), and to reflect applicable system security constraints

and required operational planning studies and ancillary services, software, communication systems and SCADA, following the amendment established in Grid Code. This action will be led by NTDC with the Grid Code Review Panel.

- In particular, NTDC with the Grid Code Review Panel will review and as needed update the Metering Code, and clarify all requirements and procedures for Revenue Meters, including remote reading.
- It is recommended that the Grid Code be complemented with standard operational procedures with details for implementation, such as on operational planning, generation scheduling, demand control, availability testing, dispatch and real time operation. The Grid code its amendments and operational procedures should be made public in NTDC website and the System Operator website.
- Once NTDC with the Panel completes the draft amendments the proposed modifications and additions will be submitted to NEPRA for review and approval.

STRENGTHENING THE SYSTEM OPERATOR

This group of actions corresponds to the strengthening of System Operator having adequate operational planning and real time operation systems and communications; data base and data exchanges for implementation of demand forecasting, operational planning, outage coordination, scheduling and dispatch, and demand management; and enhancing NPCC staffing and capacity building.

The introduction of a balancing mechanism among Market Participants requires to ensure that generation scheduling and dispatch, demand control and real time system operator are transparent and predictable. The instrument providing this predictability and at the same time ensuring system balance within security and quality requirements is the Grid Code.

The main administrator and implementer of these activities of the Grid Code in matters related to operation is the System Operator.

Additionally, arrangements (such as sharing data bases or information exchange) needs to be developed, implemented and tested, including the monitoring of capacity availability for power plants and peak demand of distribution licensees and Bulk Power Consumer.

Scope of detailed actions would include the following:

- NPCC as System Operator identifies software and system needs to fully implement Grid Code. As necessary, the System Operator starts the process to adapt existing software and systems or procurement of new ones.
- NPCC launches the System Operator website
- NPCC strengthens operational planning and dispatch function (including staffing, systems and capacity building), with daily and weekly reporting in the System Operator website of forecasted/planned and actual operation, system security constraints, generation, import/export and demand control (load shedding if any); and monthly reporting of operational planning of next 12 months (generation / demand balance, system constraints, availability) and actual results previous month.

STRENGTHENING DISCOS: READINESS AS MARKET PARTICIPANT AND CREDIT WORTHINESS

Each DISCO shall implement functions and systems for the participation in the electricity market and its function as retail supplier. Activities in this group of actions may include the following:

- DISCOs strengthen demand forecasting functions, with periodic reporting of forecasted demand, distribution system constrains and any load shedding planned or unexpected.
- DISCOs implement a retail supplier and market department/unit responsible for management of contracts and relationship (information exchange, ensuring timely payment) with the Market Operator.
- Capacity building to participate in the market and contract portfolio and relationship with SPS and IAA.
- Assessment of wholesale payment history, financial situation and efficiency (losses and collection) of each DISCO. Measures for financial strengthening as necessary, and identify worst performing and financially very weak DISCOs that would be unable to provide credit cover guarantee on their own. The MOE in representation of the owner of DISCOs shall lead this tasks in preparation of the DISCOs to be ready for integrating to the new wholesale market.

TRANSMISSION SERVICES AND OPEN ACCESS TO TRANSMISSION

This group of actions corresponds to ensuring full implementation of standard transmission connection agreements as required in the Grid Code, to clarify limits, rights and obligations of power plants, distribution licensees and Bulk Power Consumers connected to transmission, and of NTDC as transmission services provider and System Operator. The actions include the following:

- NTDC draft standard (template) transmission connection agreement and sends to NEPRA for comments/review;
- NTDC agrees details for Schedules of the agreement with each power plant (currently, data has mostly already been agreed in signed PPAs/EPAs) and each connection of DISCOs and K Electric with NTDC grid.

NTDC LEAST COST EXPANSION PLAN AND ADEQUATE SETTLEMENT METERS

This group of actions are a responsibility of NTDC required to implement a credible competitive wholesale electricity market and achieve the objectives of strengthening security of supply at reasonable costs within system reliability and performance standards.

- NTDC as Planner finalizes least cost expansion plan draft and consultation, and submit for NEPRA review and approval
- NTDC as Planner strengthens planning function, staffing and systems to produce periodic least cost generation and transmission expansion plan, update annually the transmission expansion plan, and update every (3/5) years the full plan. Annual reporting on transmission investment and system security constraints, identifying congested links and impact of congestion.
- NTDC as metering services provider verifies existing metering in connection points for sale and purchase of electricity, and compliance with requirements in Metering Code of the Grid Code, in accordance with revisions.

- NTDC tests existing Revenue meters (CDP) and identify gaps, faulty equipment and inadequate quality, to correct and ensure quality revenue meters for the start of the market. Tests will be done allowing the participation of the connected party, and CPPA G / Market Operator as observer to incorporate any issue or special arrangement in the Revenue Metering Systems Register of the market.
- If the gaps or faults cannot be addressed in a timely manner, to avoid delaying the start of the market the Market Operator will establish transitional arrangements to adjust meter readings for the calculation of balancing.
- NTDC provides information on Revenue Metering System for CPPA G / Market Operator to develop and maintain the Revenue Metering System Register;

MECHANISMS TO ENSURE TIMELY MARKET PAYMENT

This group of actions are related to the measures that are required to enhance the Market creditworthiness: credit cover mechanisms (collateral obligations and payment system and methodology and formula to determine credit cover (collateral): agreement with bank(s); systems and formula to determine credit cover. This is a CPPA G/Market Operator responsibility.

This is a critical requirement, to create a market that provides the necessary payment security and phase out government guarantees. The actions to complete the required mechanisms for the start of the market commercial operation include the following:

- CPPA G/Market Operator establishes the market payment system through agreements with Banks, with weekly settlement, payment and reporting to identify as fast as possible insufficient payment by any participating distribution licensee or Bulk Power Consumer. This system applies only for payments in the settlement prepared by the Market Operator, covering balancing, transmission use of system charges, and Market Operator fee. (Note that settlement and payment of bilateral contracts to be done directly by the parties to the bilateral contracts).
- Market Operator develops methodology and formula to determine market credit cover (collateral).
- DISCOs together with MOE (in representation of the government as owner of the DISCOs) establish for financially bad performing DISCOs (inefficient demands) a payment guarantee system for contracts of those DISCOs, where the guarantee scheme would be organized through and provided by the Special Purpose Supplier.

READINESS FOR COMMERCIAL OPERATION OF ELECTRICITY MARKET

This group of actions shall be led by CPPA G and includes all market participants; CPPA G reporting of readiness tests and results to MOE and NEPRA.

Actions are mostly related to testing that all systems, procedures and data exchanges are ready to smoothly start the market without significant disruptions. For each, the test, protocol will be developed and coordinated by CPPA G (the Market Operator Business Unit) in consultation with other stakeholders responsible for those systems, procedures, and data exchange). Tests planned and results shall be reported to MOE and NEPRA:

- NTDC with Market Operator final testing the quality and calibration of Revenue Metering systems in each market entry (sale) or exist (purchase) point.

- NPCC as System Operator tests generation scheduling and dispatch software and systems, information exchange, relevant components and information from SCADA
- Market Operator tests settlement and billing system, payment system and credit cover mechanism, quality control and internal auditing systems.
- Testing of market data management system including web based information exchange with Participants
- Capacity building of market participants and services providers
- Initial determination of required credit cover in the market and testing of credit or guarantee systems
- Pilot shadow market, to test live systems, mechanisms, information exchange and procedures.
- Collect comments and feedback from each party participating in the tests.
- Based on test results and feedback from parties, develop any required improvement or correction, and for participants to practice and learn practically information to submit and receive.
- Inform the MOE and NEPRA test results and whether readiness has been achieved, including any transitory arrangement decided.

DECLARATION OF THE START DATE OF THE COMPETITIVE MARKET

Once the tests are completed satisfactorily or transitional arrangements are agreed for systems to be further enhanced, the MoE in consultation with NEPRA will assess readiness and declare the date to start the commercial operation or require additional tests or enhancements.

CHAPTER-8: POSSIBLE EVOLUTION OF CTBCM

CTBCM EVOLUTION

Market reforms are not easy to implement and they don't happen overnight. It is a gradual process and require continuous efforts in order to achieve the ultimate target. During this course, many challenges arise and needs creative solutions. International experience shows that the markets needs to be liberalized gradually and with proper design, otherwise, the consequences can be colossal.

Keeping in view the peculiarities of the power sector of Pakistan and the current mandate given by the Government, the CTBCM has been design to introduce a competitive market on the wholesale level. Only large consumers (BPCs) are allowed to directly procure from the market. DISCOs will procure on behalf of the non-eligible consumers. As participants becomes more familiar with the market dynamics and the market matures, the threshold for the BPCs to participate in the wholesale market. This will increase competition and liquidity in the market.

GROSS POOL OR NET POOL

Initially, considering the constraints of the existing PPAs, the CTBCM has been designed as Gross Pool from the dispatch perspective as all the generators will be centrally dispatched based on the variable cost. From the contract perspective, the CTBCM is a Net Pool as participants are allowed to have bilateral contracts and there is no centrally administered settlement mechanism for the bilateral contracts and a single price for all the market participants.

The design of the CTBCM is flexible enough to evolve into a pure Gross Pool or Net Pool. The market condition will decide whether to have a pure Gross Pool or Net Pool or to have a hybrid model. All this will be purely dependent on the market conditions and actions of the market participants.

RETAIL COMPETITION

Retail competition is envisaged in the CTBCM model and it is aligned with the new NEPRA Act. With the maturity of the Market and fulfilment of certain conditions, the supply and distribution functions of the DISCOs will be separated. NEPRA can also give a supplier license to any person other than DISCO to purchase from the wholesale market and supply it to the consumers in the territory defined in the license.

POSSIBILITY OF POWER EXCHANGE IN PAKISTAN IN THE CURRENT SCENARIO

The concept of a power exchange (PX) is based on the fact that there are multiple buyers and sellers willing to sell or buy products conveniently. Both the demand and supply sides analyse their day ahead requirement and try to balance out any deviations between contracted quantities and actual consumption / supply, by procuring / selling in the PX to minimize the impact of real time balancing costs.

In Pakistan, we have generation following long terms contracts with Take-or-Pay conditions. Whole demand is over contracted which means that if there is any PX, demand side will not participate (as it has no deviations or imbalances to procure from the PX).

Similarly Generators are paid capacity charges (fixed charges) based upon their availability. Variable cost is a regulated pass through cost. If they participate in PX, it will always submit the same bid (For availability purpose it will try to be available for all the time to secure fixed capacity charges and due to regulated variable charge, it will submit same price all the time). So submitting the same bid at all times makes no sense at all.

For deeper analysis, we can segregate the demand in two type of consumers i.e. Eligible and Non Eligible. In Pakistan any BPC having load above 1MWh is eligible consumer and it can procure from the market. These eligible consumers can participate in the PX and there may be some liquidity. But as currently these eligible consumers are in the system and enough capacity has already been procured for them as well, if we allow these consumers to escape from the system and buy from the market, this will create a revenue deficit as capacity charges will not be recovered from these consumers. Also the cost of service for a bulk power consumer is low and DISCOs normally recover higher charges as compared to normal consumer (cross subsidy), the escape of eligible consumers from the system will result in high cost of service for the remaining consumers. This will result in stranded costs.

There are three methods to recover these stranded costs. (1) Allow these eligible consumers to buy from the market and divide the fixed charges in the remaining consumers in the system (this will result in high tariffs for the remaining consumers) (2) Work out these stranded costs and Govt will recover the cost through Tax (again it will be a burden on the general public), (3) Levy two charges for some defined timeframe i.e. Capacity Charge and cross subsidy charge, on the eligible consumers willing to buy from the market.

Obviously Option-3 is most suitable option and if we opt for it, BPC's may have no incentive to escape from the system and buy from the market as there will be no or little financial benefit. Again it will not increase liquidity in the market.

Following table illustrates the features of a Power Exchange and comparison with Pakistan's situation:

#	Features of Exchange	Pakistan's Situation	Remarks
1	Demand participants procure from the power exchange only those volumes that are not covered in Bilateral Contracts	All volume is already contracted (as explained above)	There will be no liquidity in the market as whole demand is already contracted
2	There are double side auctions in the PX i.e. both demand side and generation side bid in the PX	As demand is already contracted and no new procurement will be needed by DISCOs, they will not bid in the PX until demand and contracted quantities balanced in future otherwise there will be stranded costs	Eligible Consumer: • BPCs can participate but will be paying additional charges (as explained above) which will result in less participation by BPC's Non Eligible Consumer:

			• DISCOs will not participate either as demand is already over contracted.
3	Payment in the PX is Ex-ante means participants have to pay in advance	Pre-payment looks impossible by the demand participants For most of the PPA's, 45 days payment period is there after generation month.	Serious payment issues in Pakistan due to heavy losses and less recovery by DISCOs and per-payment is not an option
4	Price determination by the willingness to pay by demand and willingness to sell by generators – true market price	As per the Case depicted above, demand side will not bid and price will not reflect true market price. At the same time it can be easily worked out if one has the aggregated demand forecast of the system	Determination of True market price is only possible if both demand and supply bid in the PX
5	Generators cleared in exchange are considered committed and self-dispatched	As per NEPRA Act, SO is bound to dispatch the units centrally on Security Constraint economic principals	No self-dispatch Ref from NEPRA Act • Section 14B Generation: Sub-Section (4) In the case of a generation facility connecting directly or indirectly to the transmission facilities of the national grid company, the licensee shall make the generation facility available to the national grid company for the safe, reliable, non-discriminatory, economic dispatch and operation of the national transmission grid and connected facilities; subject to the compensation fixed by the Authority for voltage support and uneconomic dispatch directed by the national grid company.

Following is the summary of all the peculiarities of the power sector of Pakistan that are an impediment for the establishment of the Power Exchange in the current scenario.

1. The electricity act in Pakistan does not allow self-dispatch of plants.
2. Demand forecast not mature enough for ex-ante imbalances settlement.
3. Payment culture, inability at part of demand to pay in advance
4. Transmission constraints which will restrict the self-dispatch at various nodes and readjustments will be difficult and in most of the cases the contracts will not be dispatched.
5. Inflexible long term PPA and difficulty to free any volume from a signed PPA for PEX. Today and up to 2025, all demand is already contracted by paying take or pay capacity i.e.

the buyer pays the full fixed costs including their returns, hence procures energy at their regulated variable cost. Therefore, we don't foresee demand participating in a voluntary exchange and increase the total cost of purchasing by paying MCP in power exchange.

In view of the above table, to start a power exchange in Pakistan in the current scenario seems impracticable. The recommended path is that initially market starts with Bilateral contracts keeping in view transmission constraints, participants capacities etc. and with the passage of time when demand and supply are in balance, power trading platform like a PX can be established.

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