Power Wheeling Reforms to support off-take of Renewable Energy in the Corporate Sector: The CTBCM Regime

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ABSTRACT

With the on-going polycrisis—COVID-19, climate change, regional conflicts, countries are preparing their low-carbon development plans, green recovery pathways, and commitments to net-zero under their energy and climate actions. Along with national targets, the corporate sector (industry and commercial sector) is also pledging support for low-carbon development, particularly the renewable energy transition, as it enables them to further climb up the corporate ladder by making a better socio-economic and environmental case. To address this challenge, different support mechanisms such as Corporates’ “Power Purchase Agreements (PPAs)” through power wheeling are being explored. Only in 2021, the corporate RE procurement through PPAs increased by 18% as compared to 2020, reaching a record level of 36.7 GW. To further analyze its potential, this study particularly explores the socio-economic significance of power wheeling reforms in Pakistan using a mixed-method approach. This includes an extensive desk review and stakeholder consultations around the existing regulatory framework of wheeling, analyzing the drivers of increased adoption of Corporate PPAs across Asia Pacific, and analyzing the regulatory and policy support required for rapid offtake of RE in Pakistan’s corporate sector.

Using the above-mentioned approach, this study analyzes the framework of Competitive Trading Bilateral Contract Market (CTBCM) and how wheeling regulations are governed under it. Based on the country’s regulatory authority views, the wheeling structure under the CTBCM model provides a more holistic framework for Business-to-Business engagements and is completely aligned with the existing power sector regulations. However, a number of challenges still persist due to some dis-agreement on wheeling charges, lack of harmony between market players, policy inconsistency, market and institutional barriers, and limited capacity of institutions concerned. The redressal of this challenge would require a consensus among market players on market regulations and wheeling charges, comprehensive action plan for corporate PPAs, provision of compliance and enforcement mechanisms for corporate PPAs under CTBCM, clear and transparent grid access rules, developing communication channels to address inconsistency, and devising a clear methodology for use-of-system charges.

Keywords: Power Wheeling, Power Purchase Agreement, Competitive Electricity Trading, Energy Markets, Energy Policy
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1. Chapter 1: Introduction

1.1. Background

Over the years, energy availability has no longer remained a cost for corporates and businesses to manage. It has become more of a ladder for companies to climb up their corporate agenda due to changing business, social, and environmental trends. This includes increasing expectations from the corporate’s environmental actions, new business models, and constantly decreasing cost of renewable energy.

Since 2019, this opportunity has become more significant, particularly in the backdrop of COVID-19, climate change, regional conflicts, and underlying structural weaknesses that led to massive increase in electricity prices, especially for developing countries such as Pakistan (Zia et al. 2023). Many countries are procuring energy supplies in the global market through fierce competition. Further, the reliance on imported energy sources also created a vulnerability against supplies and price fluctuations leading to a challenge for the industrial and corporate sector, as it affects their global market competition (Abbas et al. 2022).

While more corporates are responding to this challenge, various support mechanisms are being explored. However, despite its low cost, many challenges are yet to be addressed in Pakistan for creating a robust demand and supply market. Power purchase agreements and wheeling regulations provide an effective way to decarbonize the power sector of corporates as well as an effective way to meet their sustainability goals. Especially in the backdrop of regional turmoil where energy security and affordability has become the top priority, the businesses are more into agreements, which protect them against increasing energy prices.

1.2. Significance of power wheeling

Power wheeling is a concept that allows for transmission of electricity from a seller to a buyer through a network owned by a third party (mainly distribution lines of a power grid). Through the process of wheeling, efficiency is improved by providing cost-effective options to a utility, which can decide if it is cheaper to build a new electric generation facility or buy power from another service area producer (Liu et al. 2022). This eventually enables a consumer to use electrical power between different service territories, without having a need to own the entire infrastructure. Power wheeling, in return, develops competition in the market, and provide corporates with increased choices in terms of how to source their electricity. Key benefits obtained through power wheeling are further depicted in Figure 1.
Along with key measure aspects in figure 1, the major advantage of power wheeling is its ability to allow for a higher uptake of renewable energy in the corporate and industrial sector. While their advantage of access to distant resources and decreased transmission costs are already highlighted, wheeling allows better integration of renewable energy (RE) in the energy markets, eventually enabling the investor’s trust in RE projects and allowing for their greater participation in RE adoption. Finally, through supporting the offtake of RE, power wheeling can contribute to reducing GHG emissions and dependence on fossil fuels, aligning with the net-zero and country’s RE commitments.

1.3. Scope and objectives

In the backdrop of opportunities and challenges highlighted above, this study aims to analyze the feasibility of power wheeling reforms in Pakistan, and how they can support the RE development in the corporate sector under the following key objectives.

- To provide an overview of corporate Power Purchasing Agencies (PPAs) in the Asia Pacific region;
- To analyze the policy landscape, institutional framework, and developments around power wheeling reforms in Pakistan; and
- To highlight the regulatory support required for rapid offtake of renewable energy in Pakistan’s corporate sector, particularly through wheeling reforms.
To address the key objectives, the study uses a mixed-method approach involving both primary and secondary data analysis. Secondary data is obtained through an extensive desk review around energy policy reforms of Pakistan, wheeling regulations under the Competitive Trading Bilateral Contracts Market (CTBCM), and the regulations of National Electric Power Regulatory Authority (NERPA). To further analyze the stakeholder perspective, this report also generates the debate through the Public Private Dialogue (PPD) organized by Sustainable Development Policy Institute (SDPI) on “Power wheeling reforms to support offtake of renewable energy in the corporate sector”.

2. Chapter 2: An overview of Corporate PPAs across Pakistan and Asia Pacific countries

2.1. Corporate PPA trend in Asia Pacific

Many countries in Asia Pacific are pushing for increased penetration of RE to address energy affordability concerns and to support their climate and low-carbon development targets. Along with national targets, RE procurement at the corporate level is also an enabling action for walking the talk on RE100 initiative and science-based targets. Hence, the corporate Power Purchase Agreements (PPAs) are also growing rapidly across the world and Asia Pacific.

According to Bloomberg biannual report on clean energy procurement, the RE procurement for clean energy projects increased by 18% in 2021 as compared to 2020, touching a record level of 36.7 GW (Cecilia Keating 2023).

Figure 2: Global trend in corporate PPAs

![Source: Klynveld Peat Marwick Goerdeler 2022]

Figure 2 indicates that even in the backdrop of regional turmoil and global economic crisis, the corporate sector and private companies have secured around 36 GW of renewable energy. Over 167 different organizations (including Amazon, Ford, McDonalds) have announced PPAs in 36 countries worldwide (BloombergNEF, 2023).

In the Asia Pacific region, corporate PPAs surged, increasing by over two-fold to reach 4.6 gigawatts, primarily driven by India and Australia (Klynveld Peat Marwick Goerdeler [KPMG], 2022). Notably, the PPA framework has become readily accessible in major markets such as Japan, China, and South Korea, a significant change from just a year ago. Anticipated growth in Asia Pacific PPA activity is on the horizon, fueled by a growing number of companies committing to achieving
100% renewable energy targets. In 2021, 67 companies made a commitment to the RE100 initiative, vowing to completely offset their electricity needs with clean energy sources. This expanded the campaign’s reach to encompass 355 members spanning 25 different countries. Collectively, these companies have an annual electricity consumption of 363 terawatt-hours, according to their most recent disclosures (ibid).

Regulatory reforms to support Corporate PPAs in Asia Pacific

Although the Asia pacific market has been challenging for the corporates due to lack of regulations, complexity, and comparatively higher costs, it also offers the biggest opportunity for investment and growth. Among Asia Pacific, the Philippines and Vietnam have emerged as leaders in adopting regulatory changes to facilitate Corporate PPAs. In Taiwan, the RE market has been liberalized, granting corporations the opportunity to procure green energy directly from generators (International Trade Administration 2021). South Korea, in a significant development, has recently opened its RE market to third-party PPAs with the state-owned utility KEPCO acting as an intermediary (PV Magazine 2021). Vietnam is currently in the process of testing direct PPA mechanisms for RE projects, ranging from 400-1,000 MW, with plans for full implementation from 2021 to 2023. Meanwhile, the Philippines has introduced a green energy option programme, offering significant power users the choice to independently source their electricity from RE. The commonly deployed structures of PPAs in this region are depicted in Figure 3.

![Figure 3: Common Corporate PPA structures used around Asia Pacific](source: Figure designed by authors based on data collected from consultations and [KPMG, 2022]).

One of the key drivers in Asia Pacific for corporate PPAs is the government push for RE deployment. While most of the countries have fossil fuel dominated energy mix,
RE has accelerated due to policy support measures such as feed-in-tariff, auctions, and RE certificates. However, still many countries operate in a market with a strong monopoly over power supply by state-owned entities. An overview of the market structure and regulations on PPAs across selected Asia Pacific countries is also indicated in Annexure 1.

Based on the discussion above, corporate PPAs are the key drivers to address RE uptake in the corporate sector. Power wheeling (direct PPAs) also responds to the regulatory support provided for the ease of making such initiatives, under the framework indicated in Figure 4.

Figure 4: Power wheeling framework (Eskom, 2023)

Along with direct PPAs, wheeling of power is also done through “open access” and “banking virtual agreements”.

- **Wheeling through Open Access**: Corporates often use open access regulations to purchase renewable energy from independent renewable energy generators located elsewhere. The energy is wheeled through the existing grid structure and delivered to the corporate’s designated facility. It entails two types of charges which include the wheeling charges and the open access charges; wheeling charges are levied by the utility for using its transmission and distribution network, whereas open access charges are applied for using the network.

- **Wheeling through Banking Virtual Agreements**: When a generator is wheeling electricity, it can virtually store the electricity for the consumer for consumption at a later time. The electricity is not physically stored but it is banked through accounting methods. To understand this, consider that a banking service enables a solar generator to sell power to a client who requires it at night. The generator can do this by putting all of its daytime production on the grid and then using energy from the grid that has been banked to meet the customer’s demand at night.
Power Wheeling: A case study of South Africa

Description

In South Africa, the privatization of power and the rise of IPPs are being driven by market forces like the pricing of renewables, which is now low enough to make large-scale renewable based projects cost competitive as compared to the fossil fuel sources, thus poses a highly attractive investment proposition. These market shifts are also shaped by macro-economic strategy policies like the Renewable Energy IPPs Procurement Program (REIPPP), the Risk Mitigation IPPs Procurement Program (RMIPP) as well as the recent amendment to schedule 2 of South Africa’s Electricity Regulation Act that raises the threshold for non-Nersa licensed self or distributed generation power plants from 1 to 100 MW (The World Bank Group 2014).

Power Wheeling in South Africa

Wheeling in South Africa has been successfully used in projects like the Darling Wind Farm, and the Bio2 Watt biomass plant which supplies power to BMW’s Rosslyn plant. Wheeling will essentially allow privately generated power to be transmitted across the national grid to customers who want it in a willer buying willing seller model. This will facilitate renewables-based energy transmission from sites with good wind and solar radiation to corporate, industrial, residential, and civic customers whose locations may be less conducive to renewable energy production. The larger plants could conceivably provide power to numerous clients across the grid simultaneously, and conversely, disparate institutions and interest groups can band together to invest in large-scale off-site renewable power generation facilities, taking advantage of group-purchasing efficiencies and economies of scale. Independently produced power builds companies’ resilience by guarding against load-shedding and allowing them to plan more effectively around ongoing operating and energy costs.

Figure B1: The contractual agreement between a third-party generator and an Eskom customer.
**Municipal Energy Resilience Initiative (MERI)**

The Municipal Energy Resilience (MER) Initiative (Western Cape Government 2023) facilitates energy security, wheeling and the liberalization of the energy supply. Steered by the Department of Economic Development and Tourism’s Energy Directorate, in conjunction with the Department of Local Government and Provincial Treasury, the three-year MER project aims to bolster economic resilience and energy security by supporting, developing, and building capacity for renewable energy projects in the Western Cape. The initiative is aligned with global COVID-19 economic recovery trends that prioritize an accelerated push towards sustainability and decarbonization. It also represents a step towards the Paris Agreement greenhouse gas emissions reduction commitment and safeguards the Western Cape’s export industry against imminent carbon border adjustments.

Much like REIPPPP, the MER project is innovative and unique in that it allows a variety of technology and energy mixes, as well as flexible financing and contracting models, potentially heralding a new ecosystem of inter-related projects, with novel methodologies and innovative delivery systems, in which wheeling will pay a crucial role. With published guidelines and tariff structures, South Africa is running pilot projects exploring the practicalities of wheeling and fine-tuning the necessary legal and policy framework.

![Figure B2: Contractual agreements involving Eskom and municipality wheeling](image)
3. Chapter 3: Pakistan’s Power market structure and wheeling regulations

3.1. Policy support for RE offtake in Pakistan

The energy policy landscape of Pakistan has observed a documented shift in support of RE over the past years. In 2019, Pakistan put forward its Alternate and Renewable Energy (ARE) policy, targeting a share of 30% from wind, solar, and biomass by 2030 and 30% share of hydropower in total power generation by 2030 (Alternate Energy Development Board (AEDB), 2019). As per the latest iteration of Indicative Generation Capacity Expansion Plan (IGCEP) 2022, Pakistan is aiming to achieve a clean energy share of around 62% by 2031 (National Electric Power Regulatory Authority [NEPRA] 2022). Further, on market regulations side, Pakistan has operationalized the Competitive Trading Bilateral Contracts Market (CTBCM) model, thus transitioning from a single to a multiple-buyer model. In 2021, Pakistan also put forward its revised Nationally Determined Contributions (NDCs) which targets a share of 60% from clean energy (incl. hydro) by 2030 along with measures, including a moratorium on use of imported coal in the power sector.

Along with policies highlighted above, various initiatives have been taken in line with the ARE policy guidelines, leading to positive albeit slow RE sector development in Pakistan. As the pivotal organization mandated to facilitate renewable energy development, AEDB (formerly known) has led most of these initiatives. RE initiatives at federal level include allocation of land (sublease agreement), upfront tariffs for RE technologies, standardized templates for energy purchase agreements and implementation agreements, net-metering, grid integration code for solar and wind, quality standards for importing solar equipment, State bank of Pakistan RE scheme (halted as of 2023), and NEPRA guidelines for competitive bidding. Recently, AEDB and PPIB also merged to pave the path for enhanced operational efficiency and facilitation of investors by offering a one-window facility for smooth and seamless development of ARE projects.

3.2. Policy Support for private sector engagement in RE sector

A comprehensive framework was presented for development of renewable energy technologies under the ARE Policy of 2006. Although the power policy 1994 had permitted the private sector to construct thermal projects as well as wind, solar and biomass, its deployment remained limited due to the lack of economic feasibility at that time. Pakistan was among the pioneers from developing countries that
designed policies to promote private sector investment in renewables at the early stages of their global uptake. The ARE policy in Pakistan laid down attractive fiscal and financial incentives for private sector investors. The ARE policy of 2019 also expanded its scope encompassing all ARE sources, competitive procurement and also addresses areas like distribution generation systems, off-grid solutions, B2B methodologies and rural energy services. This also aims to create a conducive environment for the sustainable growth of alternate and renewable energy in Pakistan.

3.3. An overview of power wheeling regulations in Pakistan

Power wheeling could be an economically feasible option for corporates for procuring RE. In Pakistan, the conventional energy procurement model is evolving, with corporates now exploring alternatives to meet their energy requirements. Commercial and industrial sector is responsible for two-third of world’s total electricity consumption, and in case of Pakistan, 35% of total electricity produced is consumed by these sectors. Through commitments to procure renewable sources for electricity, corporate sector entails a unique opportunity to drive significant additional investment in RE and help achieve their decarbonization or net-zero targets.

This opportunity is motivated by several factors. The increasing cost of electricity and cost fluctuations in electricity price generated from imported fossil fuels (rupee depreciates/disruptions in global market) makes the supply chain vulnerable to price shocks and increases the cost of production for corporates. Secondly, the rising costs and inefficiencies in the transmission of grid electricity are propelling the corporates to adopt power wheeling strategies. Further, the decreasing cost of RE sources, and environmental concern for decarbonization of energy sources have made renewables a more attractive energy option. Thus, the integration of power wheeling into the energy landscape of Pakistan is intrinsically linked with the broader goal of increasing the share of RE and ensuring access to cheaper electricity for the corporate sector. Power wheeling creates an opportunity for corporates to obtain electricity from a specific source while utilizing the existing infrastructure for distribution. A historical overview of power wheeling regulations in Pakistan is indicated below.
3.4. Wheeling regulations by National Electric Power Regulatory Authority (NEPRA)
In 2016, NEPRA approved the wheeling regulations for Pakistan. These regulations allowed the licensed generators to sell electricity to the bulk consumers; bulk consumers were defined as those who consume 1 MW or more. Through the distribution system and the transmission system, the electricity is wheeled from the generator to the consumer site and a “wheeling charge” was paid by the generator. These regulations were an important milestone in Pakistan’s plan of opening up the market to small and medium-sized generators, and promoting competition in the power market. As per the wheeling regulations, generators will have to get a generation license. They also require authorization from NEPRA to support their chosen consumer which will set out details such as the capacity that can be wheeled and the tariff that can be charged for the electricity. The generator will have to sign a Wheeling agreement and commence wheeling within 30 days and 18 months of NEPRA’s acceptance respectively. Other conditions for power wheeling included:

- **Undersupply:** The Generator delivers less electricity than that forecast (other than due to force majeure (weather fluctuations being excluded from force majeure)), it must reimburse the relevant grid operator(s) for losses suffered; and
- **Overconsumption:** the consumer imports more from the grid than the Generator generated and delivered to the grid, then the Generator is liable for such shortage at the applicable tariff rate.

Some other key aspects of the Regulations include:

- The ability for Generators to undertake dedicated grid works themselves, which are then adopted by the relevant grid operator(s), the cost of which is recovered in the setting of the Wheeling Charges; and
- The ability for Generators to “bank” electricity that is not able to be wheeled and/or consumed by the consumer (for example, as a result of grid failure). The biggest concern was whether there was sufficient capacity on the grid for wheeling to be effective, however, the introduction of the banking provisions appears to address this concern.

Further, for open access obligations for wheeling, the power sector legal framework includes the right of Open Access in all legal instruments such as NEPRA act, NE policy, Rules and regulations, Grid code, Market code, Distribution code, etc. NEPRA act provides following two regulations which provide the nature of Open Access Charges to be collected from competitive supplier and its disbursement to DISCOs:
• NEPRA electric power suppliers (performance standards) regulations, 2022.
• NEPRA open access (Interconnection & wheeling of electric power) regulations, 2022.

3.5. Wheeling regulations under the Competitive Trading Bilateral Contracts Market (CTBCM)

The Government of Pakistan while recognizing the significance of power wheeling especially for industrial and corporate sector has initiated various policy measures and regulatory frameworks to encourage its implementation. For deregulation of the power sector, the Economic Coordination Committee (ECC) authorized a decision to approve Competitive Trading Bilateral Contracts Market (CTBCM) model for promoting competition in the wholesale electricity market of Pakistan in 2022. The Central Power Purchasing Agency (CPPA-G) would act as a market operator and NEPRA would be responsible for promoting competition for generation and distribution. CTBCM would enhance the efficiency of generation, transmission and distribution as the sector will be operating at a multiple buyer model instead of current single buyer model and electricity could be traded as any other commodity. CTBCM provides a market framework for power wheeling ensuring transparency and term of transfer of electricity through bilateral contract framework. Additionally, incentives have been provided by the GOP to make power wheeling financially viable, attracting both public and private sector entities to invest in renewable energy projects. The structure of power wheeling reforms under the CTBCM model is depicted in Figure 5.

Figure 5: Power wheeling structure under the CTBCM model.
A comparative assessment of the CTBCM/Integrated model (2022) and wheeling model (2016) is also indicated in Table 1.

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<tr>
<td><strong>B2B (Under CTBCM)</strong></td>
<td><strong>B2B (under wheeling regulations)</strong></td>
</tr>
<tr>
<td>• Electric Power trading can be done among DISCOs.</td>
<td>• Trade can’t be done with more than one DISCOs.</td>
</tr>
<tr>
<td>• Speedy registration and participation based on std. contracts.</td>
<td>• Cumbersome and negotiated contract process.</td>
</tr>
<tr>
<td>• Transparent, predictable and automated processes</td>
<td>• Non-automated transactions and settlements.</td>
</tr>
<tr>
<td>• Broader Policy, regulatory and institutional structure.</td>
<td>• Limited regulatory framework.</td>
</tr>
<tr>
<td>• BME hourly and BMC annual settlements implemented.</td>
<td>• Energy banking concept discontinued.</td>
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<tr>
<th>Market-based price and net settlement</th>
<th>Regulated tariff and gross settlement</th>
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<tbody>
<tr>
<td>Not available</td>
<td>Not available</td>
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| SO & MO institutional structure for effective trading | Not available |
| DISCOs Procurement Discipline and bilateral contracts | Not included |
| Spot Market (Merchant Plants and Trader) | Not included |
| KE Integration into Central economic Dispatch | Not included |
| IT Systems, capacity building and others | Not included |

Further under the CTBCM model, three types of market transactions are allowed for the Bulk Power Consumers (BPCs):

- **Merchant**: Selling at the marginal price.
- **B2B**: Bilaterally negotiated contracts; opportunity for REs to integrate at a relatively fast pace.
- **Bilateral contracts with Utilities** – regulated procurements mainly through auctions.

Given this, the wheeling regulations are currently being governed under the CTBCM. However, still various challenges exist for the corporate sector as well as maturity and operationalization of these wheeling reforms in Pakistan.
4. Chapter 4: Power Wheeling Reforms in Pakistan: Challenges and Recommendations

Pakistan has made efforts to promote power wheeling of renewable energy sources over the past few years as a to resolve country’s power sector issues. However, optimizing the benefits of power wheeling of renewable energy sources demand more careful policy articulation and effective implementation. This section describes the key challenges and proposed policy measures to address them.

4.1. Policy & Regulatory Uncertainty

Clear policies and targets set by the Government at federal level provides facilitating environment and support through implementing agencies for development of any sector. Though the government has announced various policies and regulations for power wheeling of renewable energy in Pakistan, these policies and regulations require consistency and reforms to cater the requirements for achieving full potential of power wheeling of renewable energy in Pakistan.

Issue i- Inconsistent Power Sector Regulations

As power sector is one of the drivers of economic growth, the Government of Pakistan has announced various power policies from time to time to encourage investors for the development of renewable energy-based projects and wheeling of renewable energy. The implementation of these policies confronted an array of inconsistencies which resulted in a financial loss for the investors. Such inconsistencies in policies dilutes the investor’s confidence and they tend to stay away from such initiatives in future.

Re-opening of the closed contractual arrangements under the previous policies, and providing different interpretation by the regulator about the application of up-front tariffs for renewable energy projects have affected the confidence of investors. Similarly, DISCOs’ stance on the NEPRA notified regulations on Wheeling of Power and treatment of ‘take-or pay’ and ‘take-and pay’ principles under NEPRA determinations have not gone well with the private sector investors.

Issue ii- Determination of Price and Tariff

A debate is going on between NEPRA, Government and industry for deciding the tariff. As power wheeling price encompasses five costs i.e. transmission system
cost (TSC), the distribution system cost (DSC), stranded costs of DISCOs, cross subsidy, market operator fee, system operator fee and losses. NEPRA is proposing Rs 1.5-2/kwh whereas the DISCOs are demanding around Rs 8/kWh and the industry demands a low tariff to increase export competitiveness.

**Issue iii- Issue of Excess Capacity for Discos**

DISCOs have two functions for power wheeling; they facilitate wheeling and also are a supplier. When a consumer does not utilize the committed capacity, the DISCOs will be left with excess capacity, which eventually will result in unrecovered costs and will potentially add to the circular debt.

**Issue iv- Lack of Planning for Long-term Wheeling of Renewable Energy**

Pakistan appears to take deployment of power wheeling of renewables from a strictly technical and financial vantage point without fully valuing the social, economic, and environmental benefits it present. This undermines the prioritization that wheeling of renewable energy requires in Pakistan’ power market. To get a clear picture of this issue, Pakistan introduced its first wheeling policy in 2016, and till date only two wheeling agreements throughout the country.

**Issue v- Lack of Coordination between National and Sub-National Entities**

Progress in the deployment of power wheeling for renewable energy is limited because of a general lack of cooperation, coordination, and delays, which discourages investors. One such instance is that PEDO launched the second phase of power wheeling in which 148 MW of the power generated through PEDO HPPs was to be provided to the industrial sector, but some DISCOs, under the Federal Power Division, filed a petition in Islamabad High Court against the wheeling process and got stay orders through courts and litigation is still underway.

**Issue vi- Slow Progress towards Development of Competitive Markets**

NEPRA conceptualized the competitive power wheeling of renewables in 2016, but the auction mechanism had never been fully materialized. Similarly, the concept of Competitive Trade for Bilateral Contracts Market (CTBCM), which was first envisaged in the original NEPRA Act 1997, continues to be in pilot stages, though
background work has been fast tracked for implementation. Lack of clarity on the future road map for the electricity market is also slowing pace for offtake of power wheeling of renewable energy by commercial and industrial sector.

<table>
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<th>Policy Recommendations</th>
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<tbody>
<tr>
<td>• The NEPRA should provide a comprehensive action plan for the promotion of power wheeling of renewable energy and set achievable targets for power wheeling. The action plan should be prepared in consultation with all stakeholders, including Discos, generators, corporates/consumers, and CPPA-G, etc. as well as all the provinces.</td>
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<td>• Operationalization of CTBCM should be prioritized to encourage power wheeling as a cost-effective method for industrial growth.</td>
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<tr>
<td>• Under the CTBCM, NEPRA has taken a lead and has committed to operationalize the market by 2023. The endorsement from the Federal Government must be unequivocal in this regard.</td>
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<td>• Under CTBCM, compliance and enforcement mechanism for the long-term corporate PPAs should be designed. Competitive procurement mechanisms should be established such as Auctions and Bidding for procuring renewable energy through power wheeling for lowest possible price driven by significant interest from investors and corporates.</td>
</tr>
<tr>
<td>• To make corporate PPAs effective for power wheeling, there should be a mechanism for B2B transactions (CTBCM as an enabler for Power wheeling) that allow transparency for third party sales directly between corporate buyers and IPPs. In the areas of current Disco’s operation, any third player could come in and compete in the distribution business.</td>
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<tr>
<td>• NEPRA should offer clear and transparent grid access rules and NTDC should provide guidelines for electricity transport arrangements that permit offsite corporate PPAs.</td>
</tr>
<tr>
<td>• Market based Energy Pricing / tariffs should be developed to encourage tailored long-term renewable energy contracts for large scale corporations e.g., green tariff program.</td>
</tr>
<tr>
<td>• The government should open communication channels specially with the generators (seller) and consumers to build uniformity and consensus. Such topics can include DISCOs financials, problem of transmission and grid capacity, and on-time payments. CPPA provided payment guarantees, liquidity damages, and deemed generation benefits. There is also a need to stimulate dialogue in the public sector to encourage respect for the sanctity of contracts, irrespective of political governments.</td>
</tr>
<tr>
<td>• Special Economic Zones (SEZs) can be taken as an opportunity for the implementation of CTBCM and power wheeling; its development can then be taken as a model for development of CTBCM and power wheeling in other industrial areas.</td>
</tr>
<tr>
<td>• Devise clear methodology for Use-of-System Charges (UoSC) under wheeling regulations. Encourage bilateral contracting, first at a demonstration level and then scale up.</td>
</tr>
</tbody>
</table>
### Power Wheeling Reforms to support off-take of Renewable Energy in the Corporate Sector: The CTBCM Regime

<table>
<thead>
<tr>
<th>Term</th>
<th>Role</th>
<th>Key Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short-term</td>
<td>MoE</td>
<td>The MoE to provide a comprehensive action plan in its regulatory framework for uptake of renewable energy through power wheeling by the corporate sector. The action plan should be prepared in consultation with all the stakeholders within a fixed timeframe.</td>
</tr>
<tr>
<td></td>
<td>NEPRA</td>
<td>NEPRA should prioritize the operationalization of CTBCM to encourage power wheeling.</td>
</tr>
<tr>
<td></td>
<td>NTDC &amp; NPCC as system operator</td>
<td>Formulation of transmission services rights and obligations for power wheeling.</td>
</tr>
<tr>
<td>Medium-term</td>
<td>NEPRA</td>
<td>Under CTBCM, Competitive procurement mechanism should be established such as Auctions and Bidding for procuring renewable energy through power wheeling.</td>
</tr>
<tr>
<td></td>
<td>NEPRA</td>
<td>Market based Energy Pricing / tariffs to encourage tailored long-term renewable energy contracts for large scale corporations.</td>
</tr>
<tr>
<td></td>
<td>NEPRA, CPPA-G</td>
<td>Make corporate PPAs effective for power wheeling through mechanism for B2B transactions (CTBCM as an enabler for Power wheeling) that allow transparency.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Strengthening Discos credit worthiness and readiness as market participants for power wheeling.</td>
</tr>
<tr>
<td>Long-term</td>
<td>MoE, NEPRA, CPPA, Corporate sector</td>
<td>CTBCM and power wheeling operations should be completely operationalized in the special economic zone, this development can then be taken as a model for development in other industrial areas.</td>
</tr>
</tbody>
</table>

4.2. Market Development and Infrastructure Barriers

Power sector of Pakistan has certain inherent characteristics that impede penetration of any technological advancement. Key issues pertaining to market and infrastructure barriers for power wheeling of renewable energy in Pakistan are:

**Issue i- Regulated Power Sector**

Generation, transmission, and distribution are the three main functions of the electric power industry in Pakistan. Transmission and distribution are highly regulated phenomenon. Pakistan operates under a single buyer and single seller model where CPPA- G; a government-owned entity is responsible for electricity trading and is the sole off-taker for all electricity produced. This monopoly market has created several challenges for Pakistan, which include excess capacity, high tariffs, and stranded costs. The rigidity is that the PPAs have impeded the evolution of power sector reforms particularly wheeling reforms with delays in operationalization of CTBCM. It poses a serious threat to the efficiency of the wheeling of renewable energy as it lacks transparency and accountability.
Figure 6: Single buyer; regulated market model

**Issue ii- Constraints on Grid and Transmission Infrastructure**

Grid reliability and stability are important concerns for carrying out wheeling operations. There have been reports of frequent tripping of the grids while transmission of renewable energy due to the weak grid infrastructure. Much of the T & D network in Pakistan is overloaded; in August 2020, 60% of the transformers were overloaded which resulted in increased load shedding and maintenance charges. However, NTDC’s limited financial resources have been creating a serious challenge to meeting the sector’s requirements. Due to the limitations of public funding and the private sector’s absence from this sector, the transmission infrastructure in Pakistan remains weak.

**Issue iii- Lack of Innovative Technologies in Transmission Network**

Pakistan needs to update the outdated transmission network that is being used and resulting in high transmission and distribution losses. As transmission networks play an integral role in power wheeling, conventional transmission network should be reformed and scaling up of modern technology is required. To address the issue of constraints on transmission and grid infrastructure for power wheeling of renewables, following actions are required.
Recommendations

- Development of transmission network through upgradation of technology; such as dynamic line rating (DLR) technologies actively collect data on transmission lines to let grid operators push them to their actual, rather than assumed limits, to forestall failures that can cause outages.

- Design a comprehensive plan for Distributed Power Generation integrated with power wheeling; Given the importance of grid integrity and overall financial viability to the DISCOs, the technical and financial impacts of distributed power generation should be an integral part of Pakistan’s energy planning.

<table>
<thead>
<tr>
<th>Term</th>
<th>Role</th>
<th>Key Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short term</td>
<td>MoE, NEPRA</td>
<td>Optimization of transmission routes and grid reliability through market competition.</td>
</tr>
<tr>
<td>Medium term</td>
<td>NTDC</td>
<td>Least-cost expansion plan to increase transmission efficiency</td>
</tr>
<tr>
<td>Long term</td>
<td>NTDC, Investors, Donors</td>
<td>Development of transmission network by adopting latest technology e.g. DLR.</td>
</tr>
<tr>
<td></td>
<td>NEPRA/DISCOs</td>
<td>Design a comprehensive plan for Distributed Power Generation integrated with power wheeling</td>
</tr>
</tbody>
</table>
References


Cecilia Keating 2023, 150 GW later: The dizzying rise of the power purchase agreement, Accessed on: September 20, Available at: https://www.greenbiz.com/article/150-gw-later-dizzying-rise-power-purchase-agreement


Annexure 1: Market Status of selected Asia Pacific countries around Corporate PPAs

<table>
<thead>
<tr>
<th>Country</th>
<th>Markey Structure</th>
<th>On-site</th>
<th>Direct PPA</th>
<th>Virtual PPA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Philippines</td>
<td>Partial retail liberalization</td>
<td>✔️</td>
<td>✔️</td>
<td>✖</td>
</tr>
<tr>
<td>Malaysia</td>
<td>Regulated</td>
<td>✔️</td>
<td>✖</td>
<td>✖</td>
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<tr>
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<td>Regulated</td>
<td>✔️</td>
<td></td>
<td>✖</td>
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<tr>
<td>Singapore</td>
<td>Retail full liberalization</td>
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<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Thailand</td>
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<td></td>
<td>✖</td>
</tr>
<tr>
<td>Vietnam</td>
<td>Retail liberalization in progress</td>
<td>✔️</td>
<td>✔️</td>
<td>✖</td>
</tr>
<tr>
<td>China</td>
<td>Retail liberalization in progress.</td>
<td>✔️</td>
<td>✔️</td>
<td>✖</td>
</tr>
<tr>
<td>South Korea</td>
<td>RE retail</td>
<td>✔️</td>
<td>✔️</td>
<td>✖</td>
</tr>
<tr>
<td>Japan</td>
<td>Retail full liberalization</td>
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<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Taiwan</td>
<td>RE retail</td>
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<tr>
<td>Australia</td>
<td>Retail full liberalization</td>
<td>✔️</td>
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</tr>
<tr>
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