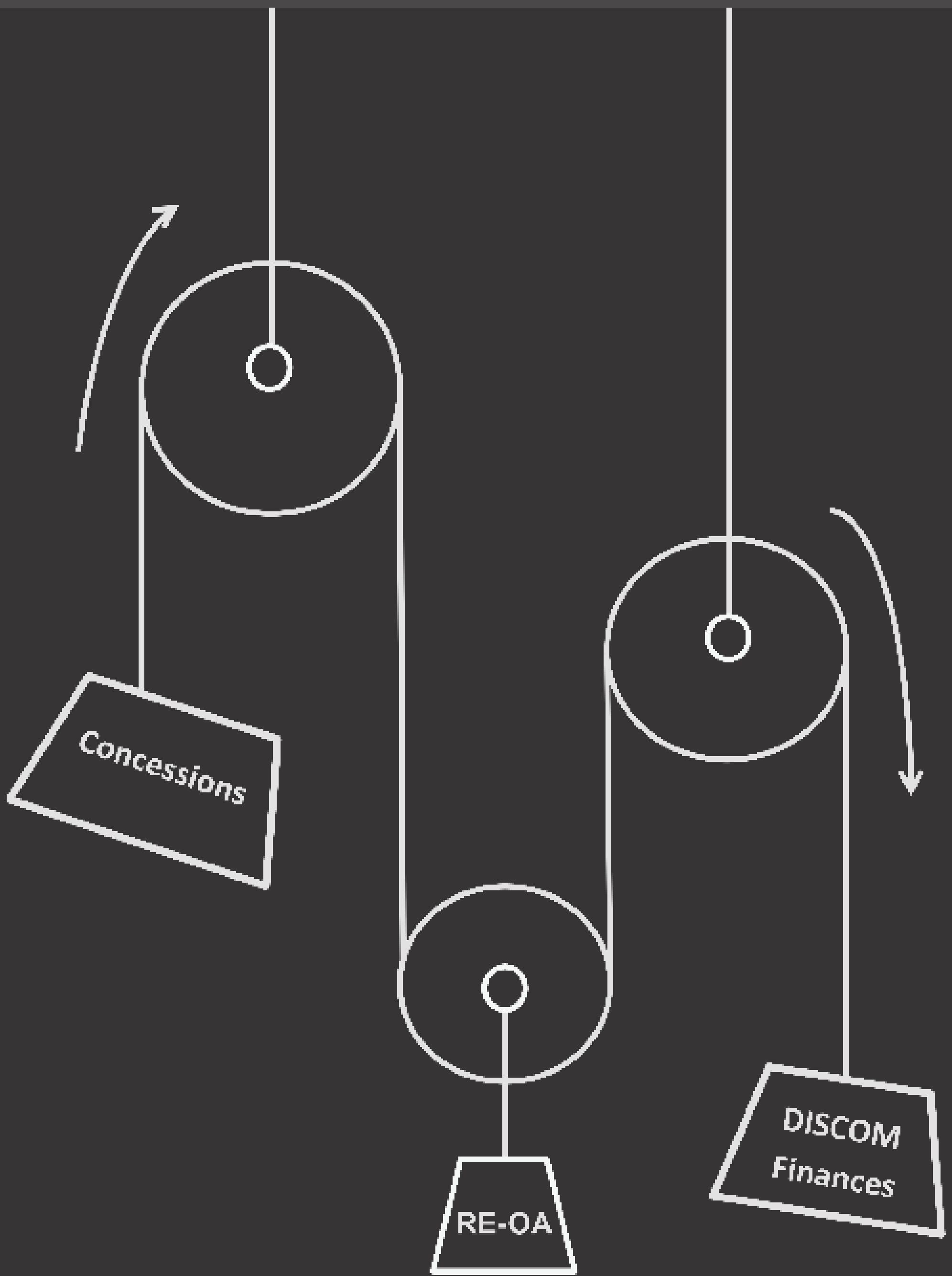
Choosing Green:
The Status and Challenges of Renewable Energy based Open Access

Working Paper



Prayas (Energy Group)

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The Status and Challenges of Renewable Energy based Open Access

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September, 2017

प्रयास
Prayas (Energy Group)

ABOUT PRAYAS

Prayas (Initiatives in Health, Energy, Learning and Parenthood) is a non-governmental, non-profit organisation based in Pune, India. Members of Prayas are professionals working to protect and promote the public interest in general, and interests of the disadvantaged sections of the society, in particular. Prayas (Energy Group) works on theoretical, conceptual regulatory and policy issues in the energy and electricity sectors. Our activities cover research and intervention in policy and regulatory areas, as well as training, awareness, and support to civil society groups. Prayas (Energy Group) has contributed to energy sector policy development as part of several official committees constituted by Ministries and the Planning Commission/NITI Aayog. Prayas is registered as SIRO (Scientific and Industrial Research Organisation) with Department of Scientific and Industrial Research, Ministry of Science and Technology, Government of India.

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CONTENTS

LIST OF FIGURES

LIST OF TABLES

EXECUTIVE SUMMARY

Despite the growth in short-term open access (OA) volume coupled with reducing prices, implementation of OA faces various challenges and operational difficulties. The existing OA framework has not been implemented in the same spirit as envisaged in the Electricity Act, 2003 and is thus yet to realise its full potential, mainly on account of the resistance from DISCOMs. Given the rapidly falling price of wind and solar power, renewable energy (RE) based OA and captive options are likely to pick up in a big way in the coming years. More importantly, considering the unique characteristics of RE generation like intermittency, seasonality, etc., coupled with concessional OA charges in some states and provisions like energy banking, will bring about newer challenges for the OA framework.

This working paper is our first attempt in trying to understand such challenges. The first part of the report estimates the status of RE based OA in a few RE-rich states, subject to the availability of data. The second part of the report critically analyses the important open access charges like CSS, AS and energy banking. The report ends with broad observations and outlines potential options to make the open access framework more amenable to renewable energy. We hope that this working paper will generate discussions and deliberations among various sector actors around some of these issues and help improve our collective understanding of the subject.

Given the inherent seasonal and diurnal variation in RE generation, RE based OA is presently quite unviable without some form of banking framework. It is important to quickly transition from the existing practice of nominal 'in-kind' energy banking charges, to a new framework which appropriately values banked and un-banked energy in monetary terms. A yearly banking mechanism, valuing banked and un-banked energy at the lowest variable cost of backed down power and highest variable cost of dispatched power respectively, is an appropriate way forward. Such a framework would also make any monthly, seasonal and ToD restrictions on banking/un-banking redundant and will spur innovative business models using a mix of options such as grid level storage, demand response, demand aggregation, and hybrid wind-solar projects. More importantly, such a banking framework coupled with the forecasting, scheduling and deviation settlement mechanism regulations will address the financial implications of renewable energy's seasonal and day-ahead variation for the DISCOM to a large extent. In effect these two frameworks would largely internalise the cost of RE grid integration, thereby reducing the reluctance of DISCOMs towards RE and paving the way for further capacity addition.

Falling power prices are quickly rendering most concessions and waivers unnecessary for renewable energy. Hence it is prudent to gradually withdraw such concessions to encourage the growth of RE based OA on its own fundamental economic proposition. More than concessions, a medium to long-term certainty, especially in the most significant charge, i.e. cross subsidy surcharge (CSS) is vital to encourage consumers to move towards medium/long-term OA and avoid the problem of frequent switching between DISCOM and market supply. CSS should be set at a level which does not deter competition through open access. In terms of additional surcharge, what is lacking is a standard methodology across states which would prevent any over/under recovery of actual fixed costs of backed-down power on account of OA. Availability of OA data is extremely poor, is spread across multiple sources and thus is a strong hindrance to critical and objective analysis of various policy-regulatory challenges like arriving at a roadmap for removal of concessions for renewable energy, impact of banking on DISCOMs, etc. There is a dire need for greater public availability of comprehensive data related to OA in general and RE-OA in particular. Finally, truly independent and empowered state load despatch centres (SLDCs), with adequate and effective measures for ring-fencing them from DISCOMs, are a necessary step for realising the full potential of open access.

1. INTRODUCTION

The Electricity Act, 2003 aimed at bringing about competition, consumer choice and efficiency in the power sector through, amongst other things, the phased introduction of open access (OA). The Act defines open access as '*the non-discriminatory provision for the use of transmission lines or distribution system or associated facilities with such lines or system by any licensee or consumer or a person engaged in generation in accordance with the regulations specified by the Appropriate Commission*' (Ministry of Law and Justice, 2003). Open access essentially allows consumers with certain minimum contract demand (generally > 1MW) to avail electricity supply from suppliers other than the Distribution Company (DISCOM) in whose area of supply the consumer is situated. Eligible consumers have to follow the laid down application process, submit required bank guarantees, and pay all the necessary charges, most important of which are the cross subsidy surcharge and transmission and distribution network charges.

The Central Electricity Regulatory Commission's (CERC) Open Access in Inter-State Transmission Regulations of 2004, 2008 and their subsequent amendment in 2009 set up the initial framework for inter-state open access (CERC, 2004). In terms of time frames, the rules allowed for short-term (up to one month at a time), medium-term (three months to three years) and long-term open access (twelve years and twenty-five years) (CERC, 2008). Transactions could either be done bilaterally or collectively. A bilateral transaction is *'between a specified buyer and a specified seller, directly or through a trading licensee or discovered at power exchange through anonymous bidding, from a specified point of injection to a specified point of drawal',* while a collective transaction is a '*set of transactions discovered in power exchange through anonymous, simultaneous competitive bidding by buyers and sellers*' (CERC, 2009a). Following CERC's lead and considering the mandate of the Electricity Act, 2003, State Electricity Regulatory Commissions (SERCs) started coming up with intra-state and distribution open access regulations[1], from 2004 onwards. Intra-state OA transactions also have similar time frames, namely short-term, medium-term and long-term.

Figure 1 illustrates the various dimensions of such OA transactions, including the duration, the type of contract (bilateral/collective), and the location of the buyer and seller (inter/intra state).Each of these routes has different procedures for application, grant of connectivity, type of agreements, charges and scheduling, as specified in their respective regulations. The Model Terms and Conditions of Intra-State Open Access Regulations, issued by the Forum of Regulators (FoR) in September 2010, clearly lay out the differences in the categories of consumers depending on the system to which they are connected (transmission/distribution), location of drawal, injection points and duration of OA. The application process, nodal agencies involved, and applicable charges depend on these aspects (FoR, 2010).

While periodic data for Long-Term Open Access (LTOA) and Medium-Term Open Access (MTOA) transactions is not consistently and easily available in the public domain[2], the CERC regularly

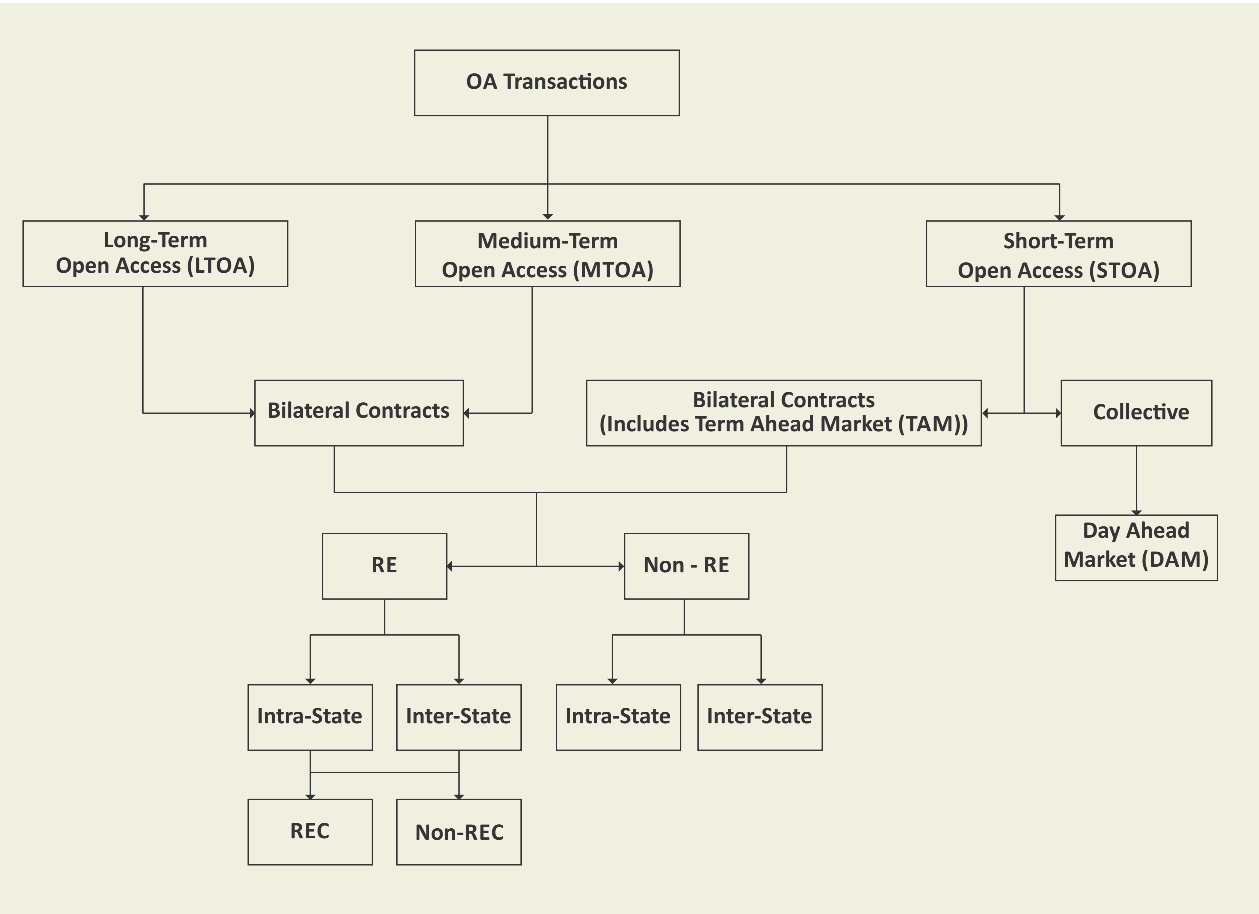
[1] Allowing open access within the boundaries of the state and distribution periphery respectively.

[2] The fourth report of the parliamentary standing committee on energy (2014–15) provides some indication of the open access availed only on the Inter-State Transmission System from 2008–09 to 2014–15. It provides data on the number of transactions and approved energy for bilateral and collective OA together. It is unclear if this includes any direct bilateral transactions between DISCOMs and power purchase by DISCOMs through exchanges (Lok Sabha Secretariat, 2015).

publishes a market monitoring report on the short-term power market in the country. This report provides details of on the short-term OA (STOA) transactions implemented through power exchanges, but there is no corresponding information on bilateral OA transactions. Figure 2 illustrates the volume of STOA power transacted along with its corresponding price at the power exchanges (IEX and PXIL) in the six years from 2010-11 to 2016-17.While the absolute volume of power transacted under STOA has gone up six times (from 4 BU to 24 BU), its share in the total day ahead volume transacted at the exchanges has doubled from 30% to 60% in the same time period. The average total number of OA consumers participating in the exchanges has also increased steadily from 608 in 2010-11 to 4,420 in 2016-17. Most of these consumers are located in the states of Tamil Nadu, Andhra Pradesh, Gujarat, Haryana, Punjab, Rajasthan, Karnataka and Uttarakhand (CERC, 2017a). However, the weighted average price of such transactions decreased from ₹2.74/kWh in 2010-11 to ₹2.43/kWh in 2016-17.

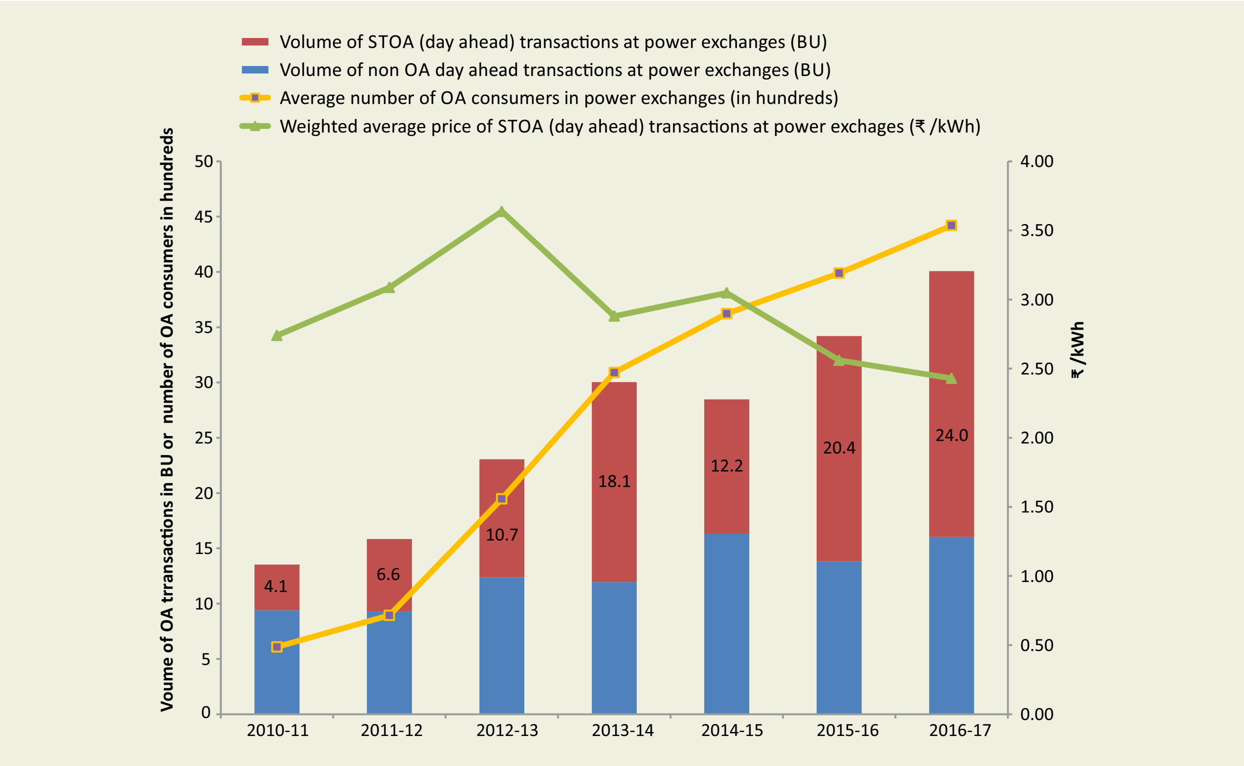
This decrease is also reflected in the prices of short-term transactions of electricity (power exchanges and bilateral contracts through inter-state trading licensees) as noted in Figure 12 in Annexure I. Coupled with the rising industrial tariffs, it makes a compelling case for greater procurement of power through open access.

Figure 1 : Existing framework for open access transactions



Source: Prayas (Energy Group) analysis

Figure 2 : Volume and weighted average price of short term OA transactions (day ahead) in exchanges from 2010-11 to 2016-17



Source: Central Electricity Regulatory Commission's annual reports from market monitoring cell on Short-term Power Market in India from 2010-11 to 2016-17

In spite of the growth in short-term OA transactions in the power exchanges as shown in Figure 2, a number of issues continue to plague its operationalisation. These are as follows:

1. One of the biggest hurdles to implement OA is the resistance from DISCOMs for fear of losing their cross-subsidising consumers (Lok Sabha Secretariat, 2015). This manifests at times through non-price barriers such as delays in processing applications and issuing no-objection certificates, and overall procedural complexity. The lack of independent SLDCs is a crucial factor as they play an important role in implementing OA.

2. Frequent switching by open access consumers between the market and the DISCOM supply leads to further difficulty in efficient power procurement planning by the DISCOM (MoP, 2017).

3. Restrictions are imposed by states, under section 11 of the Electricity Act, 2003, on open access transactions of export and import of power in case of prevailing power deficits and surplus conditions in the states (Singh, 2017) (Lok Sabha Secretariat, 2015). To quote the parliamentary standing committee on power on this issue,

   These powers have been exercised by several State Governments (beginning with Karnataka and followed by Tamil Nadu, Odisha and Andhra Pradesh) prohibiting export of power from their State on the ground of power shortages. Orders of CERC holding that open access cannot be restricted by such directions of the State Governments were challenged in the High Courts. CERC contested these cases. On the basis of the opinion of the Ministry of Law, the Ministry of Power had written to the

States that Section 11 does not permit prohibiting open access. The Karnataka High Court has upheld the order of the State Government. The Ministry of Power has moved the Supreme Court against the order of the Karnataka High Court. The matter is sub-judice in the Supreme Court.

4. Cross Subsidy Surcharge (CSS) and Additional Surcharge (AS) are perceived as too high by consumers, while CSS is insufficient to recover the entire loss of cross subsidy for the DISCOM. Lack of long-term certainty on these charges exacerbates the issue.

   Three recent reports discuss these existing challenges and propose various potential solutions as a means to address them (MoP, 2017); (Singh, 2017); (Lok Sabha Secretariat, 2015). Prayas (Energy Group) has also provided various options as ways of instituting a better structured open access framework for the coming years (Prayas (Energy Group), 2017a).

   Given the rapidly falling price of renewable power, especially wind and solar power, Renewable Energy (RE) based open access (RE-OA) and captive consumption is likely to pick up in a big way, especially in the southern and western states of the country. More importantly, considering the unique characteristics of renewable energy generation like intermittency and seasonality, coupled with concessional OA charges in some states and provisions like energy banking, will pose newer challenges for the open access framework. This makes it imperative to try and understand the possible impacts of increasing renewable energy on the open access rules and vice versa.

   This report is our first attempt in this direction. The first part of the report estimates the status of renewable energy based open access in a few RE-rich states, subject to the availability of data. The second part critically analyses the important open access charges like CSS, AS and energy banking. It highlights the variety of different methodologies adopted by various states in determining such charges and the concessions/waivers offered to renewable energy. The report also estimates the possible landed price of power procured through open access for the coming years (either through solar/wind power or coal) through an illustrative example for Maharashtra. The report ends with broad observations and outlines potential options to make the open access framework more amenable to renewable energy. As mentioned before, this paper is just a beginning towards understanding issues specific to renewable energy based open access. Lack of data has also not enabled us to separately examine the status and challenges of captive and group-captive procurement of renewable energy.

   Our hope in releasing it as a **working paper** is to generate discussions and deliberations among various sector actors around some of these issues and help improve our collective understanding of the subject.

2. Status of Renewable Energy based Open Access

2.1 Estimating the status of RE-OA

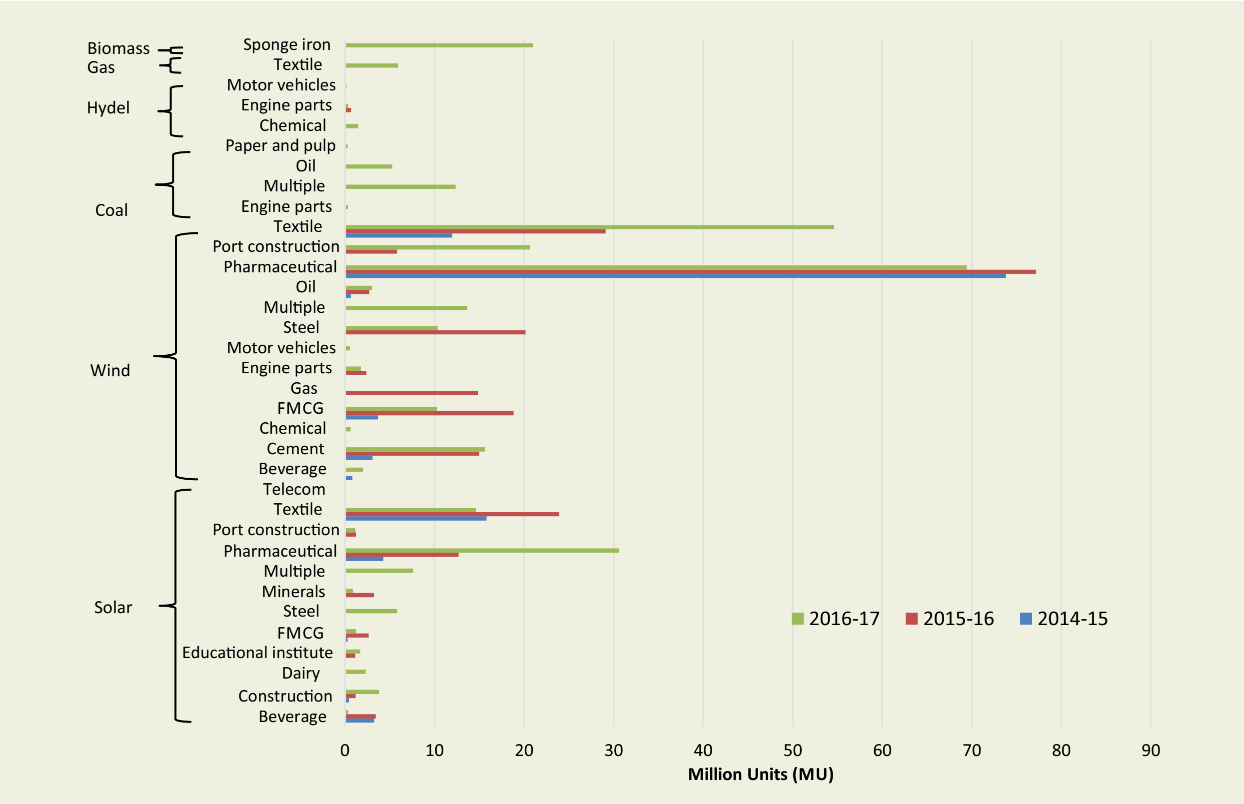
Data management has been and continues to be a weak link in the Indian energy sector (Sridhar, 2017). While rich data is available in the public domain on certain segments of the electricity sector, availability of data regarding open access is extremely poor and thus a major hindrance for critical analysis (Singh, 2017); (Prayas (Energy Group), 2017b, p. 195). At present, data with respect to some aspects of open access can be found in the public domain through various sources such as tariff determination orders for DISCOMs/ performance true-up orders passed by the respective State Electricity Regulatory Commissions (SERCs) as well as the DISCOM petitions in the matter, state and regional energy accounts of Load Despatch Centres (LDCs), monthly Market Monitoring Committee reports of the CERC, etc.

Data specific to renewable energy based open access transactions is further not uniformly available across these sources. For example, the state energy accounts of the SLDCs of Gujarat and Madhya Pradesh give the non- conventional/renewable energy wheeled through the network of DISCOMs, while this information is not available publicly in the Maharashtra SLDC's monthly reports. Further, such data also suffers from lack of standardisation in formats, terminologies and granularity across states. For example, the Maharashtra Electricity Regulatory Commission's (MERC) tariff orders of the Tata Power Company Distribution Limited and the Maharashtra State Electricity Distribution Company Limited (MSEDCL) give separate data on conventional and renewable energy based open access consumption in their energy balance, while this information is not available in the Reliance-Infra tariff order.

This made our task of estimating the present status of RE-OA extremely challenging. Hence we requested detailed data on RE-OA transactions from State Load Despatch Centres (SLDCs) of nine RE-rich states and two central institutions (POSOCO, CERC) under the Right to Information Act (RTI), 2005. While six states responded with data, it varied significantly across them. Some of our queries and doubts with regard to this data were partially clarified after following up with the concerned agencies.

Ideally, with good data availability, interesting analysis could have been carried out. A good example of this is illustrated in Figure 3, which shows the industry-wise volume of power purchased through open access from various renewable energy sources in the state of Andhra Pradesh from 2014-15 to 2016-17. The textile and pharmaceutical industries are the largest procurers of RE based open access. It is interesting to see that while solar-based OA procurement increased exponentially over the years under the pharmaceutical segment, a similar trend was also observed with wind-based OA for the textile industry. Although this analysis is not directly relevant to the report's conclusions and observations, it throws light on the avenues that good data availability and collation can open up for analysis.

Figure 3 : Industry-wise consumption of intra-state open access in Andhra Pradesh from 2014-15 to 2016-17



Source: Prayas (Energy Group) analysis based on data received from APTRANSCO under the Right to Information Act, 2005

Consequently, the lack of availability of coherent data across states as provided by different institutions severely limited the level of analysis that could be carried out. Since the data was collected from different sources, mainly SERC tariff orders for DISCOMs, state energy accounts of SLDCs, state nodal agencies for renewable energy, and through specific RTI requests, there might be potential areas where the data is not consistent. **Hence, the estimates derived from our analysis should be treated as preliminary.** The data used for our analysis is for three years, 2014-15 to 2016-17, and is restricted to the following categories[3] :

1. Total power purchase (in MU) -Total power purchase of all DISCOMs in the state available from tariff petitions, orders and state energy accounts.
2. Total OA consumption (in MU) -Total open access consumption wheeled through the networks of DISCOMs.
3. Total RE-OA consumption (in MU) - Total renewable open access consumption wheeled through the networks of all DISCOMs in the state[4].

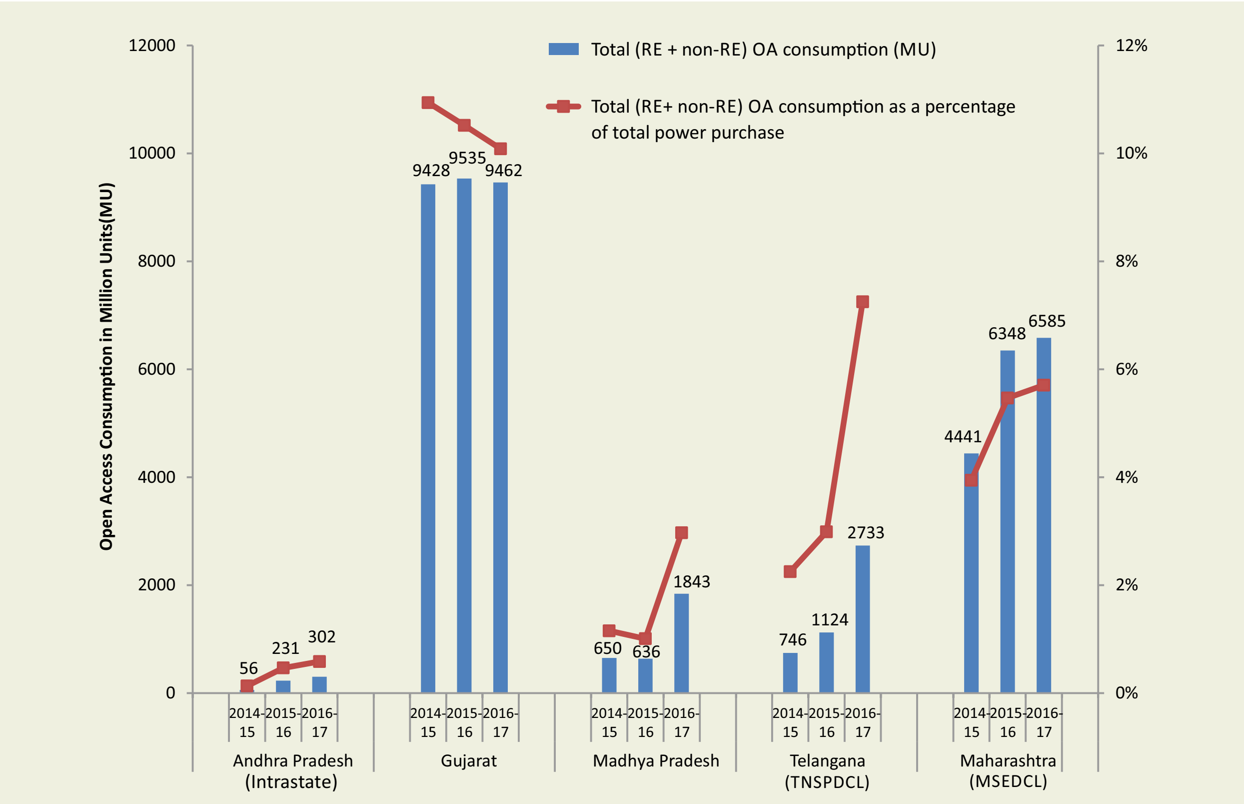
   For more clarity on the various state-wise sub-components of the above parameters, please refer to the detailed note on data used for this analysis in Annexure 2.

[3] The state energy accounts of Gujarat and Madhya Pradesh specify that the non-conventional/renewable energy wheeled through the network of the distribution utility for non-utility purposes is inclusive of captive and non-captive sources. Such specifications were not provided by other states.

[4] Segregation of RE data among wind, solar and others sources was subject to availability of data in those states.

Figure 4 shows that the total quantum and the percentage of open access consumption as a share of total power procurement has been increasing steadily from 2014-15 to 2016-17 across all states. Gujarat has the highest absolute quantum of open access consumption (greater than 9000 MU), and also the highest share of open access consumption (greater than 10% of total power procurement) among the states considered[5]. However the share of OA has been slowly falling in Gujarat unlike other states. Figure 5 illustrates that the quantum of RE-OA has increased in all states except in the case of the Maharashtra State Electricity Distribution Company Limited[6]. The share of RE-OA in total OA does not increase across all states, because total OA has increased at a higher growth rate than RE-OA. For instance, in the case of Madhya Pradesh, total OA has tripled as opposed to RE-OA which increased at the rate of only 4.8% from 2014-15 to 2016-17.

Figure 4 : Open access trends in certain RE-rich states/DISCOMs from 2014 to 2017



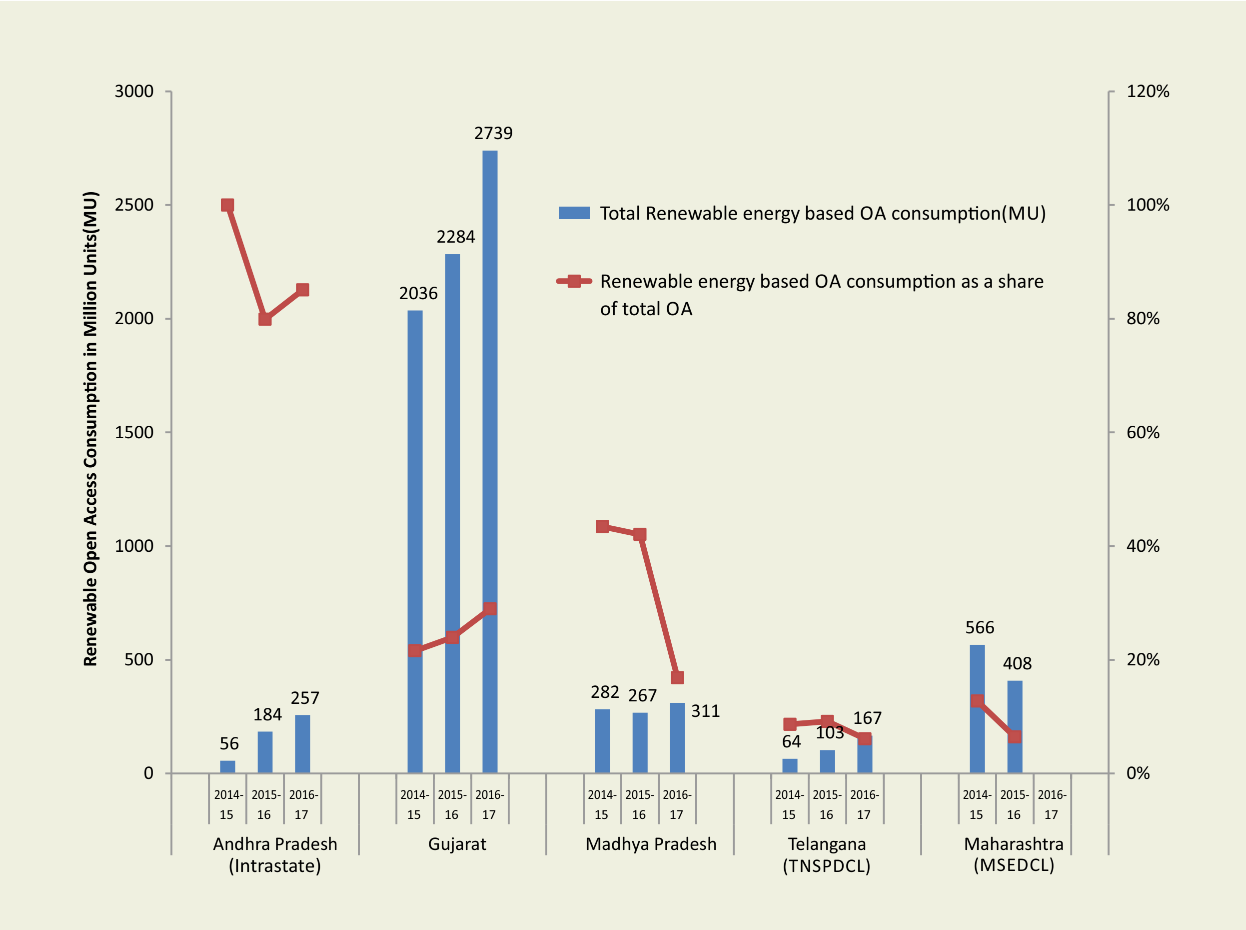
Source: Prayas (Energy Group) analysis based on data received from APTRANSCO under the Right to Information Act, 2005
Note: Only intra-state open access consumption wheeled through the network of DISCOMs was made available for Andhra Pradesh.

[5] There can be multiple reasons for high share of open access consumption in Gujarat like industrial growth, design of regulatory charges, level of cross subsidy in tariff design, etc.

[6] Data for 2016-17 was not available for MSEDCL.

Overall, the quantum of RE-OA consumption in the states analysed has increased from 2014-15 to 2016-17. There are multiple factors contributing to growth of RE-OA like falling power prices, concessional OA charges, rising consumer tariffs, etc. These need further analysis which is presently limited due to the lack of data.

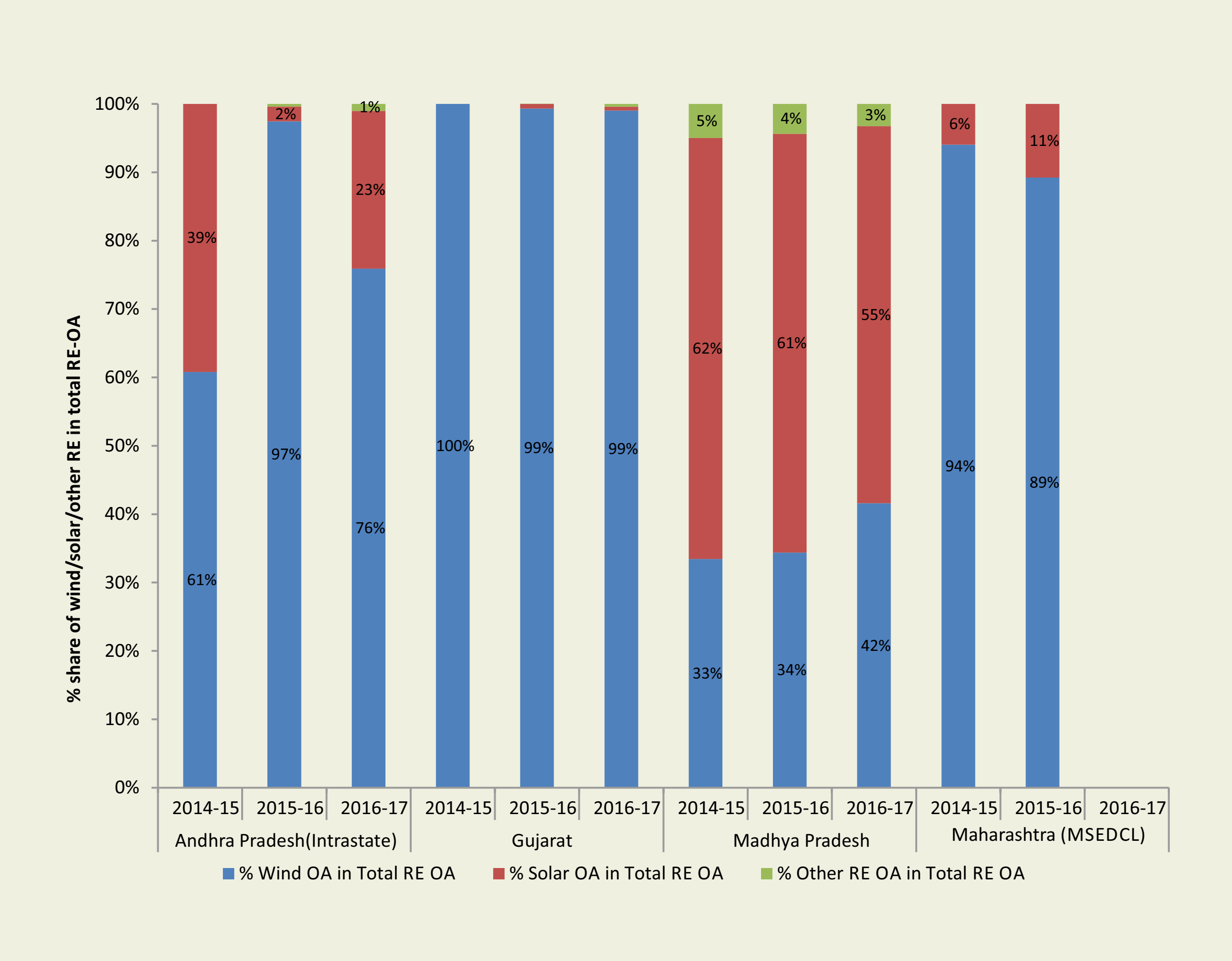
Figure 5 : Renewable energy based OA trends in certain RE-rich states/ DISCOMs from 2014-15 to 2016-17



Source: Prayas (Energy Group) analysis based on various state tariff orders, state energy accounts and data received under the Right to Information Act, 2005
Note: MSEDCL RE-OA data only till February 2016

Figure 6 brings out the dominance of wind power in RE-OA consumption, with the exception of Madhya Pradesh. In Madhya Pradesh, solar generation based OA comprises almost 60% in total RE-OA. But over the three years, quantum of wind generation based OA has increased while that of solar has remained constant translating into a decrease in the share of solar-based OA.

Figure 6 : Source-wise RE-OA as a share of total RE-OA for certain RE-rich states/DISCOMs from 2014-15 to 2016-17



Source: Prayas (Energy Group) analysis based on various state energy accounts and data received under the Right to Information Act, 2005
Note: MSEDCL RE-OA data only available till February 2016

2.2 Data management with regard to RE-OA

As already mentioned in the previous section, there are several lacunae in the open access data available in the public domain. Hence, there is a dire need to ensure uniformity in the data formats related to OA in general and RE-OA in particular. Given that RE-OA is now gaining traction, there is a need for stronger monitoring and data collection. Policies and regulations with regard to RE-OA should be based on rigorous data analysis.

The proposed National Open Access Registry(NOAR) by the CERC is an attempt to create an e-registry to streamline the OA application process, including the granting of NOCs, and ensure coordination among various parties. This is a very positive step and can greatly help in simplifying the existing processes. The CERC staff paper rightly notes that it can also serve as a 'data repository' unit and can *'provide faster and better access to information to all the market participants'* (CERC, 2016). However, the data repository function seems to only be limited to STOA transactions at the inter-state level. Ideally, it should also include medium-term and long-term OA transactions coupled with other categorisations like RE and non-RE OA. Finally, it is critical that states also set up a similar framework to cover intra-state OA transactions (as recommended by the NOAR), since data in this regard is unavailable in the public domain as of now.

Section 32 in the Electricity Act, 2003 identifies energy accounting and settlement as one of the main functions of the SLDC. Similarly, transmission and distribution open-access regulations in states mandate the collection of real-time generation data for the purpose of energy accounting. The sections for information systems under such transmission and distribution open access regulations require data collection for open access applications. There is a wide variation across states in the type of application details that are mandated to be published in the public domain. For instance, Maharashtra mandates the publishing of information including the name of the consumer, the period of open access, and the capacity, while Gujarat, Andhra Pradesh and Madhya Pradesh in addition to these details also mandate the publishing of point of injection/drawal.

A recent report from POSOCO titled "Scheduling, Accounting, Metering and Settlement of Transactions in Electricity (SAMAST)" recognises the importance of data and has made certain recommendations in this regard (FoR, 2016). Important recommendations amongst these are reproduced below. It is pertinent to note that the report recommends public availability of data, including for research and academic purposes.

SAMAST recommendations regarding data

8.4 Uniform Energy Accounting System

Energy Accounting System to be compliant with the Basic principles of Accounting such as the Double Entry System, Full Disclosure principle, Going Concern Principle, etc.

Formats for Energy Statements issued by SPC/SLDC/RLDC/RPC/NLDC/NPC to be standardized.

8.9 STOA Registry and Clearing Agency

a. STOA Registry and Central Clearing House to be established similar to depositories in the capital market.

8.10 Transparency

c. Detailed Statements related to Declared Capacity, Long-term/Medium-term/Short-term Schedule, Scheduled Transmission Losses, Interface Points (tie lines), Interchange Computation Formulae, CT/PT Ratio, Interface Energy Meter Data, Discrepancy Statements, Deviation Account, Energy Account, Reactive Energy Account, STOA charges, SLDC charges, Metered Transmission Losses, Pool Account Liabilities/Assets/Defaults/Reserves, etc. to be put in the public domain for reference and verification by the respective entities.

e. All Energy Statements and Accounts to be kept open for pre-defined duration for reconciliation at periodic intervals and correction of any errors/omissions.

f. Data to be shared for research and academic purposes.

8.15 Archival and Utilisation of Energy Meter Data

a. The data related with Implemented Schedule, Interface Energy Meter and Deviation to be archived by the SLDC and the State Power Committee.

b. Energy Meter Data to be used for Load Forecasting.

c. Energy Meter Data to be utilised for Big Data Analysis.

d. Archived data to be shared for research and academic purposes.

8.18 Governance Structure

b. The recommended governance structure with roles and responsibilities of various entities in the State for the energy accounting and settlement system to be notified by the SERC.

Accordingly, the data related to RE and non-RE OA should be appropriately standardised and tagged in line with present market structures for open access transactions in the country, and should be made available in the public domain. As many consumers avail open access as well as captive options, data collection and analysis should include captive consumers and generators as well. Some suggestions in this regard are detailed below (Prayas (Energy Group), 2017a):

a. Open access registry: The efforts of the CERC to initiate an open access registry are a commendable step in the right direction. However, it is also important that the data submitted via the registry is compiled, analysed and publicly disseminated. Such analyses can help identify issues with operationalising open access at an early stage and can help devise policy solutions. Data to be collated can include intra-state and inter-state magnitude of open access, name of consumer and details of industry, duration of contract, whether open access is for conventional power or renewable energy, as well as the region and state of the open access consumer.

b. Intra-state and inter-state market monitoring committee reports: The CERC Market Monitoring Committee Report is currently the only publicly available document which collates market related information. The scope of this report should be broadened to include open access trades for durations longer than one year, and if possible to include trends in captive and group captive markets. Similar to the CERC Market Monitoring Committee Reports, SERCs should publish reports tracking trends in the intra-state market which includes open access, captive options, renewable energy open access and banking and the performance of intra-state trading licensees.

c. Tariff petition and orders to have data and discussion on open access and captive power: Given the increasing impact of sales migration on the DISCOM operations and finances, it is pertinent to note that many DISCOMs do not comprehensively provide data on distribution open access and captive sales migration for their distribution area in the petitions and the annual revenue requirement (ARR) formats submitted during the tariff determination process. It is important that such information is used to analyse potential future scenarios in terms of demand, capacity addition requirements, and loss of revenue for the DISCOM. Category-wise data on sales migration as well as information on time of day (ToD) and seasons in which open access is availed would also help plan power procurement. DISCOMs should also submit category-wise data on open access and captive sales migration, revenue loss and revenue from charges such as additional surcharge, CSS, wheeling, etc. It should also submit information on whether the open access was for renewable energy or conventional power, the duration of the contract, the type of contract (RTC, peak, off-peak), standby power supplied, penalties imposed, and the contracted demand the open access consumer has retained with the DISCOM. With respect to captive sales migration, it should annually report open access sales to captive consumers, current shareholding pattern for group captive options, as well as standby power provided to captive consumers.

d. Central Electricity Authority (CEA) reports on captive power: As of today, the CEA is the only agency which reports the state-wise and industry-wise capacity and consumption of captive power plants with an installed capacity of greater than 1 MW. The CEA currently provides this information in its "General Review" publication. It is requested that this information be provided on an annual basis at the end of the financial year along with additional information on group captive plants and renewable energy based captive plants across states.

e. Compliance with specifications in existing regulations: Open access and trading license regulations across states have data submission related provisions with data formats to be filled by licensees on a periodic basis. Electricity Regulatory Commissions (ERCs) should ensure that such regulations are complied with to enable them to get a better sense of market-related trends. It is important that this information is also available in the public domain.

Availability of such data on RE-OA will throw greater light on its uptake and how it fares across states. This can help to analyse various hypotheses on whether RE-OA has seen an uptake solely due to the regulatory concessions in various states, or whether there are other reasons. Such analysis can significantly aid in better planning and decisions on the future trajectory of regulatory concessions.

3. OPEN ACCESS CHARGES

There are a variety of fees, charges and surcharges that consumers have to pay in order to avail electricity through open access. These are over and above the power purchase cost of the electricity itself. These include application fees, network (transmission and distribution) charges and losses, cross subsidy surcharge and additional surcharge, etc. details the variety of open access charges and their rationale. Some of the charges may or may not be applicable depending on the type of OA transaction (intra-state vs inter-state, bilateral transactions or through exchange).

Table 1 : Open access charges and their rationale

Open Access Charges	**Rationale**	**Who receives it**
Application fees	One-time fee for duration of open access to process the application for availing open access. Varies by type of OA transaction based on duration, injection or drawal points.	Nodal Agency depending on type of OA transaction based on duration, injection or drawal points.
NLDC application fees (power exchanges only)	Fees to process the application for collective transaction	National Load Dispatch Centre
NLDC/RLDC/SLDC scheduling and operating charge	Operating charge for daily scheduling, system operation, energy accounting	NLDC/RLDC/SLDC
Point of Connection (PoC) and transmission charge	Payment for the use of transmission network at ISTS/ InSTS level	Central Transmission Utility (CTU) / State Transmission Utility (STU)
PoC and transmission loss	Payment in kind to account for energy losses in the transmission network at ISTS/InSTS level	CTU/STU
Wheeling charge and loss	Payment for the use of distribution network and payment in kind to account for energy losses in the distribution network	DISCOM
Cross subsidy surcharge	Payment for compensating the distribution licensee for loss of cross-subsidy	DISCOM
Additional surcharge	Payment for compensating the distribution licensee for fixed cost of stranded generation capacity attributable to OA	DISCOM
Banking charge	Payment for banking the excess energy with distribution licensee	DISCOM
Standby charge	Payment for over-drawal above the contracted capacity with distribution licensee	DISCOM
Trading margin	Payment to the power trader for its service, if applicable	Trading licensee
Exchange charge	Payment to the exchange for processing power exchange transactions	Power Exchange

Source: Prayas (Energy Group) compilation based on transmission and distribution open access regulations

Apart from inter-state transmission charges, losses and trader margin which are determined by the CERC, all other important charges (CSS, AS, wheeling charges, intra-state transmission charges, banking charges, standby charges) are decided by the State Electricity Regulatory Commissions (SERCs). While national policies do have guiding principles for SERCs in terms of methodologies for determining such charges, there are some differences in methodologies across states. This is inevitable and rightly so, given the differences in sales mix, tariff design, power procurement mix and financial losses across DISCOMs. We limit our analysis to some important charges like CSS, AS and some renewable energy specific issues like concessional charges/waivers, energy banking and forecasting, scheduling, and deviation settlement penalty.

3.1 Concessional charges for RE-OA consumers

Various SERCs have been offering concessions/waivers in open access charges for renewable energy based open access. These concessions are in the form of reduced transmission charges, exemptions from payment of cross subsidy surcharge, nominal energy banking charges, reduced application fees, etc. Table 2 documents such concessions and waivers available in some RE rich states. It clearly brings out the significant differences in the charges and level of concessions across states.

The largest component of the charges, i.e. CSS, has seen a wide level of concessions across states, ranging from full waivers (Rajasthan, Madhya Pradesh), 75% waiver (Maharashtra) to 50% waiver (Tamil Nadu). Some states further differentiate between the applicability of concessions for wind and solar power. Gujarat gives a full waiver for solar projects, but only 50% for wind projects. Similarly, Karnataka gives a full concession for solar, but none for wind power. Andhra Pradesh and Telangana offer full waivers for CSS for solar projects for a period of five years after project commissioning. Maharashtra seems to be the first state which has completely removed the concessional rate for CSS from April 2017.

In terms of additional surcharge, most states don't offer any concessions while some states like Tamil Nadu and Andhra Pradesh do not even levy it. Only Gujarat offers a 50% concession for wind power.

For transmission and distribution (wheeling) network charges, again the picture is quite varied across states. Some states (Maharashtra, Rajasthan) offer no concessions, while Tamil Nadu offers a concessional charge of 30% for solar and 40% for wind. Andhra Pradesh offers complete waiver of such charges as well.

Payment of electricity duty has also been waived by many states for OA and/or captive projects. While Maharashtra introduced electricity duty on captive and OA consumers from September 2016, it re-granted the exemption from paying duty for RE generators and OA consumers since such a provision had already been provided under the renewable energy policy of the state issued in 2015 (MSEDCL, 2016a). Most other states also have a complete waiver of duty for solar projects.

Most renewable energy generation sources have seasonal and diurnal variations (especially wind and solar), and have low Capacity Utilisation Factors (CUF). Hence, a consumer opting for open access supply from such sources may seek open access permission for capacity greater than his stated drawal requirement (MERC, 2017). In such cases, renewable energy generation (from wind/solar) may not match with the demand of the RE-OA consumer in real time, resulting in excess generation (schedule of generator - schedule of consumer) in some time blocks, or excess demand in others. To integrate such differences in renewable generation and demand patterns, the banking mechanism mandates the DISCOMs to absorb the excess generation and notionally bank it with the DISCOM usually over one year. The RE-OA consumer is allowed to draw from this banked power as required, subject to some charges and time of day/seasonal constraints. Given the seasonal and diurnal variation in renewable energy generation, open access based on renewables would be quite unviable/impractical without some form of banking framework.

In terms of the energy banking framework, there are four elements to consider, namely the banking charge, banking period, restrictions on banking periods, and buy back rates for unutilised banked energy. Most states have a nominal rate of 2% of energy banked (in kind) as their energy charge. Andhra Pradesh is the only state which applies the 2% charge on total energy drawal under open access and not on energy banked. The banking period also varies from state to state, depending on the consumer type (captive or OA), generator type (Renewable Energy Certificates (REC) or non-REC), etc. but is mostly an entire year (April to March) in most states. Only Gujarat and Rajasthan have a monthly banking period. Some SERCs restrict the injection and drawal of the banked energy during certain time slots of the day and certain months depending on the time of peak load in the respective state. Finally, buy back rates for unutilised banked energy have generally been linked to the Average Power Purchase Cost (APPC) and range from 50%-100% of the APPC. However, Rajasthan is the only state which has pegged the buy-back rate at 60% of the large industrial category tariffs.

3.2 Landed cost of solar/wind and coal power through OA, an illustrative example of MSEDCL

In this section, we attempt to quantify the impact of such concessional open access charges for renewable energy through an illustrative example in the MSEDCL supply area. We assume an industrial consumer connected at the 33 kV voltage level comparing potential landed cost of power through open access via renewables (solar/wind) or coal. The analysis is done for the years 2015-16 to 2019-20. We further assume that the buyer and seller are both located within the state and must pay a power purchase rate of ₹ 3.5/kWh for power from coal. Considering the declining RE prices, the power purchase rate for solar and wind power has been assumed to decrease from ₹ 5/kWh to ₹ 3/kWh from 2015-16 to 2019-20.The effective banking charge is calculated assuming that around 40% ofthe energy generated is banked[7]. Also we assume the same banking charge of 2% of banked energy (in kind) for the coming years, valued at the landed cost of power (without banking charge). The cost of open access power from coal also includes a Renewable Purchase Obligation (RPO) cost which is calculated at the floor price of the Renewable Energy Certificate mechanism. The results of this example shown in Figure 7 and Figure 8 have been presented in per kWh terms for easy interpretation. We would like to re-iterate that this is an illustrative example and results are strongly linked to the various assumptions made for the purpose of these calculations.

Figure 7 shows that in 2015-16, in spite of the 75% waiver in CSS, the landed cost of wind/solar power is ₹ 0.45/kWh (7%) higher than that of coal-based OA, which is ₹ 6.21/kWh. This is mainly attributable to the difference in power purchase costs. However in 2016-17, landed cost of renewable-based OA was 11% lower than that of coal-based OA, partly due to the reduced RE power prices and waiver in CSS. Landed cost for coal and renewables in 2016-17 is much higher than the earlier year, mainly due to the introduction of the additional surcharge of ₹ 1.11/kWh.

From April 2017 the CSS concession has been withdrawn by the Maharashtra Electricity Regulatory Commission (MERC), thus requiring renewable energy open access consumers to pay the same rate as that from conventional power. Hence, going forward the major determinant for competitiveness will be the base price of electricity itself. With the low prices for wind and solar being discovered through bidding, it is very likely that renewables will be more cost competitive compared to coal under open access procurement, even if all concessions/waivers in charges are removed. Figure 8 shows the improving economics of renewable energy based open access primarily being driven by reducing power purchase costs. However, it might be prudent to have a gradual withdrawal of the concessions/waivers for renewable energy over two to three years rather than abruptly ending them at one point. A clear signal and roadmap in this regard from policy makers and regulators will give the industry and consumers ample time to plan for the coming years.

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[7] To estimate the percentage of banked RE- OA quantum, we projected the total RE-OA quantum for 2016-17 as 375 MU, based on actual figures for 2011-12 (572 MU) and 2015-16 (408 MU). The MSEDCL has stated that the total RE-OA quantum which was banked in 2016-17 was 160.3 MU. Hence, the estimate of ~40% of energy being banked, i.e. 160.3/375 (MSEDCL, 2017).

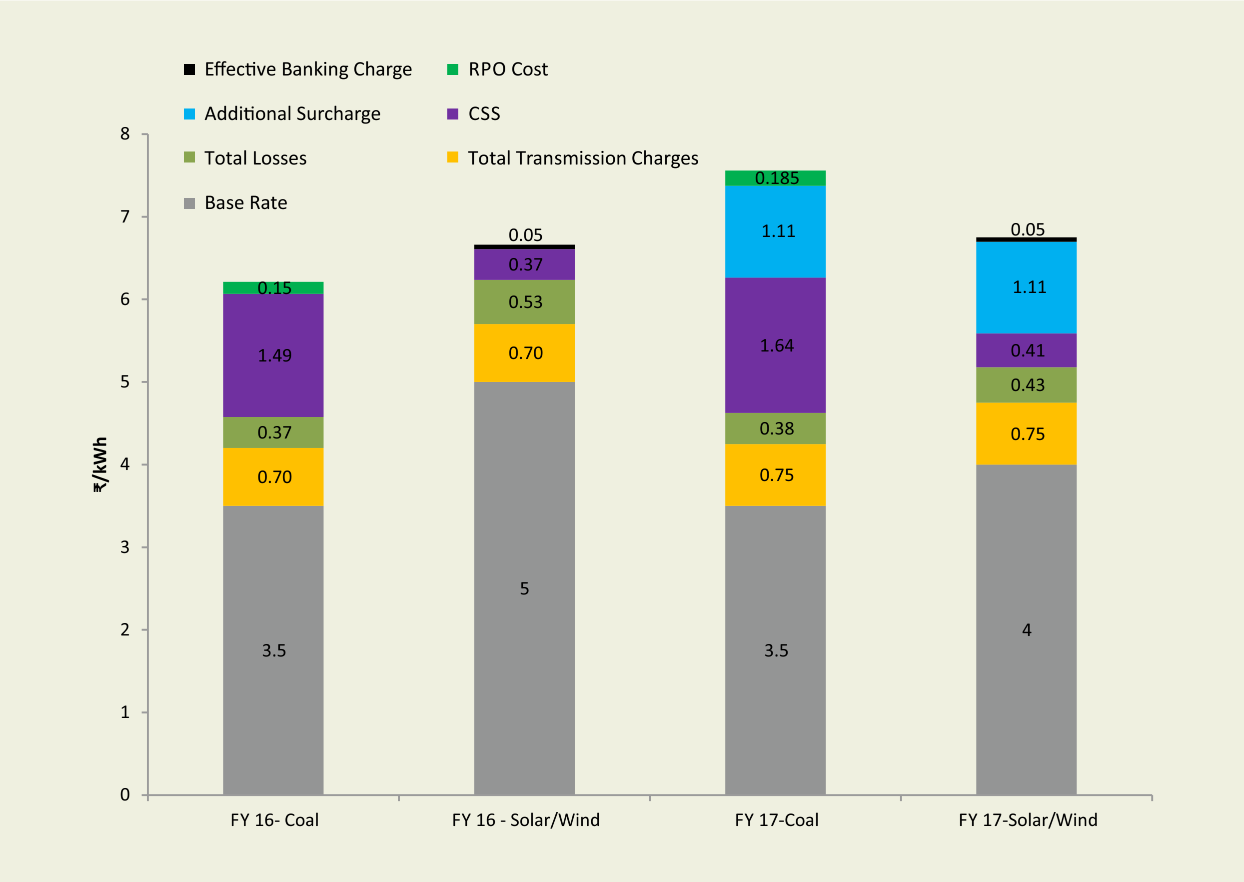
Table 2 : Existing concessional charges for renewable energy based open access

States	Tamil Nadu	Maharashtra	Rajasthan	Gujarat	Karnataka	Andhra Pradesh	Madhya Pradesh	Telangana
State Transmission	30% for solar (TNERC,2017a); 40% for wind. No concession for energy loss (TNERC, 2016a)	No concession (MERC, 2016a)	No concession (RERC, 2014)	No concession (GERC, 2015); (GERC, 2016a)		0% for both CPP and OA projects within the state (GoAP, 2015a); (GoAP, 2015b)	No concession	0% for captive projects within state; no concession for third party sale; no concession on energy loss (GoTS, 2015)
Distribution (Wheeling)	30% for solar (TNERC, 2017a); 40% for wind (TNERC, 2016a)	No concession (MERC, 2016a)	No concession (RERC, 2014)	50% wheeling charge and loss for CPP wind consumption below 66 kV (GERC, 2016a)	0% charges for solar OA/CPP (non-REC) within state (commissioned between 2013–2018 for 10 years) (KERC, 2014a) 5% in kind as wheeling charge for wind (non-REC CPP) (KERC, 2014b)	0% for both CPP and OA projects within the state Wheeling loss to be 0% for solar generators injecting at or below 33kV (GoAP, 2015a); (GoAP, 2015b)	2% in kind on injected energy with a grant of 4% of energy injected by the GoMP, the balance to be borne by RE beneficiary (MPERC, 2016a); (MPERC, 2016b)	0% for captive projects within state; no concession for third party sale; no concession on energy loss (GoTS, 2015)
Cross Subsidy Surcharge	50%(TNERC, 2017a);(TNERC, 2016a)	Was 25% up to Mar, 2017; no concession from Apr 2017 (MERC, 2016a)	0% (RERC, 2014)	0% (for Solar OA and CPP); 50% (for Wind OA and CPP); no concession for REC projects (GERC, 2015);(GERC, 2016a)	0% (solar OA within state) (KERC, 2014a); No concession for wind (KERC, 2017a)	0% (only for solar within state) for 10 year period after commissioning of projects (GoAP, 2015a)	0% (GoMP, 2012); (GoMP, 2013)	0% for solar giving power within state for 10 years from commissioning (GoTS, 2015)
Additional Surcharge	Not levied	No concession (MERC, 2016a)	No concession (RERC, 2016a)	50% for Wind, No concession for Solar (Government of Gujarat, 2015); (GERC, 2016a)	Not levied	Not levied at present by APERC but 100% exemption if applicable (only for solar within state) for 10 year period after commissioning of projects (GoAP, 2015a)	No concession (MPERC, 2017a)	Not levied

States	Tamil Nadu	Maharashtra	Rajasthan	Gujarat	Karnataka	Andhra Pradesh	Madhya Pradesh	Telangana
Electricity Duty	0% for solar power for self-consumption (GoTN, 2012)	0% for OA projects (MSEDCL 2016b)	0% for solar CPP (RERC, 2016b)	0% for wind and solar (CPP and OA projects within state) (Government of Gujarat, 2015); (GERC, 2016a)	No concession for solar and wind (Government of Karnataka, 2014)	0% for both CPP and OA solar projects within the state (GoAP, 2015a)	0% for solar and wind for 10 years from date of commissioning (GoMP, 2012); (GoMP, 2013)	0% for solar (CPP and OA) within state (GoTS, 2015)
Banking Charge	12% of banked energy in kind (wind) (TNERC, 2016a)	2% of banked energy (MERC, 2016b)	2% of banked energy, only for CPP (RERC, 2014)	2% of banked energy (wind) (GERC, 2016a)	0% (solar OA within state) (KERC, 2014a) 2% of injected energy (wind, mini hydel) (KERC, 2014b)	2% of energy delivered at the point of drawal APERC, (2016)	2% of banked energy (GoMP, 2013)	2% (solar) of energy delivered at point of drawal GoTS, (2015)
Banking Period	Apr to Mar (1 year) (TNERC, 2016a)	Apr to Mar (1 year) (MERC, 2016b)	1 month for CPP (RERC, 2014)	1 month only for CPP wind and solar projects and none for OA and REC projects (GERC, 2015);(GERC, 2016a)	1 year for non-REC;1 month for REC projects) (KERC, 2014a); (KERC, 2014b)	1 year (Apr to Mar) (APERC, 2016)	1 year (Apr to Mar) (GoMP, 2012) (GoMP, 2013)	1 year (Apr to Mar) (GoTS, 2015)
Banking Restriction	Adjustment of off-peak generation to normal/peak hours and generation to peak hours not allowed for wind power(TNERC, 2016a)	Un-banking not allowed in April, May, Oct, Nov Energy banked in cannot be used in peak hours (MERC, 2016b)	No restriction (RERC, 2014)	No restriction (GERC, 2016a)	No restriction (KERC, 2014a); (KERC, 2014b)	No drawal in Apr to June, Feb to Mar, and in peak hours (APERC, 2016)	Drawal has several seasonality constraints (15 Jul to 15 Oct, 23:00 to 24: 00 and 0:00 to 17:00), Nov to Feb keeping in view the availability of power and demand (MPERC, 2016a); (MPERC, 2016b)	No drawal from Feb to Jun and peak hours 18:00 to 22:00 (GoTS, 2015)
DISCOM buy back rate for excess, balance or unutilised	All balance at 75% of applicable wind tariff; All balance at 75% of applicable solar tariff after each	All excess, limited to 10% of total yearly generation at APPC (MERC, 2016b)	Only 10% of unutilised banked energy @ 60% of energy charges of large industrial	All excess at APPC for OA and CPP wind (non-REC)	APPC for captive REC projects and 85% of respective RE tariff for non-REC projects	All unutilised banked energy at 50% of pooled cost of power purchase (APERC, 2016)	For inadvertent flow of solar energy into system @ APPC; For inadvertent flow	Unutilised energy APPC (GoTS, 2015)

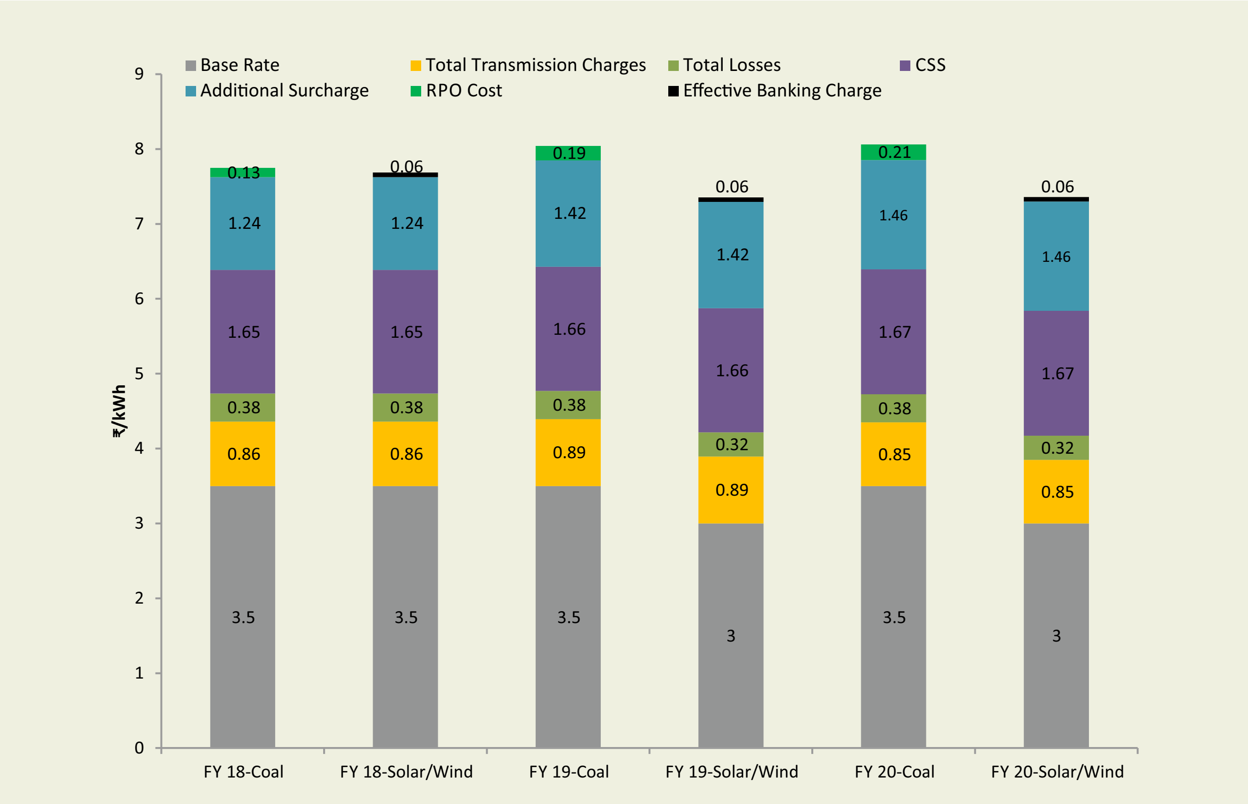
States	Tamil Nadu	Maharashtra	Rajasthan	Gujarat	Karnataka	Andhra Pradesh	Madhya Pradesh	Telangana
energy beyond banking period	billing period; All balance at 75% of APPC for REC projects (wind) (TNERC, 2016a)		tariff (excl. fuel surcharge) (RERC, 2014)	All excess deemed sale at APPC for captive solar (non- REC) All excess @ 85% of APPC for wind and solar REC (GERC, 2015); (GERC, 2016a)	(KERC, 2014a); (KERC, 2014b)		of wind energy into system @ ₹2.5/kWh (MPERC 2016a); (MPERC, 2016b)	
Others	Application fee for seeking connectivity to required distribution system reduced to 50% for cogeneration and RE sources (TNERC, 2014)	Application fee for seeking connectivity to distribution system reduced to 50% for RE based generators; Bank guarantee to nodal agency reduced to 50% for RE based transactions /MW for each time of OA (MERC, 2016b)	Highest priority for adjustment of energy drawal by OA consumer each time block is given to RE generation (RERC, 2016c)					100% refund of VAT/SGST for all inputs for solar projects for five years from 2015 (GoTS, 2015)

Figure 7 : Landed price of coal and solar/wind generators for MSEDCL OA consumers from 2015–16 to 2016–17



Source: Prayas (Energy Group) analysis based various MERC orders and regulations

Figure 8 : Landed price of coal and solar/wind generators for MSEDCL OA consumers from 2017–18 to 2019–20



Source: Prayas (Energy Group) analysis based on various MERC orders and regulations

3.3 Cross Subsidy Surcharge

CSS is the most significant of the open access charges and hence critical to ascertaining the viability of open access procurement in the future. It is levied to compensate the DISCOM for its loss of cross-subsidy needed to provide subsidised power for agriculture and low income residential segments. Table 3gives an idea of the level of CSS charges applicable in some states for 2017-18.

Table 3 : Existing concessional charges for renewable energy based open access

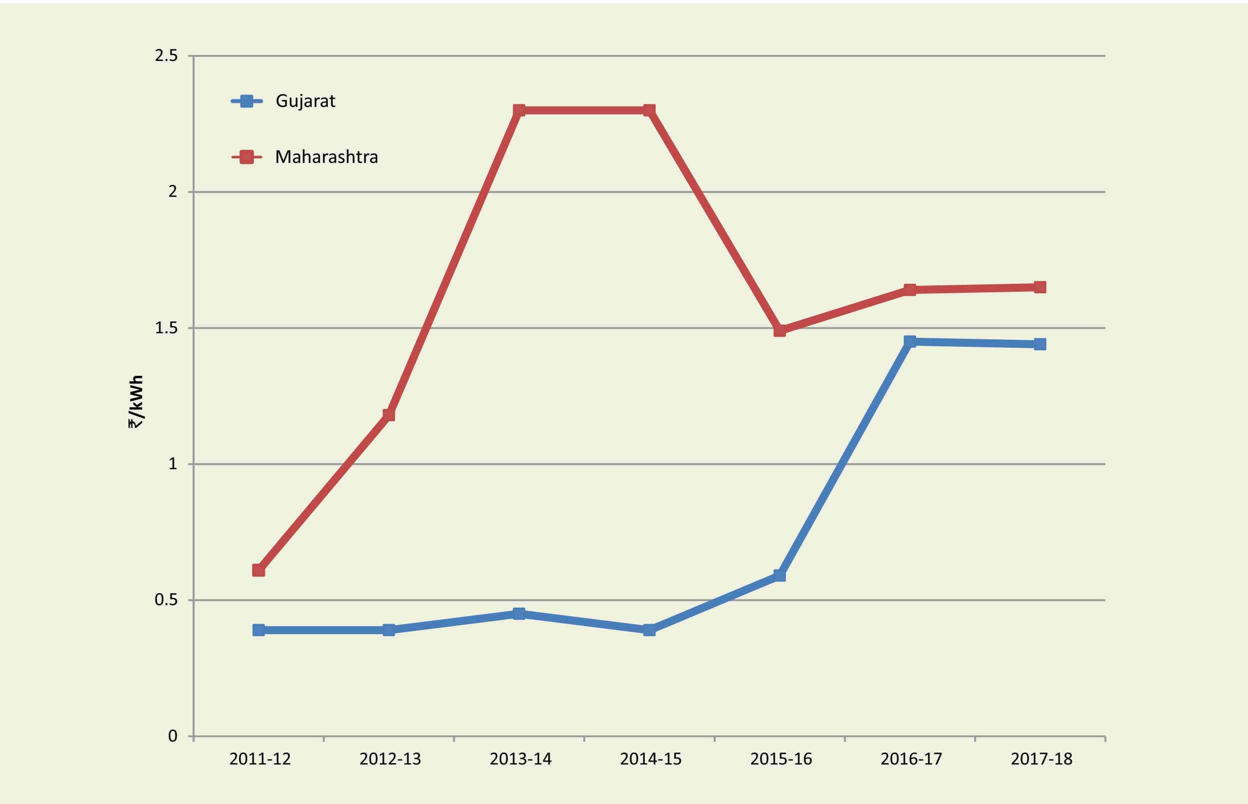
State	**Karnataka** (BESCOM) (KERC, 2017b)	**Andhra Pradesh** (APSPDCL, APEPDCL) (APERC, 2017)*	**Haryana** (HERC, 2017)	**Gujarat** (GERC, 2017a)	**Maharashtra** (MERC, 2016a)	**Telangana** (TSSPDCL, TSNPDCL) (TSERC, 2017)	**Tamil Nadu** (TNERC, 2017b)	**Madhya Pradesh** (MPERC, 2017b)
CSS (₹/kWh)	0-3.29	0-2.55 0-2.45	0.19-1.73	1.62	1.24-3.67	0.36-2.76, 0.21-3.55	1.67-2.26	0.44-4.71

Source: Gujarat Tariff Order 2017–18 and Maharashtra MSEDCL MYT for 2016–17 to 2019–20
Note: *As filed by DISCOMs

The National Tariff Policy (NTP), 2016 and the National Electricity Policy, 2005 state that while the CSS should compensate the DISCOM, it should not be too onerous to constrain competition through open access. Additionally, section 8.3(2) of the NTP 2016 specifies that tariffs should be brought within +/- 20% of the average cost of supply, and section 8.5.1 specifies that CSS should be capped at 20% of the tariff applicable to any category of consumers. SERCs have been capping the CSS at 20% of the respective consumer tariffs, without bringing tariffs for all consumer categories within +/- 20% of the average cost of supply (ACoS) (MoP, 2017).Thus, the current level of CSS approved by SERCs is clearly insufficient to completely recover the loss of cross-subsidy by DISCOMs (Jenny Heeter, 2016);(MoP, 2017). On the other hand, there is a sense from potential OA consumers that the CSS charge is still quite high, making open access unviable (PTI, 2016). Similar arguments have been made by the renewable energy industry, notwithstanding the various concessions offered by states on CSS (as documented in Table 2) (Electronics B2B, 2017);(Ramesh, 2017). It is indeed a difficult task for the regulators to determine a level of CSS which balances the need of both, the DISCOM and potential OA consumers.

Additionally, volatility and uncertainty of the CSS charges is a large barrier for any potential consumer to move away from STOA. Figure 9 illustrates this volatility in CSS for HT industry consumers of MSEDCL and the state DISCOMs in Gujarat from 2011-12 to 2016-17. Sometimes the category of consumers for which CSS is determined also changes over the years, as is seen in the case of MSEDCL consumers connected at 33 kV. From 2010-11 to 2015-16, CSS was determined separately for express and non-express feeders for all voltage levels, while from 2016-17 onwards this segregation of express and non-express feeders has been completely dropped. Such volatility and uncertainty completely undermines any possibility of long-term OA planning.

Figure 9 : CSS in Gujarat and Maharashtra from 2011–12 to 2017–18



Source: Prayas (Energy Group) compilation based on various MERC and GERC tariff orders.

Considering the above issues, we highlight some elements which should be necessarily considered while determining CSS.

1. CSS should be set at a level which does not deter competition through open access.

2. There should be medium-term certainty of the CSS charge to encourage consumers to move towards MTOA/LTOA instead of current practice of STOA and its associated problems of frequent switching.

3. CSS alone cannot fully compensate the DISCOM for loss in revenue due to sales migration, especially considering the rising consumer tariffs. Thus some form of additional transitional support from the state and central government is necessary. Such support can be provided through subsidies or via cross-subsidy with the levy of duties on all grid-connected consumers including captive consumers as suggested in the National Energy Policy (NITI Aayog, 2017). In the long run, DISCOMs need to fundamentally rethink their business models to account for the very likely large scale sales migration due to the increasing viability of alternative options. They should also strongly focus on reducing their average cost of supply through a variety of measures.

4. Any existing concessions/waivers of CSS for renewable energy based open access should be gradually removed. In any case, the economics of renewable energy based open access are primarily being driven by reducing power purchase costs rather than concessional charges (see Figure 8). A clear sunset clause in this regard from policy makers and regulators will make for a smoother transition to an era without concessions.

3.4 Additional surcharge

Section 42 (4) of the Electricity Act, 2003 enables the SERCs to levy an additional surcharge (AS) on the charges of wheeling to meet the fixed cost of the DISCOM, arising out of its obligation to supply. The NTP, 2016 makes it clear that such an AS '*... should become applicable only if it is conclusively demonstrated that the obligation of a licensee, in terms of existing power purchase commitments, has been and continues to be stranded, or there is an unavoidable obligation and incidence to bear fixed costs consequent to such a contract*'. Essentially, AS can be levied to recover backing down costs due to sales migration from OA.

Several states (for example, Punjab, Haryana, Maharashtra, and Gujarat) are grappling with a capacity surplus for the last few years, thereby necessitating an AS in those states. Table 4 shows additional surcharges applicable in some renewable rich states. However, out of these states open access was seen as a major contributor only in Rajasthan, where it contributed almost 60% of backed down power. In other states like Madhya Pradesh, Punjab and Maharashtra, OA contributed 3%, 10% and 25% of backed down power respectively (Prayas (Energy Group), 2017c).

Table 4 : Additional surcharge applicable in various states for respective periods

State	**Punjab** (PSERC, 2016)	**Haryana** (HERC, 2017)	**Gujarat** (GERC, 2016b)	**Maharashtra** (MERC, 2016a)	**Rajasthan** (RERC, 2016a)
Additional Surcharge (₹/kWh)	1.25	0.99	0.44	1.11	0.8
Applicable period	October 2016 to March 2017	Effective from July 2017	October 2016 to March 2017	Effective from November 2016	May 2016 to July 2016

Source: Prayas (Energy Group) analysis based on SERC orders for respective states

Additionally, the methodology for computation of AS varies across states, and depending on the power procurement mix, may result in over/under recovery of actual fixed costs of backed down power on account of OA. For details on the different methodologies used for computation of the additional surcharge in Gujarat, Maharashtra and Rajasthan, please see Table 5. Gujarat and Maharashtra use the fixed costs of the total available capacity and not the fixed cost of the specific backed down units due to OA while calculating AS. It is important to note that while backing down generally happens on a merit order (variable cost basis), the fixed costs of such backed down plants with higher variable cost may be quite different from the average fixed costs of the entire available capacity. States where older depreciated plants with high variable costs are backed down will have lower fixed costs than the DISCOMs average fixed cost for power procurement. Conversely, in states where the recently commissioned plants with higher fixed costs are being backed down, such as Maharashtra, Punjab, Madhya Pradesh and Andhra Pradesh, the fixed costs of the backed down plants will be higher than the average. This may result in under-estimating or over-estimating the additional surcharge.

Table 5 : Methodology of additional surcharge calculation by Gujarat, Rajasthan and Maharashtra

State	Frequency of computation	Formula for calculation of per unit additional surcharge
Gujarat	Bi-annually; using actual data of same six months of last year	{ [Fixed cost of total available capacity (₹/MW) X Average OA quantum (MW)] - Excess demand charges recovered from OA consumers by the DISCOM In addition to T&D Charges (₹) } / Scheduled OA energy (kWh)
Maharashtra	Annually; using projected and approved data for future year	{ Per unit fixed cost of total available capacity (₹/kWh) X Total projected backed down/RSD volume for year (kWh) X Ratio of average OA volume (kWh) to average backing down quantum (kWh) } / Projected and approved OA volume for year (kWh)
DISCOMs in Rajasthan[8]	Annually; using actual data of the previous year	{ Weighted average of unit fixed cost of each thermal generating stations with weight equal to contribution of each station in surrendered power (₹/kWh) X Surrendered power equal to lower of the back-down quantum and OA quantum (kWh) } / Quantum of surrendered power for year (kWh)

Source: GERC (GERC, 2017b), RERC (RERC, 2016a), MERC(MERC, 2016a)

[8] RERC did not allow full additional surcharge, as calculated by the DISCOMs, to be passed on to OA consumers to strike a balance between the interest of the DISCOMs and OA consumers.

Two important principles which can help in standardising the methodology for AS computation are as follows:

Firstly, average capacity backed down due to open access over the year (based on aggregate open access schedules and generation schedules on a 15 minute basis) should be used to determine the AS rather than the average energy backed down due to open access.

Secondly, as the fixed cost of backed down capacity can be very different from the average fixed cost of the distribution licensee's total power procurement, average fixed cost of only the backed down capacity due to open access demand should be considered while estimating additional surcharge. For more details on the way forward with regard to AS computation methodology, please see (Prayas (Energy Group), 2017a).

Finally, in terms of concessions, presently only Gujarat gives a 50% concession on AS for wind power, while the Andhra Pradesh policy has proposed a complete waiver of AS for solar projects within the state for five years after commissioning of projects. Similar to CSS, we suggest a gradual removal of all waivers/concessions to enable the growth of RE based OA on its own fundamental economic proposition rather than being driven by concessions.

3.5 Energy banking

3.5.1 Need for energy banking mechanism

Most renewable energy generation sources have seasonal and diurnal variations (especially wind and solar) and have low capacity utilisation factors (CUF). Hence, a consumer opting for open access supply from such sources may seek open access permission for capacity greater than his stated drawal requirement (MERC, 2017). In such cases, renewable energy generation (from wind/solar) may not match with the demand of the RE-OA consumer in real time, resulting in excess generation (schedule of generator - schedule of consumer) in some time blocks, or excess demand in others. To integrate such differences in renewable generation and demand patterns, the banking mechanism mandates the DISCOMs to absorb the excess generation and notionally bank it with the DISCOM generally over one year. The RE-OA consumer is allowed to draw from this banked power as required, subject to some charges and time of day/seasonal constraints. Given the seasonal and diurnal variation in renewable energy generation, open access based on renewables would be quite unviable/impractical without some form of banking framework.

3.5.2 Characteristics of existing energy banking mechanism

Table 2 documents important characteristics of the existing banking mechanism like banking charge, banking period, buy-back rate, restrictions on time of injection, and withdrawal of the banked energy across different states. It is clear from the table that there exists a wide variety of approaches in framing rules around energy banking. Additionally, we find that rules around energy banking have been specified in different types of documents in different states. For example, Maharashtra provides the details of energy banking in their distribution open access regulations, while Kerala provides the same in their renewable energy regulations. States like Gujarat, Rajasthan and Karnataka provide the same details in their wind and solar policies(KERC, 2014b, p. 9); (GoAP, 2015a, p. 5);(GoTS, 2015, p. 8).

Banking is presently allowed by SERCs upon levy of a banking charge which differs in magnitude across states. Additionally various attributes of the energy banking framework such as seasonality constraints, buy-back rates, accounting for RPO, etc. also differ across states.

The Andhra Pradesh Electricity Regulatory Commission (APERC) levies the banking charge on total energy drawal which implicitly assumes that all RE-OA consumers necessarily cause the same amount of banking, while MERC, the Madhya Pradesh Electricity Regulatory Commission (MPERC), the Rajasthan Electricity Regulatory Commission (RERC), and the Gujarat Electricity Regulatory Commission (GERC) levy it on the total energy banked by any RE-OA consumer. The difference between charges arrived using the above methods can be significant. Some SERCs apply banking charges 'in-kind' (adjusting in energy units and not in monetary terms), while the Haryana Electricity Regulatory Commission (HERC) applies the banking charge in monetary terms in ₹/kWh. The banking period also varies from state to state, depending on the consumer type (captive OA or non-captive OA), generator type (REC based or non-REC based), etc. but is mostly an entire year (April to March) in most states. Some SERCs restrict the injection and drawal of the banked energy during certain time slots of day and certain months depending on the time of the peak load in the respective states. Finally, buy-back rates for unutilised banked energy have generally been linked to the Average Power Purchase Cost (APPC), and range from 50% to 100% of the APPC. However, some states have also pegged the buy-back rate at a certain percentage of large industrial category tariffs or renewable energy generation tariffs. States also specify limits on the maximum amount of energy which can be bought back by the DISCOM at the end of the banking period. Though there are bound to be differences across states, given their unique circumstances, we feel that it would be better if principles used to define the energy banking rules are largely uniform across the states.

3.5.3 Critical analysis of existing banking mechanism and potential framework for the future

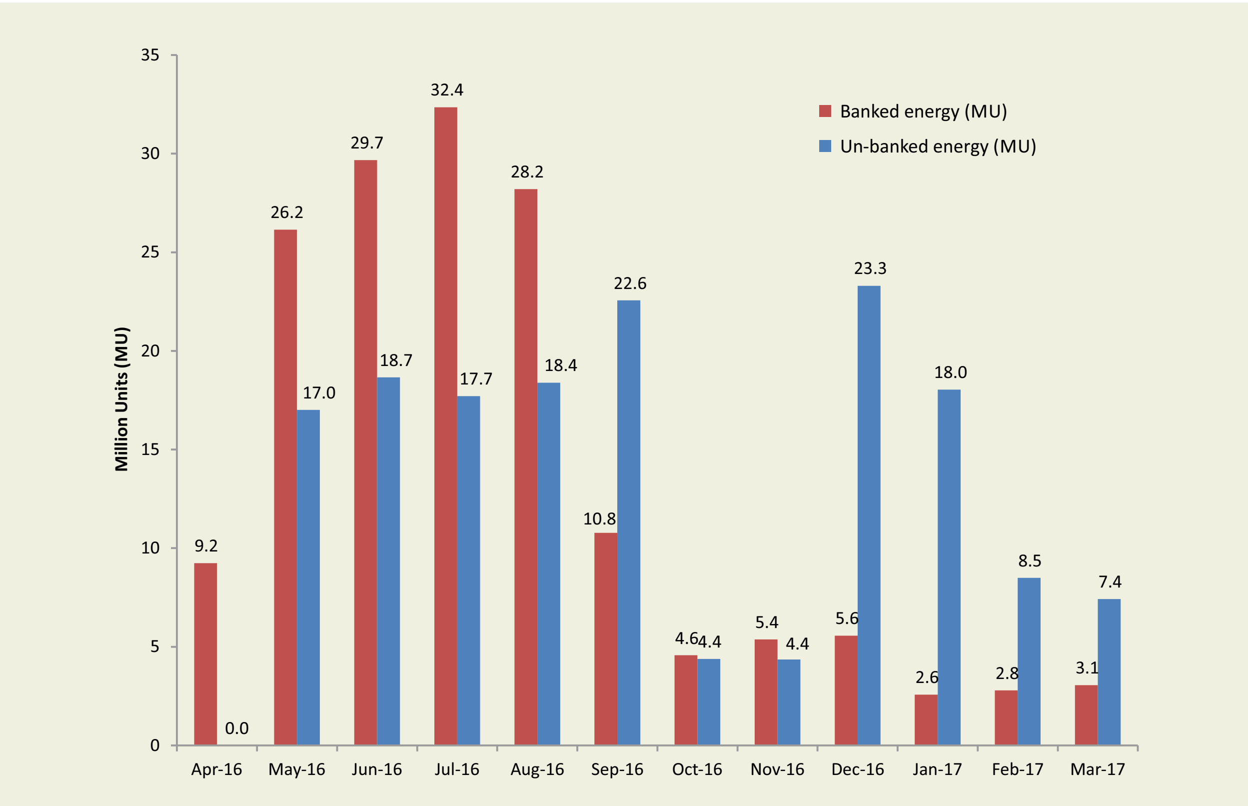
The MSEDCL has recently petitioned the MERC and proposed a new energy banking framework for renewable energy. This section critically examines the existing banking framework and the MSEDCL's proposed framework **as an illustrative example** to try and arrive at a principled approach for a renewable energy banking framework which could be adopted by any state in the future.

Banking Charge: Banking is presently allowed by most states upon levy of a nominal banking charge equal to 2% of the total energy banked. However, such 'in-kind' nature of the banking charge makes it difficult to calculate the financial impact on all the stakeholders involved (i.e. DISCOM and OA consumer). There can be a significant difference between the variable cost of power purchase of the DISCOM at the time of injection and drawal of the banked energy. The difference between these costs does get passed on to the non-open access consumers of the distribution utility, if such costs are higher than the value of the 2% (in most states) of banked energy.

In a recent petition (case 85 of 2017) before the MERC, the MSEDCL has brought up the issue of the financial loss it has incurred due to the existing banking mechanism. They argue that this is mainly because most of the renewable energy (predominantly wind) is banked during the monsoon season (and particularly at night time), when demand and hence prices of power for MSEDCL are at their lowest during the year. However un-banking of power (drawal) is done during months when the MSEDCL demand and hence power purchase price is higher. Figure 10 shows the monthly trend of banking and un-banking of energy by RE-OA consumers in the MSEDCL region for 2016-17. The difference between power purchase cost at the time of banking of energy and its drawal is passed on to the non-OA consumers of MSEDCL.The MSEDCL calculated the impact of such energy banking on its power purchase on 15 minute block basis as the difference between the lowest cost of generation displaced due to banking, and the highest cost of on bar generation at the time of drawal of the banked energy. They have pegged this financial loss at ₹ 11 crore for 2016–17 based on data for 228 RE-OA consumers availing banking.

A similar view on financial loss has also been expressed by DISCOMs in Karnataka (KERC, 2013). The KERC (2013) which earlier had an additional component of banking charge as difference *in Unscheduled Interchange (UI) charges at the time of injection and drawal to compensate for the difference in power purchase cost at the time of injection and drawal* has discontinued it via an order in July 2014.[9] Karnataka DISCOMs had argued that this charge is not able to compensate their loss in power purchase costs and is difficult to calculate. They have also pointed to the severe transmission corridor constraints to provide banked power to eligible OA consumers during the peak time.

Figure 10 : Monthly trend of renewable energy banking and un-banking in MSEDCL area in FY 16–17



Source: : Prayas (Energy Group) analysis based on MSEDCL petition in case 85 of 2017

[9] The HERC also has set a UI based banking charge to compensate the distribution utilities for the difference between power purchase cost at the time of banking of energy and its drawal. This charge which is to be paid by the generator is the difference between the UI charges at the time of injection and withdrawal. Such UI linked banking charges may not reflect the variable cost of displaced generation for the particular distribution utility, and may under or over compensate the DISCOMs.

Wind Energy Banking in Tamil Nadu

Prior to the Tamil Nadu Electricity Regulatory Commission's (TNERC) wind tariff order of 2012, energy banking was allowed at a nominal charge of 5% of banked energy (in-kind) (TNERC, 2012). Considering the financial loss due to the difference in power purchase at the time of banking and un-banking incurred by the Tamil Nadu Generation and Distribution Corporation (TANGEDCO), the Government of Tamil Nadu, and the Tamil Nadu Energy Development Agency objected to continuing the wind energy banking facility in the State Advisory Committee meeting held in March 2012. However, the open access consumers and generators availing banking facility argued for its continuation. Taking cognisance of these views, the TNERC analysed the prevalent banking mechanism in various states. It also looked at different options for trading of banked energy, procuring energy needed at the time of un-banking power, and ways to compensate TANGEDCO. It finally fixed the banking charge as the difference between the national average purchase cost through the bilateral trading segment, and the maximum preferential tariff for wind energy. This worked out to ₹ 0.94/kWh, would be levied on all the units drawn from the bank, and would continue till 31st March, 2013. All unutilised wind energy at the end of the banking period will be bought by TANGEDCO at a buyback rate of 75% of the relevant purchase tariff.

Aggrieved by the wind tariff order of 2012, the Indian Wind Turbine Manufacturers Association (IWTMA), the Indian Wind Power Association (IWPA), the Southern India Mills Association (SIMA),etc. challenged it in the Appellate Tribunal for Electricity (APTEL). They raised methodological issues on banking charge calculations and also pointed out the abrupt increase in the charge from 5% (which they estimated at 28.46 p/kWh) to ₹ 0.94/kWh. Subsequently, in May 2013, the APTEL directed the TNERC to reconsider the computation of the banking charges after due public consultations (APTEL, 2013). It also directed the TNERC to keep in view the APTEL's observations made in Appeal No 98 of 2010 (APTEL, 2011); (Tamil Nadu Electricity Board (TNEB) appeal of TNERC wind order of 2009), wherein they had upheld the TNERC decision to reject the increase in the banking charge from 5% to 15% as proposed by the Tamil Nadu Electricity Board(TNEB).

During the ensuing public consultations, the IWPA, IWTMA and Tamil Nadu Spinning Mills Association submitted that TANGEDCO had not supported their argument for incurring losses with appropriate data (TNERC, 2016b). They also questioned the TNERC's method of calculating banking charge using national average power purchase cost of bilateral trades, and the maximum preferential wind tariff applicable in the state. Instead, they claimed that a 'scientific way' of calculating the banking charge as the difference between the average cost of power incurred by TANGEDCO (at ₹4.05 for the year 2011-12), and the average sales realisation per unit (at ₹4.99 for the year 2011-12) would satisfy regulatory requirements. This would mean that there is actually no loss to TANGEDCO due to banking!

Counter arguing, TANGEDCO submitted that the banking obligation is causing it high financial losses considering the increase in volume of unutilised banked energy from 2008 to 2013, and the difference in power purchase cost at the time of energy banking and un-banking. Questioning the methodology of computing the banking charge suggested by the IWTMA and IWPA, TANGEDCO calculated separate banking charge in windy and off-wind season. This was equal to the difference between the state average power purchase cost and average wind tariff in the state, and resulted in a banking charge of ₹1.22/kWh and ₹1.89/kWh in windy and off-wind seasons respectively for the year 2011-12. Further, arguing that banking is a **service provided** by the DISCOM, just like wheeling and transmission, it asked the TNERC to determine the banking charge in two component (a) service charges for banking, and (b) compensation charges for banking consisting (i) the rate at which the energy to be banked, and (ii) the rate at which the energy is to be redrawn from the bank.

The TNERC in its decision accepted the need for gradually removing the concessional banking framework. However, siting difficulties and complexities in the calculation of the actual cost of banking, especially in the absence of sufficient data, the commission continued with its method of fixing an in-kind energy charge of 10% (TNERC, 2016b). This was revised to 12% in its comprehensive tariff order on wind energy order No 3 of 2016 dated 31st March, 2016 (TNERC, 2016a).

MSEDCL proposal : The MSEDCL has proposed a banking mechanism that is based on the difference between power purchase cost at the time of banking of energy and its drawal, which is revenue neutral to both the DISCOM and the consumers eligible for banking. This would also entail a change from an 'in-kind' banking charge to a monetary charge. In its proposed method, the MSEDCL would value the banked energy at the lowest variable cost of backed down power for the respective 15 minutes time slot. When the customer draws power (un-banking), he would have to pay the difference between lowest variable cost of backed down power at the time of banking and highest variable cost of on-bar power[10] at the time of utilisation of the power. Figure 11 shows the monthly average monetary value (in ₹/kWh) of the banked energy (blue bars) and un-banked energy (red bars) at the lowest variable cost of backed down power and highest variable cost of on-bar power respectively. The monetary value of the banked energy is lower in the monsoon months because of the low load, high wind and hydro generation. The value of un-banked energy units is highest in the summer months with higher load. The difference in the value of banked and un-banked energy, as depicted by the green line, also points to likely banking in times of low demand (and hence prices), and un-banking in times of high demand (and hence higher prices).

Apart from the methodology for valuing banked/un-banked energy, the MSEDCL has also proposed to limit energy banking to only one month[11] unlike the existing framework which allows banking over the whole year (April to March). Additionally, unutilised banked energy in that month, limited to 10% of the total actual generation in that month, would be considered as deemed purchase by MSEDCL at its lowest variable power purchase cost for that month (buy-back rate), and such power shall be eligible for its renewable purchase obligation (RPO). Energy banked in excess of this 10% threshold would lapse. Finally, the MSEDCL has also proposed that if the above framework comes into place, there is no need for the seasonal and time-of-day banking/un-banking constraints as imposed under section 20.4 of the existing regulations (MERC, 2016b); (MSEDCL, 2017).

The analysis of the Prayas (Energy Group) based on MSEDCL data provided in petition 85 of 2017 shows that the RE-OA consumer would have to pay anywhere between ₹0.22 to ₹0.81/kWh of banked energy as the banking charge. On average this works out to be ₹0.69/kWh of banked energy for the year 2016-17.[12] The monetary value of the current 'in-kind' banking charge (2% of the banked energy), valued at the average lowest variable cost of backed down power per month, works out to a mere ₹0.04/kWh of banked energy. If we assume that roughly 40% of the total renewable energy based OA consumption is banked, this would increase the landed cost of each unit of power by ₹0.28/kWh (40% of ₹0.69/kWh). As Figure 8 shows, the landed cost of wind/solar power based OA in the MSEDCL area in 2017-18 is estimated to be ~ ₹7.69/kWh. This assumes a power price of ₹3.5/kWh, and includes the existing 2% in-kind banking charge which is valued at ₹0.06 per kWh consumed. A move to the proposed banking valuation framework would increase the landed cost of each unit of power by ₹0.22/kWh (₹0.28/kWh - ₹0.06/kWh), resulting in a 3% increase in price.

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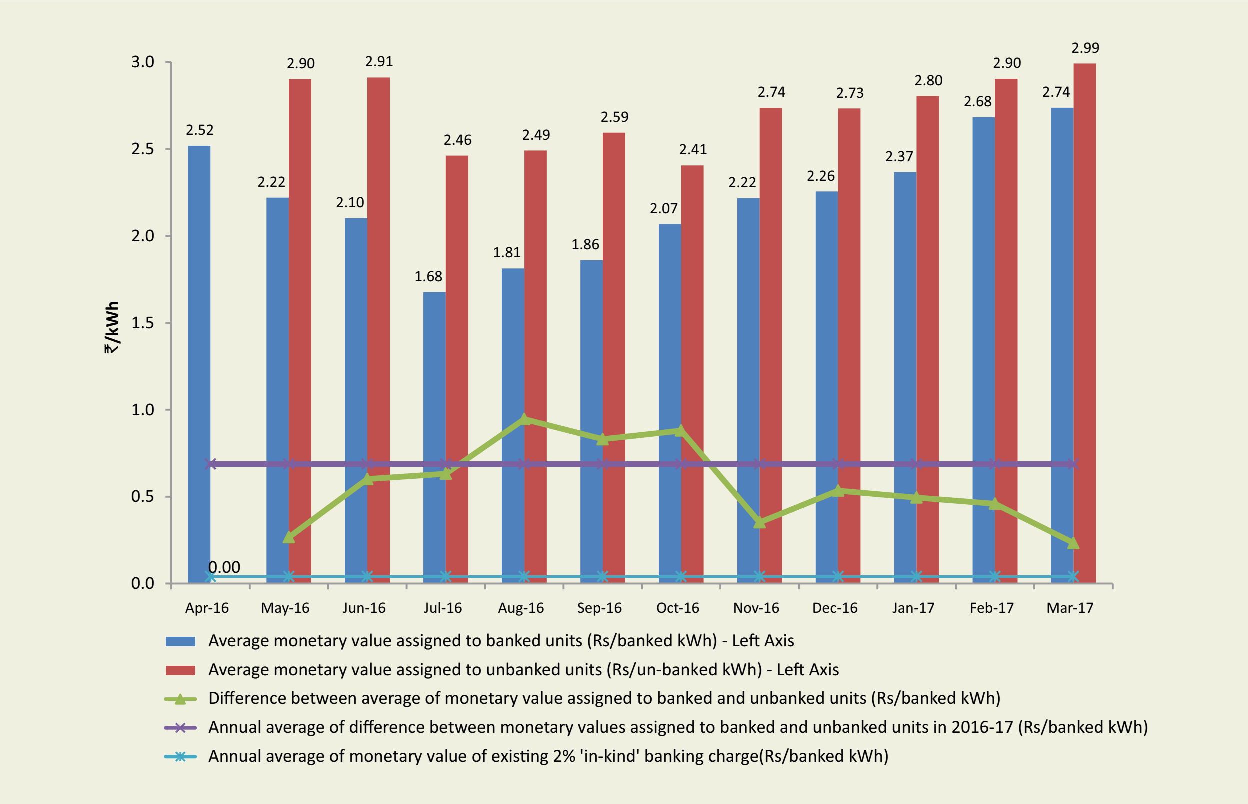
[10] We have interpreted 'highest variable cost of on-bar power' to mean 'the highest variable cost of the dispatched power (including any power bought from exchanges)'.

[11] MSEDCL in its first submission in petition 85 of 2017 had proposed a yearly banking period.

[12] These calculations assume a yearly banking period in line with the existing framework.

Figure 11 : Average monetary value of banked and un-banked energy (₹/kWh) in MSEDCL area in FY 16-17



Source: Prayas (Energy Group) analysis based on MSEDCL petition in MERCcase 85 of 2017
Note: No un-banking of energy took place in April 2016.

It is important to note that this data is specific to MSEDCL, and charges emanating from such a framework may vary a lot across DISCOMs, depending on its load shape and procurement mix. Additionally, these calculations are based on average values, and that for any particular consumer may vary significantly depending on his load and generation profile. Also as the share of solar-OA is likely to increase, the MSEDCL could see more energy being banked in summer months and in day-time, which could be beneficial to them going ahead. As the share and scale of RE-OA increases, an effective banking charge would be crucial to avoid DISCOM losses.

Such a framework (linking the banking charge to merit order dispatch of the DISCOM) will also enable the market to compare the cost of flexibility and value addition by other options such as grid level storage, demand response, demand aggregation, hybrid wind-solar projects, etc. to overcome the seasonal and diurnal variations in wind and solar generation. Innovative new business models using a mix of these above strategies are very likely to emerge to reduce such cost of energy banking and thereby contribute to reducing the overall cost of RE grid integration.

At present, all open access charges are known in advance and can be used to assess the viability of alternative electricity sourcing options. However, detailed calculation for banking charge as presented above can only be done post facto. This will possibly increase the uncertainty and risk of RE-OA viability, as multiple factors like DISCOM demand, variable cost of generators in merit order stack of the DISCOM, and network constraints occurring in the year will contribute to the banking charge.

View of Prayas (Energy Group) on a new banking framework

Any proposed framework for valuing banked and un-banked energy at the lowest variable cost of backed down power and highest variable cost of dispatched power respectively, is a good starting point, especially with low level of renewable based open access. However, as the quantum of banking done by renewable based open access increases in the future, a better framework may become necessary. One possibility could be as follows. The banked energy could be valued at the weighted average variable cost of the backed down generators due to total banked renewable open access quantum. Similarly, at the time of drawal, the energy can be valued at weighted average variable cost of additional generators which are dispatched. The renewable open access consumer availing the banking should be required to pay the difference between these weighted average costs. Such a framework would be more accurate in estimating the banking charges, especially if more than one generation unit is backed down or dispatched due to banking/un-banking. Also, in order to ensure a fair banking mechanism for both (DISCOMs and RE-OA consumers), if the monetary value of the banked energy is higher than that of the un-banked energy, the DISCOM should pay the difference to the RE-OA consumer.

We strongly feel that the energy banking period should not be limited to one month with arbitrary caps like 10% of monthly generation as proposed by the MSEDCL. A yearly banking period is necessary, since there is a strong seasonal element to wind and solar generation profiles through the year. Also, since the banked energy is fully valued, both at the time of banking and drawal, there should not be any time of day based constraints on the drawal of the banked energy unless there are network constraints. Since all the banked and un-banked energy in valued in monetary terms and settled either on a monthly basis or at the end of the year, there is no need for specifying any buy-back rate for excess power banked with the DISCOM at the end of the month/year as was needed in the erstwhile banking framework. However, the green attribute of any unutilised banked energy at the end of the year should be credited to the DISCOM's RPO.

Since wind and solar power have relatively low CUFs (20–30%), open access consumers may seek permission for open access generation capacity greater than their stated drawal requirement. However to ensure that the energy banking service provided by any DISCOM is not misused, there is a need to cap the maximum renewable generation capacity that can be procured in relation to the contract demand. A principle which can be considered for this purpose is that the renewable energy capacity contracted should be such that there is no significant excess generation (say up to 10–15%) over the yearly energy demand of the consumer.

Table 6 compares the current banking mechanism of the MERC, proposed mechanism by the MSEDCL, and suggestions by Prayas (Energy Group).

Table 6 : Comparison of existing,proposed (by MSEDCL) & Prayas (Energy Group's) suggestions with regard to energy banking mechanism

Parameter	MERC's existing mechanism	MSEDCL's proposed mechanism	Suggestions by Prayas (Energy Group)
Banking Charge	2% of banked energy	Banked energy valued at the lowest variable cost of backed down power for the respective 15 mins time slot. Un-banked energy valued at highest variable cost of on-bar power at the time of utilisation of power for each 15 mins time slot. Customer pays the DISCOM the difference between these two values on monthly basis.	We agree with this approach if, 'highest variable cost of on-bar power' means 'the highest variable cost of the dispatched power (incl. any power bought from exchanges)' Also if the value of banked energy is higher than the un-banked energy, DISCOM should pay the difference to the consumer.
Banking Period	One year (Apr-Mar)	One month	One year (Apr-Mar)
Un-banking restrictions	Un-banking (drawal) not allowed in Apr, May, Oct, Nov. Also energy banked in off-peak period not allowed for drawal in peak time period.	No time of day or seasonal restrictions on un-banking	No time of day or seasonal restrictions on un-banking
Buy back rate for unutilised banked energy	@ Pooled 'Cost of Power Purchase', settled at the end of the banking period	@ 'Lowest variable power purchase cost for that year' settled at the end of the banking period	No need of buyback rate since the surplus or deficit in monetary terms with respect to each consumer shall be settled on a yearly basis.
RPO accounting for unutilised banked energy	Unutilised banked energy not eligible for RPO fulfillment of DISCOM, but RE generator eligible for RECs	Unutilised banked energy eligible for RPO fulfillment of DISCOM	Unutilised banked energy eligible for RPO fulfillment of DISCOM
Maximum quantum allowed for buy back	10% of the total annual generation from the contracted RE-OA capacity	10% of the total monthly generation from the contracted RE-OA capacity	No need for this parameter However there should be an upper cap on renewable energy capacity allowed to be contracted such that there is no significant excess generation (say up to10%) over the yearly energy demand of the consumer.

3.6 Forecasting, scheduling and deviation settlement charges

Forecasting, scheduling and deviation settlement mechanism regulations (F&S) for wind and solar generators have until recent times been a critical missing piece in the Indian renewable energy scale-up process. They have been recently made operational at the regional level and in a few states (Karnataka, Andhra Pradesh, Chhattisgarh, etc.), while they remain in draft stage in various states. These regulations are indispensable for better day ahead scheduling of demand/generation and more effective grid operation. Also these regulations are applicable to all wind and solar generators, irrespective of whether they are connected to the intra-state/inter-state grid, or their procurer (DISCOM, Open Access, Captive). For more information on these regulations please see (Prayas (Energy Group), 2016) and (Prayas (Energy Group), 2017d).

Variable renewable generation (wind and solar) has diurnal and seasonal variations and cannot be forecasted with 100% accuracy. Considering this, F&S regulations, at the central and state level (for most states), allow some deviation without penalties (~ 10-15% deviation with respect to available capacity). Beyond such a threshold, there are graded deviation penalties which increase as the level of deviation increases. The Forum of Regulators in their model deviation settlement mechanism (DSM) regulations proposed an absolute value (in ₹/kWh) based deviation charge for the intra-state OA transactions. Most states have adopted/proposed a similar framework with penalties of ₹0.5/kWh (~15-25% deviation), ₹1/kWh (~25-35% deviation) and ₹1.5/kWh (~> 35% deviation). However, all inter-state OA transactions have deviation penalties specified as a percentage of their PPA tariffs unlike the absolute value specified above (FoR, 2017). An exception to this is made for inter-state and intra-state OA transactions wherein the buyer is not accounting for the RPO (i.e. REC and captive projects). For such transactions, deviation penalty is linked to the national APPC as specified by the CERC. The differences in the DSM penalties for three such RE-OA transactions are shown in Table 6.

Table 7 : Illustrative comparison of DSM penalties for different RE-OA transactions

Type of OA transaction	DSM penalty linked to	Percentage Deviation			
		0–15%	15–25%	25– 35%	>35%
		Deviation Penalty (₹/kWh)			
		0%	10%	20%	30%
Inter-state OA transactions	PPA tariff. We have assumed ₹2.65/kWh as the recently discovered solar price for this example.	0	0.265	0.53	0.8
Inter-state and intra-state OA transaction wherein buyer is not accounting for RPO (REC and captive projects)	National Average Power Purchase Cost as determined by CERC. It was ₹3.48/kWh for 2016–17(CERC, 2017b).	0	0.35	0.70	1.04
Intra-state OA transactions	Fixed absolute value penalty specified in ₹/kWh	0	0.50	1.00	1.50

Source: Prayas (Energy Group) analysis

Assuming a hypothetical solar project with a tariff of ₹2.65/kWh, the DSM charges it pays for an intra-state transaction are significantly higher than those in inter-state transactions. Hence the impact of DSM penalties for a project can vary significantly just based on the type of transaction. This points to the urgent need to transition intra-state transactions to a schedule based payment, thereby linking their DSM charges to their PPA tariffs. Until this is done, the absolute value penalty specified in ₹/kWh for intra-state transaction should be revised more frequently to bring it in line with market realities.

The recent consultation paper on OA recognises the high deviations between scheduled and actual drawal power being practised by the short-term OA consumers (MoP, 2017). Presently, DSM penalties on this account are borne by the DISCOM (in most states). Hence, going forward, there is a need for an equitable, transparent mechanism to share the burden. Some form of back-to-back (DISCOM to OA consumer) application of UI charges can be thought of as a solution.

3.7 Network charges

Some states allow for concessional wheeling and intra-state transmission charges for RE-OA as has been documented in Table 2. A peculiarity observed in Karnataka and Madhya Pradesh is the levying of wheeling charges 'in-kind'. It might be prudent to switch to a wheeling charge specified in ₹/kWh so that the true cost of distribution is more clearly represented for OA consumers in these states.

In terms of intra-state transmission charges, most states levy them on a per kW/MW basis. Maharashtra is an exception as it presently levies transmission charges for STOA on a per kWh basis.It pays the state transmission utility (STU) on a per MW basis for the entire booked transmission capacity, while the OA consumers at times do not utilise the network up to its contracted demand. Hence, there may be an under-recovery by MSEDCL, leading to losses. Specifically with regard to RE-OA consumers, since the CUF of wind and solar generators is low (20-30%), transmission charges on a per kWh hour basis would certainly lead to losses (Jenny Heeter, 2016).The MSEDCL has recently filed a petition (case 98 of 2017), with the MERC requesting a shift to a per MW basis for charging for transmission network use. We feel that this is an appropriate way forward since transmission planning and use is done on a capacity basis and not on energy basis.

4. SUMMARY

In spite of the growth in short-term open access transactions through the power exchanges (see Figure 2) over the last few years, the existing open access framework has not been implemented in the same spirit as envisaged in the Electricity Act, 2003 (Lok Sabha Secretariat, 2015), and is yet to realise its full potential (CERC, 2016). OA continues to face a large number of challenges and operational difficulties. The total quantum and the percentage of open access consumption as a share of total power procurement has been increasing steadily (see Figure 4) from 2014-15 to 2016-17 across all states analysed in the report. The quantum of RE-OA has increased in all states over this time period except in the case of MSEDCL[13] (see Figure 5). However, it varies significantly across states depending on a variety of factors. Also, wind power currently enjoys a lion's share within the total RE-OA consumption, with the exception of Madhya Pradesh, which has a higher share of solar power based OA (See Figure 6). Given the rapidly falling price of wind and solar power, renewable energy based open access and captive options are likely to pick up in a big way in the coming years. More importantly, considering the unique characteristics of renewable energy generation like intermittency, seasonality, etc. coupled with concessional OA charges in some states and provisions like energy banking will bring newer challenges for the open access framework.

Gradual withdrawal of concessions/ waivers in OA charges for renewables: Currently, there are various concessions/waivers in OA charges for renewable energy based OA. These are in the form of lower CSS (in many states), lower network charges (in some states) and lower AS (in few states). These measures have indeed contributed to promoting RE-OA in many states. However, given the falling prices of renewable energy, especially for wind and solar, such concessions are increasingly becoming unnecessary (see Figure 8). The costs not recovered though such concessions are either passed on to the non-OA consumers of the DISCOM, or become part of the DISCOM's growing losses. If the state or the central government deems it necessary to promote renewable energy open access, such costs incurred by the DISCOMs should ideally be compensated by way of subsidies by the appropriate government. However it might be prudent to have a gradual withdrawal of the concessions/waivers for RE-OA over a two to three year period rather than abruptly ending them at one point. A clear signal and roadmap in this regard from policy makers and regulators will give the industry and consumers ample time to plan for the coming years. This will also encourage the growth of RE based OA on its own as a fundamental economic proposition rather than being driven merely by concessions.

Medium-term certainty needed in Cross Subsidy Surcharge and standardising the methodology for calculating Additional Surcharge: It is indeed a difficult task for the regulators to determine a level of CSS which balances the interests of both, the DISCOM and potential OA consumers. However, we feel that CSS should be set at a level which does not deter competition through open access. At the same time, there should be medium-term certainty of the CSS charge to encourage consumers to move towards MTOA/ LTOA instead of the current practice of STOA and its associated problems of frequent switching. CSS alone cannot fully compensate the DISCOM for loss in revenue due to sales migration, especially considering the rising consumer tariffs. Thus some form of

[13] Data for 2016-17 was not available for MSEDCL.

additional transitional support (via subsidies or through duties) from the state and central government is necessary. In the long run, DISCOMs need to fundamentally re-think their business models to account for the very likely large scale sales migration due to the increasing viability of alternative supply options. The methodology for computation of AS account for the very likely large scale sales migration due to the increasing viability of alternative supply options. The methodology for computation of AS varies across states and may result in over/under recovery of actual fixed costs of backed down power on account of OA. Two principles for standardising AS calculation methodology could include, a) the use of 'average capacity backed down due to open access' instead of energy backed down and b) use of 'average fixed cost of only the backed down capacity' rather than 'average fixed cost of the distribution licensee's total power procurement'.

Towards a new energy banking framework appropriately valuing banked and un-banked energy: Some form of energy banking is essential for the growth of RE-OA considering the seasonal and diurnal variation of renewable energy generation. At present, there exist a wide variety of approaches in framing rules around energy banking across states (see Table 2). We feel that there is an urgent need to move away from the existing practice of levying nominal 'in-kind' charges for banking. An appropriate way forward would be a yearly banking mechanism that is based on the difference between power purchase cost at the time of banking of energy and its drawal, which is revenue neutral to both the DISCOM and the consumers eligible for banking. Such a framework (linking the banking charge to merit order dispatch of the DISCOM) will also enable the market to compare the cost of flexibility and value addition by other options such as grid level storage, demand response, demand aggregation, and hybrid wind-solar projects to overcome the seasonal and diurnal variations in wind and solar generation. This framework would also make any monthly, seasonal and ToD restrictions on banking/un-banking redundant.

Need to re-align DSM penalties for different OA transactions: Considering the limitations of existing forecasting accuracy, F&S regulations, at the central and state level (for most states), allow some deviation without penalties (~ 10-15% deviation with respect to available capacity). Beyond such threshold, there are graded deviation penalties which increase as the level of deviation increases, but vary depending on the type of OA transaction. Our calculations show that for a hypothetical solar project with a tariff of ₹2.65/kWh, the DSM charges it pays for an intra-state transaction are significantly higher than those for inter-state transactions. Hence the impact of DSM penalties for a project can vary significantly just based on the type of transaction. This points to the urgent need to transition intra-state transactions to a schedule based payment, thereby linking their DSM charges to their power purchase agreement (PPA) tariffs. Until this is done, the absolute value penalty specified in ₹/kWh for intra-state transaction should be revised more frequently to bring it in line with market realities.

Dire need for greater data availability in the public domain: Availability of data regarding open access is extremely poor, spread across multiple sources and thus was a strong hindrance to critical analysis. Data specific to renewable energy based OA transactions is further not uniformly available across sources. This prevents an objective discussion on various policy-regulatory challenges like a roadmap for removal of concessions for renewable energy, impact of banking on DISCOMs, etc. Hence it is vital that SERCs ensure monitoring of intra-state OA transactions and collate appropriate data. Building on the recommendations of SAMAST (see box 1), we feel the need for a more comprehensive OA registry complemented with periodic intra-state and inter-state market monitoring committee reports. Detailed OA data (both captive and non-captive) should also be included in tariff orders of

DISCOMs. We strongly feel that the data related to RE and non-RE OA (including captive power) should be appropriately standardised and tagged, in line with present market structures for open access transactions in the country, and should be made available in the public domain. Finally, all applicable OA charges and concessions are presently documented in a variety of documents including DISCOM tariff orders, renewable energy tariff regulations, open access regulations, renewable energy policies, state government notifications, etc. Detailed documentation of all charges and waivers in one place can help potential consumers make more informed choices.

Independent and empowered SLDCs: SLDCs play a critical role in operationalising open access and remain a weak link in the whole process. Truly independent and empowered SLDCs with adequate and effective measures for ring-fencing them from DISCOMs are a necessary step for realising the full potential of open access.

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6. ANNEXURES

Annexure I

The CERC's market monitoring report collates data on 'short-term transactions of electricity' (CERC, 2017a). These refer to the contracts of duration less than one year for the following trades:

(a) Electricity traded under bilateral transactions through Inter-State Trading Licensees (only inter-state trades),

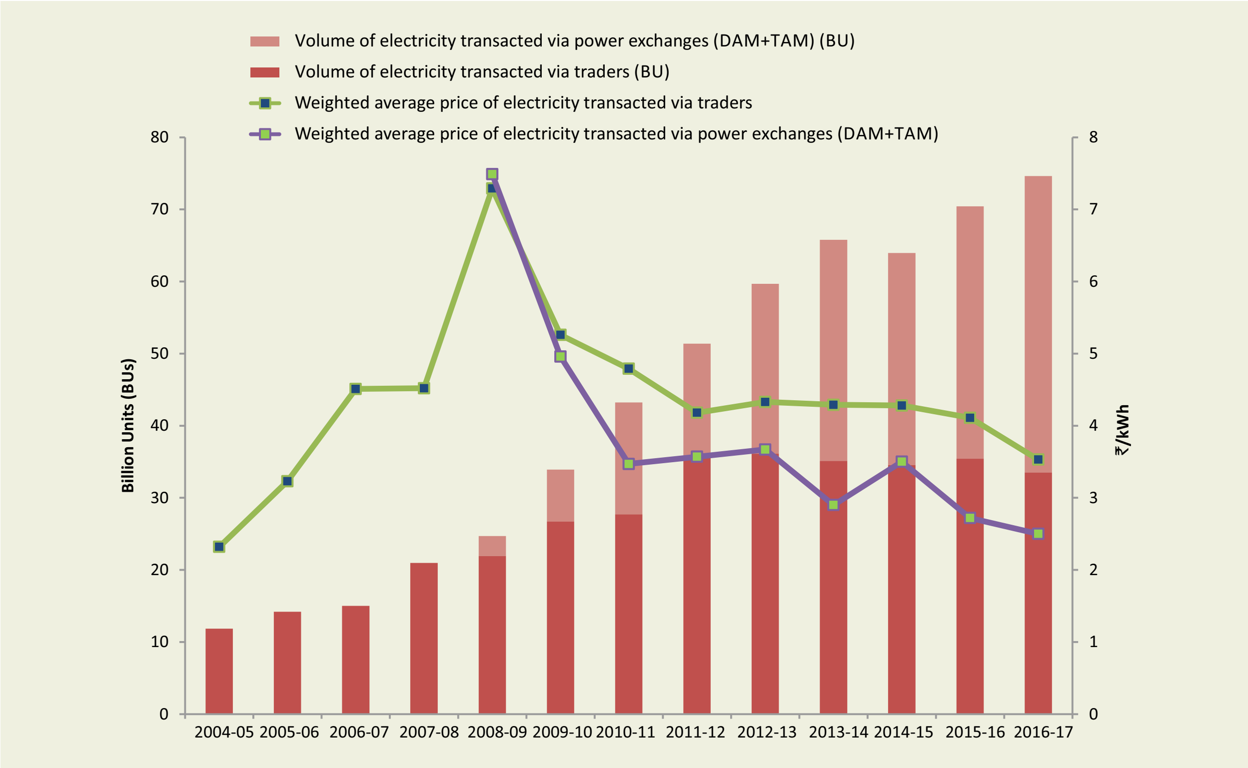
(b) Electricity traded through Power Exchanges (IEX and PXIL),

(c) Electricity traded directly by the Distribution Licensees (DISCOMs), and

(d) Electricity transacted through Deviation Settlement Mechanism (DSM).

Figure 12 illustrates the trends of volume and prices of electricity traded under a) bilateral transactions through inter-state trading licensees (only inter-state trades) and b) through power exchanges from 2004-05 to 2016-17. The percentage of electricity traded remained roughly at 2-3% of the total electricity generation until the establishment of power exchanges in 2008-09. Trade in the power exchanges rose steadily from 2.7 BUs (2008-09) to 41.1 BUs (2016-17), while transactions through inter-state trading licensees (only inter-state trades) have stagnated at roughly 35 BU over the last six years (CERC, 2009b). The total trade (traders + power exchanges) for 2016-17 stood at 74 BUs, translating to a share of 6.5% of the total generation in the country (CERC, 2017a). The weighted average price of electricity traded via inter-state trading licensees and power exchanges reached a high of ₹ 7.3/kWh in 2008-09, but has steadily decreased since then. However prices discovered through exchanges have been consistently lower than those compared with inter-state trading licensees. The 2016-17 weighted average price discovered in power exchanges is roughly ₹ 1/kWh lower as compared to prices discovered through inter-state trading licensees (CERC, 2017a).

Figure 12 : Volume and price of electricity traded via inter-state trading licensees and power exchanges



Source: Prayas (Energy Group's) analysis based on CERC's Market Monitoring Committee reports

Note: The above data does not include any short-term transactions done outside power exchanges and bilateral intra-state trades. It also does not include any trades which are for a duration > 1 year.

Annexure II

In order to ensure clarity in the data that was used for the analysis carried out in section 2, Table 8 tabulates all the components of each term and data source. For the purpose of the analysis, it is assumed that information pertaining to RE-OA transactions refers to 'non -utility energy wheeled through the wires of all DISCOMs within the state'. The terminologies of all other components are as defined by the respective source-state energy accounts, tariff orders, petitions etc.

Table 8 : Data sources and terminology used for calculations in chapter 2

			Total power purchase		Total OA		RE-OA	
State	Year	DISCOMs	Source	Components	Source	Components	Source	Components
Andhra Pradesh	2014–15 2015–16 2016-17		Power purchase petitions of APSPDCL and APEPDCL	Total (from all generation sources) Dispatch of both (DISCOMs) EPDCL and SPDCL	RTI to The Transmission Corporation of Andhra Pradesh APTRANSCO)	Total Intra-state OA= Sum of OA consumption in MU of categories (Industrial and Commercial) from all generation sources (Solar, Wind, Hydro, Biomass, Coal, and Gas)	RTI to APTRANSCO	Sum of OA consumption in MU of all categories (Industrial and Commercial) for each RE source (Solar, Wind, and Hydro)
Gujarat	2014–15	Aspen	Case No1560 of 2016; pg 24, Section 4.3	Energy procured	Monthly State Energy Account	Sum of 'Details of Bilateral Exchange within GETCO-GETCO and WR-GETCO Route' (only included buyers situated in Gujarat), and 'Scheduled energy supplied for use of their own consumption either through wheeling and other arrangement credited in schedule to distribution licensee	Monthly State Energy Account	Renewable Energy Supplied for use of their own consumption either through wheeling and other arrangement credited in schedule to distribution licensee
		KPT	Case No 16 Case No 1639 of 2017; pg 11, Table 7	Power purchase (This is not yet approved by the ERC)				
		TPL A	Case No 1552 of 2015; pg 58 Section 4.3	Energy requirement of Ahmedabad Distribution area				
		TPL S	Case No 1553 of 2015; pg 44 Section 4.3	Energy requirement of Surat distribution area				

			Total power purchase		Total OA		RE-OA	
State	Year	DISCOMs	Source	Components	Source	Components	Source	Components
	2014-15	TPD DJ	Case No 1554 of 2015; pg 32, Table 4.3	Energy requirement (A)				
		UGVCL	Case No 1547 of 2015; pg 63, Table 4.5	Total energy required/ procured				
		DGVCL	Case No 1548 of 2015; pg 66, Table 4.5	Total energy required/ procured				
		MGVCL	Case No 1549 of 2015; pg 62, Table 4.5	Total energy required/ procured				
		PGVCL	Case No 1550 of 2015; pg 84, Table 4.5	Total energy required/ procured				
		MPSEZ	Case No 1556 of 2016; pg 22, Table 4.3	Energy required				
	2015-16	Aspen	Case no1638 of 2017; pg 23, Section 4.3	Energy procured	Monthly State Energy Account	Sum of 'Details of Bilateral Exchange within GETCO-GETCO WR-GETCO Route' included buyers situated in Gujarat), and 'Scheduled Energy supplied for use of their own consumption either through wheeling and other arrangement credited in schedule to distribution licensee'	Monthly State Energy Account	Renewable energy supplied for use of their own use of their own through wheeling and other arrangement credited in schedule to distribution licensee
		KPT	Case No 1639 of 2017; pg 11 Table 7	Power purchase (This is not yet approved by the ERC)				
		TPL A	Case No 1627 of 2016; pg 76, Section 4.3.1	Energy requirement of TPLD-Ahmedabad				
		TPL S	Case No 1628 of 2016; pg 74, Section 4.3.2	Energy requirement of Surat distribution area				

			Total power purchase		Total OA		RE-OA	
State	Year	DISCOMs	Source	Components	Source	Components	Source	Components
	2015–16	TPD DJ	Case No 1629 of 2016; pg 32, Table 4–6	Energy requirement				
		UGVCL	Case No 1622 of 2016; pg 64, Table 4.8	Total energy requirement				
		DGVCL	Case No 1623 of 2016; pg 68, Table 4.6	Total energy requirement				
		MGVCL	Case No 1624 of 2016; pg 67, Table 4.6	Total energy requirement				
		PGVCL	Case No 1625 of 2016; pg 62, Table 4.6	Total energy requirement				
		MPSEZ	Case No 1561 of 2016; pg 39, Table 4–6	Total energy requirement				
		Aspen	Case no1638 of 2017; pg 33, Table 5.6	Estimated and approved — 'Energy procured''	Monthly State Energy Account	Sum of 'Details of Bilateral Exchange within GETCO-GETCO and WR-GETCO Route' (only included buyers situated in Gujarat), and 'Scheduled energy supplied for use of their own consumption either through wheeling and other arrangement credited in schedule to distribution licensee'. (Note: We have not added RE-OA in this as the	Monthly State Energy Account	Renewable energy supplied for use of their own consumption either through wheeling and other arrangement /third party sale credited in schedule to in schedule licensee
		KPT	Case No 1639 of 2017; pg 11, Table 7	Assumed to be , same as previous year, since projected value was rejected by ERC				
		TPL A	Case No 1627 of 2016; pg 131, Section 5.1.13	Energy requirement of TPLD- Ahmedabad				
		TPL S	Case No 1628 Table 5.16	Energy requirement				

			Total power purchase		Total OA		RE-OA	
State	Year	DISCOMs	Source	Components	Source	Components	Source	Components
		TPD DJ	Case No 1629 of 2016; pg 63, Table 5–9	Energy requirement		bilateral transactions within the state may already include it)		
	2016–17 (Estimated and approved by GERC)	UGVCL	Case No 1622 of 2016; pg 125,Table 5.34	Total energy requirement				
		DGVCL	Case No 1623 of 2016; pg 132,Table 5.33	Total energy requirement				
		MGVCL	Case No 1624 of 2016; pg 204, Table 5.99	Total energy requirement				
		PGVCL	Case No 1625 of 2016; pg 197, Table 5.99	Total energy requirement				
		MPSEZ	Case No 1561 of 2016; pg 69, Table 5–7	Total energy requirement				
Madhya Pradesh	2014–15 2015-16 2016–17	MPPuK VVCL, MPMaK VVCL, and MPPaK VVCL	RTI - Monthly State Energy Account	Sum of Scheduled Energy of State Sector Generating Stations (Thermal, IPP, Hydro, and National Hydroelectric Development Corporation (NHDC)/Narmada Valley Development Authority(NVDA) Hydel); Adjustment of Bilateral Projects; Scheduled Energy of ISGS Stations	Monthly State Energy Account	Sum of 'Monthly Scheduled Energy for Inter and Intra State Open Access (Only included Wheeling) and 'Apportionment of Firm/Infirm power purchased by MPPMCL from CPPs'. (Note: We have included wheeling only if net power wheeled into the distribution system is positive)	Monthly State Energy Account	Apportionment of power injected by non-conventional entities for wheeling including 2% (of wheeling charge)

			Total power purchase		Total OA		RE-OA	
State	Year	DISCOMs	Source	Components	Source	Components	Source	Components
				(Rajgarh Solar); 'Scheduled Energy of Inter and Intra State Open Access (Bilateral, and Collective)'; 'Energy purchased by MPMPCL from Other Sources'; and 'Apportionment of Firm/Infirm power purchased by MPPMCL from CPPs'				
TSSPDCL	2014–15	Only SPDCL	Retail Supply Tariffs for FY 2015–16; pg 50; Section 3.3.7	Approved Power Purchase	RTI to Transmission Corporation of Telangana Limited (TSTRANSCO)	Sum of RE and Non-RE Inter and Intra state open access transactions	RTI to TSTRANSCO	Sum of RE Inter and Intra state open access transactions
	2015-16		Retail Supply Tariffs for FY 2015–16; pg 25; Section 2.3.2	Projected and approved Total of 'Monthly Energy Requirement'				
	2016-17		Retail Supply Tariffs for FY 2016–17; pg 132; Table 13	Projected and approved 'Energy Requirement'.				

			Total power purchase		Total OA		RE-OA	
State	Year	DISCOMs	Source	Components	Source	Components	Source	Components
MSEDCL	2014-15		Case No 48 of 2016, pg 114,Table 3–15	Approved 'Total Power Purchase' by MERC	Case No 48 of , 2016, pg 111 Table 3–12	Sum of OA sales (Conventional, HT and Renewables)	Request for dataf rom consumer representatives during technical validation session of tariff determination process	Sum of Open Access Sales (Wind, Solar)
	2015–16		Case No 48 of 2016; pg 176, Table 4–12	Approved 'Total Power Purchase' by MERC	Case No 48 of 2016, pg 168, Table 4–7	Sum of OA sales (Conventional, HT and Renewables)		
	2016–17		Case No 48 of 2016, pg 239, Table 5–29	Projected and approved 'Total Power Purchase' by MERC	Case No. 48 of 2016, pg 403, Table 8-45	Projected Open Access volume, revenue from wheeling		

LIST OF ABBREVIATIONS

ACoS	Average Cost of Supply
APPC	Average Power Purchase Cost
APTEL	Appellate Tribunal for Electricity
APTRANSCO	Transmission Corporation of Andhra Pradesh
ARR	Annual Revenue Requirement
AS	Additional Surcharge
BU	Billion Unit
CERC	Central Electricity Regulatory Commission
CSS	Cross-subsidy Surcharge
CTU	Central Transmission Utility
CUF	Capacity Utilisation Factor
DAM	Day Ahead Market
DISCOM	Distribution Company
DSM	Deviation Settlement Mechanism
LTOA	Long-Term Open Access
MSEDCL	Maharashtra State Electricity Distribution Company Limited
MTOA	Medium-Term Open Access
MU	Million Unit
NEP	National Electricity Policy
NLDC	National Load Despatch Centre
NOAR	National Open Access Registry
NTP	National Tariff Policy
OA	Open Access
POSOCO	Power System Operation Corporation Limited
RE	Renewable Energy
REC	Renewable Energy Certificates
RLDC	Regional Load Despatch Centre
RPO	Renewable Purchase Obligation
RTC	Round the Clock
RTI	Right to Information
SAMAST	Scheduling, Accounting, Metering and Settlement of Transactions in Electricity
SERC	State Electricity Regulatory Commission
SLDC	State Load Despatch Centre
STOA	Short-Term Open Access
STU	State Transmission Utility
ToD	Time of Day
UI	Unscheduled Interchange

Related publications of Prayas (Energy Group)

1. India's Journey towards 175 GW Renewables by 2022 - A July 2017 Update
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   http://www.prayaspune.org/peg/publications/item/358-comments-and-suggestions-on-consultation-paper-on-issues-related-to-open-access.html

3. PEG comments on draft National Energy Policy, 2017
   http://www.prayaspune.org/peg/publications/item/351

4. India's Journey towards 175 GW Renewables by 2022 (2017)
   http://www.prayaspune.org/peg/publications/item/329

5. Grid Integration of Renewables in India: An Analysis of Forecasting, Scheduling and Deviation Settlement Regulations for Renewables (2016)
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6. The future electricity grid: Key questions and considerations for developing countries (2016)
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7. Data Gaps in India's Energy Sector (2015)
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8. Comments and Suggestions for the Draft Amendment of the National Tariff Policy, May 2015 (2015)
   http://prayaspune.org/peg/publications/item/299

9. A 'Dashboard' for the Indian Energy Sector (2015)
   http://prayaspune.org/peg/publications/item/296

10. A Commentary On The Electricity (Amendment) Bill, 2014 (2015)
    http://prayaspune.org/peg/publications/item/293

11. Many Sparks but Little Light: The Rhetoric and Practice of Electricity Sector Reforms in India
    http://www.prayaspune.org/peg/publications/item/332

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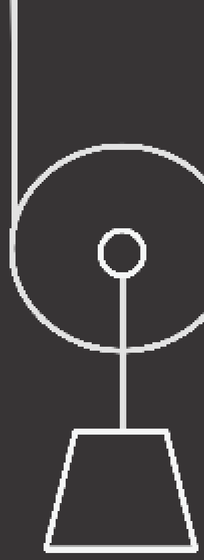

With the rapidly falling price of wind and solar power, renewable energy based open access and captive sales migration is likely to pick up in a big way in the future. Renewable energy's unique characteristics like intermittency, seasonality etc., their concessional OA charges in some states and provisions like energy banking will bring newer challenges for the OA framework. This working paper is an attempt in understanding the existing status of renewable energy based OA and its implications for the OA framework and vice versa. It critically analyses the important charges, specifically cross subsidy surcharge, additional surcharge and rules around energy banking, a critical necessity for renewable energy based OA. The report concludes with some potential options to make the OA framework more amenable to renewable energy.

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