ಕರ್ನಾಟಕ ವಿದ್ಯುಚ್ಛಕ್ತಿ
ನಿಯಂತ್ರಣ ಆಯೋಗ

KARNATAKA ELECTRICITY
REGULATORY COMMISSION

ಸಂಖ್ಯೆ : 16ಸಿ-1, ಮಿಲ್ಲರ್ ಟ್ಯಾಂಕ್ ಬೆಡ್ ಏರಿಯ
ವಸಂತನಗರ, ಬೆಂಗಳೂರು-560 052

No. 16 C-1, Miller Tank Bed Area
Vasanthanagara, Bengaluru-560 052.

ಸಾರ್ವಜನಿಕ ವಿಚಾರಣೆ ಬಗ್ಗೆ ಸೂಚನೆ

ಸಂಖ್ಯೆ: ಕೆವಿನಿಆ/ಉ.ನಿ(ಪ್ರಸರಣ)/ ವೀಲ್ಲಿಂಗ್ ಬ್ಯಾಕಿಂಗ್/2020-21/ 628 ದಿನಾಂಕ 05.08.2022

ವಿಷಯ: ನವೀಕರಿಸಬಹುದಾದ ಇಂಧನ ಮೂಲಗಳಿಂದ ವಿದ್ಯುತ್ ಉತ್ಪಾದನೆ ಮಾಡುವ ಯೋಜನೆಗಳಿಗೆ ಅನ್ವಯವಾಗುವ ವೀಲ್ಲಿಂಗ್ ದರ ಮತ್ತು ಬ್ಯಾಕಿಂಗ್ ವ್ಯವಸ್ಥೆ ಬಗ್ಗೆ ಚರ್ಚಾ ಪತ್ರವನ್ನು ಪ್ರಕಟಿಸಿದ ಹಿನ್ನಲೆಯಲ್ಲಿ ಸಿದ್ಧಪಡಿಸಿದ ನವೀಕರಿಸಬಹುದಾದ ಇಂಧನ ಮೂಲಗಳಿಂದ ವಿದ್ಯುತ್ ಉತ್ಪಾದನೆ ಮಾಡುವ ಯೋಜನೆಗಳಿಗೆ ಅನ್ವಯವಾಗುವ ವೀಲ್ಲಿಂಗ್ ದರ ಮತ್ತು ಬ್ಯಾಕಿಂಗ್ ವ್ಯವಸ್ಥೆಯಿಂದ ಆಗುವ ಆರ್ಥಿಕ ಪ್ರಭಾವದ ಅಧ್ಯಯನ ವರದಿಯ ಬಗ್ಗೆ ಸಾರ್ವಜನಿಕ ವಿಚಾರಣೆ

ಕರ್ನಾಟಕ ವಿದ್ಯುಚ್ಛಕ್ತಿ ನಿಯಂತ್ರಣ ಆಯೋಗವು, ನವೀಕರಿಸಬಹುದಾದ ಇಂಧನ ಮೂಲಗಳಿಂದ ವಿದ್ಯುತ್ ಉತ್ಪಾದನೆ ಮಾಡುವ ಯೋಜನೆಗಳಿಗೆ ಅನ್ವಯವಾಗುವ ವೀಲ್ಲಿಂಗ್ ದರ ಮತ್ತು ಬ್ಯಾಕಿಂಗ್ ವ್ಯವಸ್ಥೆ ಬಗ್ಗೆ ಚರ್ಚಾ ಪತ್ರವನ್ನು ಪ್ರಕಟಿಸಿ ಭಾಧಿತ ವ್ಯಕ್ತಿಗಳಿಂದ ಅನಿಸಿಕೆ / ಅಭಿಪ್ರಾಯ / ಸಲಹೆಗಳನ್ನು ಆಹ್ವಾನಿಸಿತ್ತು. ಅನೇಕ ವ್ಯಕ್ತಿಗಳು ತಮ್ಮ ಅನಿಸಿಕೆ / ಅಭಿಪ್ರಾಯ / ಸಲಹೆಗಳನ್ನು ಲಿಖಿತ ರೂಪದಲ್ಲಿ ಆಯೋಗಕ್ಕೆ ಸಲ್ಲಿಸಿರುತ್ತಾರೆ. ಈ ವಿಷಯದಲ್ಲಿ ಆಯೋಗವು ದಿನಾಂಕ 27.01.2021 ರಂದು ಬೆಳಿಗ್ಗೆ ವಿಡಿಯೋ ಕಾನ್ಫರೆನ್ಸ್ ಮೂಲಕ ಸಾರ್ವಜನಿಕ ವಿಚಾರಣೆಯನ್ನೂ ನಡೆಸಿತ್ತು. ಬಾಧಿತ ವ್ಯಕ್ತಿಗಳ ಅನಿಸಿಕೆ / ಅಭಿಪ್ರಾಯ / ಸಲಹೆಗಳನ್ನು ಪರಿಗಣಿಸಿ, ಆಯೋಗವು ಕೆ.ಪಿ.ಟಿ.ಸಿ.ಎಲ್ / ಎಸ್ಕಾಂಗಳಿಗೆ ನವೀಕರಿಸಬಹುದಾದ ಇಂಧನ ಮೂಲಗಳಿಂದ ವಿದ್ಯುತ್ ಉತ್ಪಾದನೆ ಮಾಡುವ ಯೋಜನೆಗಳಿಗೆ ಅನ್ವಯವಾಗುವ ವೀಲ್ಲಿಂಗ್ ದರ ಮತ್ತು ಬ್ಯಾಕಿಂಗ್ ವ್ಯವಸ್ಥೆಯಿಂದ ಆಗುವ ಆರ್ಥಿಕ ಪಭಾವದ ಬಗ್ಗೆ ಅಧ್ಯಯನ ನಡೆಸಿ ವರದಿ ಸಲ್ಲಿಸುವಂತೆ ಆದೇಶಿಸಿತ್ತು. ಕೆ.ಪಿ.ಸಿ.ಎಲ್ / ಎಸ್ಕಾಂಗಳ ಪರವಾಗಿ ಪಿ.ಸಿ.ಕೆ.ಎಲ್ ಅವರು ಪ್ರಯಾಸ್, ಪೂಣೆ ಮೂಲಕ ಅಧ್ಯಯನ ವರದಿಯನ್ನು ಸಿದ್ಧಪಡಿಸಿ ಆಯೋಗಕ್ಕೆ ಸಲ್ಲಿಸಿರುತ್ತಾರೆ. ಈ ಅಧ್ಯಯನ ವರದಿಯು ಆಯೋಗದ ವೆಬ್‌ಸೈಟ್ https://kerc.karnataka.gov.in ನಲ್ಲಿ ಲಭ್ಯವಿರಿಸಲಾಗಿದೆ.

ಆಯೋಗವು, ಮೇಲಿನ ವರದಿಯ ಬಗ್ಗೆ ಬಾಜೀದಾರರಿಂದ **31.08.2022** ರೊಳಗೆ ಲಿಖಿತ ರೂಪದಲ್ಲಿ ಅನಿಸಿಕೆ / ಅಭಿಪ್ರಾಯ / ಸಲಹೆಗಳನ್ನು ಆಹ್ವಾನಿಸಿ, ಆಯೋಗದ ಕಾರ್ಯದರ್ಶಿಯವರಿಗೆ ಸಲ್ಲಿಸಲು ಕೋರಿದೆ.

ಆಯೋಗವು ಮೇಲಿನ ವಿಷಯದ ಬಗ್ಗೆ **08.09.2022 ರಂದು ಬೆಳಿಗ್ಗೆ 11.00 ಗಂಟೆಗೆ** ಸಾರ್ವಜನಿಕ ವಿಚಾರಣೆಯನ್ನು ಆಯೋಜಿಸಿದೆ. ಬಾಧಿತ ವ್ಯಕ್ತಿಗಳು/ಆಸಕ್ತ ವ್ಯಕ್ತಿಗಳು ಮೇಲಿನ ಸಾರ್ವಜನಿಕ ವಿಚಾರಣೆಯಲ್ಲಿ ಭಾಗವಹಿಸಿ ತಮ್ಮ ಅಭಿಪ್ರಾಯಗಳನ್ನು ವೈಯಕ್ತಿಕವಾಗಿ ಆಯೋಗದ ಮುಂದೆ ಸಲ್ಲಿಸಬಹುದಾಗಿದೆ.

ಕಾರ್ಯದರ್ಶಿ
ಕರ್ನಾಟಕ ವಿದ್ಯುಚ್ಛಕ್ತಿ ನಿಯಂತ್ರಣ ಆಯೋಗದ ಪರವಾಗಿ

Phone : 080-22268677/78/79 ✦ Fax : 080-22268667 (Chairman Office) ✦ 080-22370214 (Secretary Office)
E-mail : kerc-ka@nic.in ✦ Website : www.karnataka.gov.in/kerc

ಕರ್ನಾಟಕ ವಿದ್ಯುಚ್ಛಕ್ತಿ
ನಿಯಂತ್ರಣ ಆಯೋಗ

KARNATAKA ELECTRICITY REGULATORY COMMISSION

ಸಂಖ್ಯೆ : 16ಸಿ-1, ಮಿಲ್ಲರ್ ಟ್ಯಾಂಕ್ ಬೆಡ್ ಏರಿಯ
ವಸಂತನಗರ, ಬೆಂಗಳೂರು-560 052

No. 16 C-1, Miller Tank Bed Area
Vasanthanagara, Bengaluru-560 052.

PUBLIC HEARING NOTICE

No: KERC/DD-Trans/Wheeling Banking/2020-21/ 628 Dated 05.08.2022

Sub: Public Hearing on the Study Report of Financial Impact of Wheeling and Banking arrangement, carried out consequent to issue of the Discussion Paper on 'Wheeling Charges and Banking Facility' for Renewable Energy Power Projects.

The Commission issued a Discussion Paper on 'Wheeling Charges and Banking Facility' for Renewable Energy Power Projects inviting comments/views/suggestions from stakeholders and has received written comments/views/suggestions from several persons. The Commission also held a public hearing in the matter on 27.01.2021, through video conferencing. Considering the comments/views/suggestions received from the stakeholders, the Commission directed KPTCL/ESCOMs to conduct a financial impact study of Wheeling and Banking arrangement. PCKL through Prayas, Pune has conducted the study on behalf of KPTCL/ESCOMs and has submitted the study report. The study report is hosted on the KERC's website https://kerc.karnataka.gov.in.

The Commission invites written comments/views/suggestions from Stakeholders on the above study report, latest by 31.08.2022, which may be sent to the Secretary, KERC.

Meanwhile, the Commission has scheduled a public hearing in the matter on 08.09.2022 in the Court Hall of the Commission at 11.00 AM. Stakeholders/ Interested Persons may participate in the hearing and submit their views in person before the Commission.

Secretary
for **Karnataka Electricity Regulatory Commission**

Phone : 080-22268677/78/79 ✦ Fax : 080-22268667 (Chairman Office) ✦ 080-22370214 (Secretary Office)
E-mail : kerc-ka@nic.in ✦ Website : www.karnataka.gov.in/kerc

Estimating impact of renewable energy wheeling and banking arrangement on Karnataka ESCOMs

Prayas (Energy Group)
July 2022

Prayas (Energy Group)

About Prayas

Prayas (Initiatives in Health, Energy, Learning and Parenthood) is a non-Governmental, non-profit organization based in Pune, India. Members of Prayas are professionals working to protect and promote 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 engagement in policy and regulatory matters, as well as training, awareness, and support to civil society groups. Prayas (Energy Group) has contributed to policy development in the energy sector as part of several official committees constituted by Ministries, Regulatory Commissions and the Planning Commission / NITI Aayog. Prayas is registered as SIRO (Scientific and Industrial Research Organization) with Department of Scientific and Industrial Research, Ministry of Science and Technology, Government of India.

Prayas (Energy Group)

Unit III A & III B,
Devgiri, Kothrud Industrial Area,
Joshi Railway Museum Lane, Kothrud Pune 411 038.
Maharashtra
☎ +91 20 2542 0720
✉ energy@prayaspune.org
https://energy.prayaspune.org/

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July, 2022
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Estimating impact of renewable energy wheeling and banking arrangement on Karnataka ESCOMs

Submitted to
Power Company of Karnataka Limited (PCKL)

Prayas (Energy Group)
July, 2022

Prayas Research Team: Shantanu Dixit, Saumendra Aggrawal, Ashwin Gambhir, Ann Josey.
Prayas Data Analysis Support: Nimita Kulkarni, Abhiram Sahasrabudhe.

Estimating impact of renewable energy wheeling and banking arrangement on Karnataka ESCOMs

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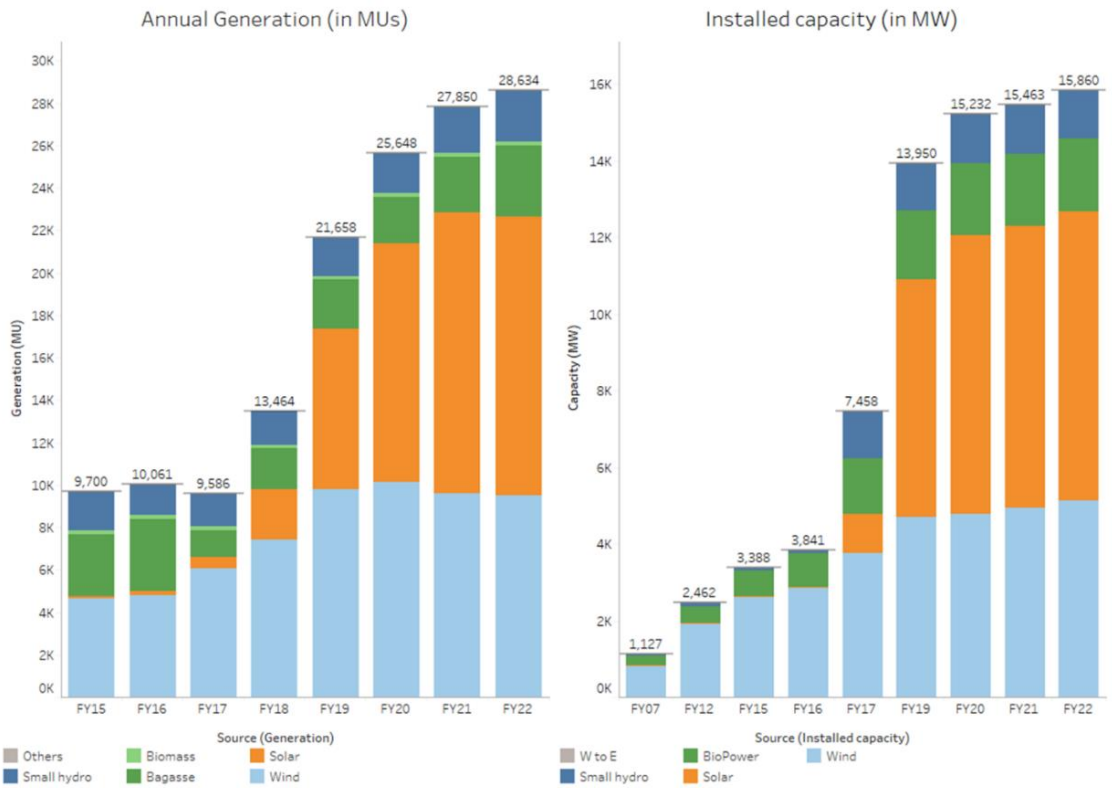
1 Background and Context

Renewable Energy (RE) is a compelling success story in Karnataka. As seen in Figure 1, RE capacity at the state level, has grown from a mere 1 GW in March 2007 to 15.9 GW (52% of total) by March 2022, while RE generation has increased from 9.7 TWh in FY 2014-15 to 28.6 TWh in FY 2021-22. At the state level, for FY 2020-21, with a consumption of 52,820 MU (excl. hydro), according to the RPO mandate, the required RE purchase was 10,502 MU while in reality the compliance was nearly double at 20,160 MU. Thus, the share of RE (excl. hydro) is already over 38% (Annexure 10) in Karnataka. Including hydro energy, the share of RE is 50%. Going ahead, this is very likely to increase quite sharply since KERC has itself proposed an RPO of 45% by 2030[1] while the Government of Karnataka (GoK) RE policy of 2022[2] has an additional target of 10 GW by 2027.

Figure 1: Growth of renewable energy capacity and generation in Karnataka over last few years.



Source: Prayas (Energy Group) analysis based on data compiled from CEA and MNRE.

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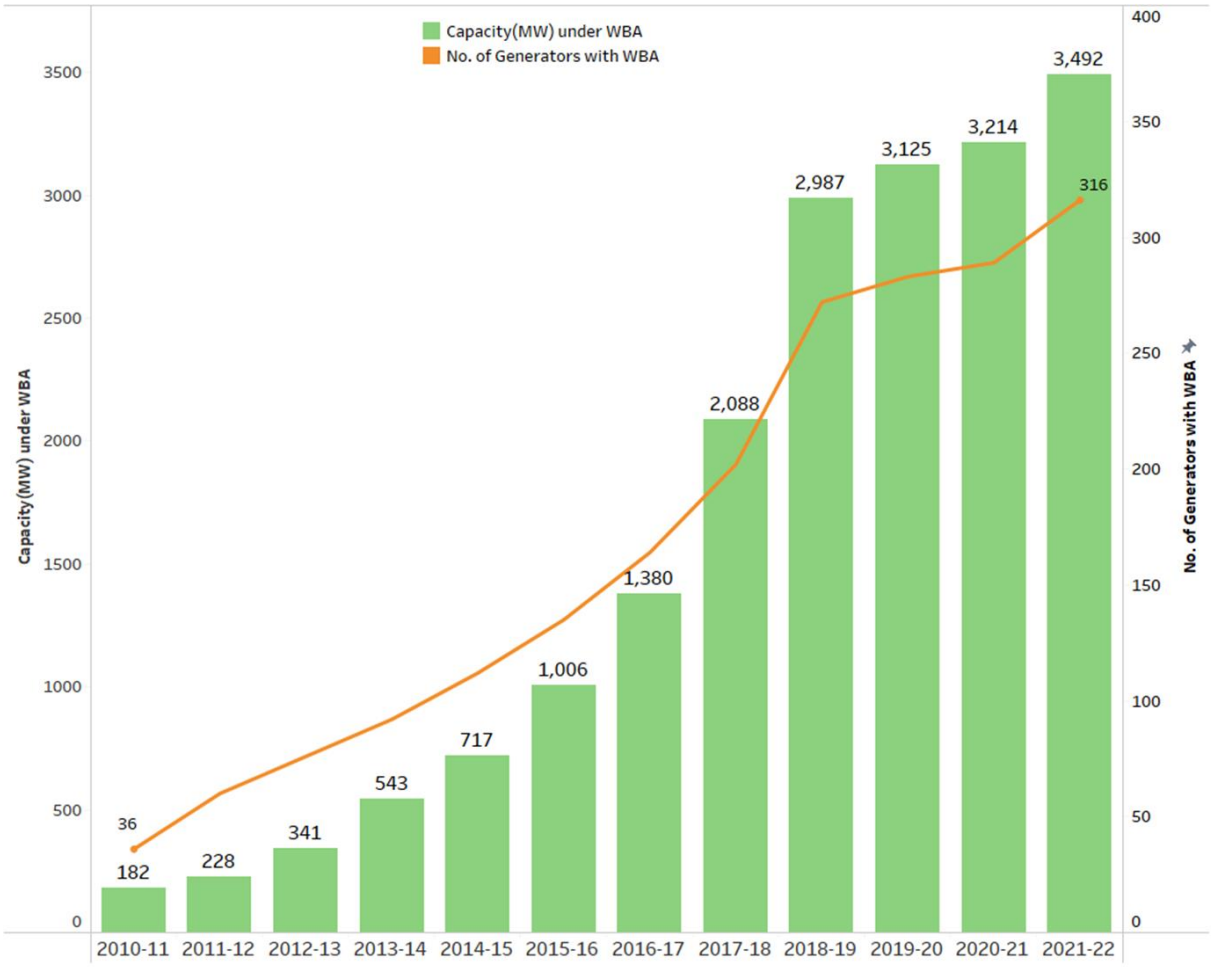
[1] https://karunadu.karnataka.gov.in/kerc/Documents/KERC%20(Procurement%20of%20Energy%20from%20Renewable%20Source%20(Eighth%20Amendment)%20Regulations%2C%202022.pdf

[2] https://kredl.karnataka.gov.in/storage/pdf-files/Policy/Karnataka%20Renewable%20Energy%20Policy%202022-27%20Notification%20Copy.pdf

Similarly, wheeling and banking transactions have increased from 222 MU in FY 13 to 5,814 and 5,770 (energy wheeled) for FY 2019-20 and FY 2020-21 respectively. As seen from Figure 2, RE capacity with Wheeling and Banking (WBA) agreements has increased from 182 MW to 3,492 MW from FY 11 to FY 22. Similarly, the number of generators with WBA agreements has risen from 36 to 316 in the same time period.

Figure 2: Growth in RE based Wheeling and Banking Capacity

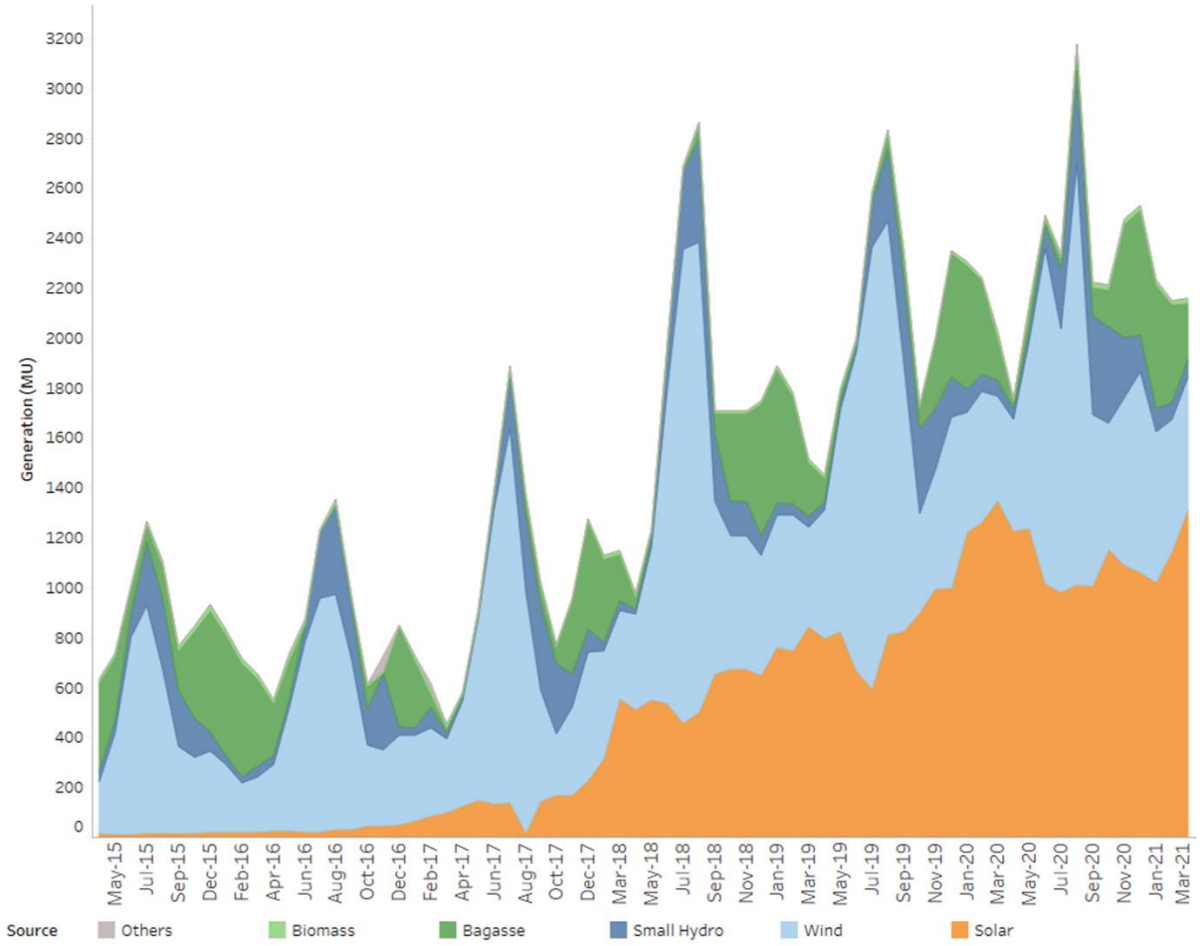


Source: Prayas (Energy Group) analysis based on data provided by PCKL.

Many promotional incentives and concessions have been provided in order to foster RE development in Karnataka. Notable among them are promotional banking framework and concessional charges on wheeling and banking. Given the growth and development of RE in Karnataka and the falling prices of renewable energy, this study examines whether these promotional measures should continue and if discontinued, recommends alternate frameworks for banking and levying transmission and wheeling charges.

Banking facility for renewable energy projects have been provided since 2005 allowing RE open access and captive consumers to bank 'excess generation' in a particular time period with the ESCOM which is drawn at a later time period. Given seasonal (Figure 3) and diurnal variations in renewable energy generation, such a facility led to significant investments in renewable energy based open access and captive in the state.

Figure 3: Monthly renewable energy generation in Karnataka from April 2015-March 2021



Source: Prayas (Energy Group) analysis based on data compiled from CEA and MNRE.
Note: Others include Waste to Energy etc.

For a 'must-run' generation source like renewable energy, facilities like banking aids better utilisation and optimisation. As mentioned earlier, in Karnataka, banking along with concessions on wheeling were major contributors to scaling up and mainstreaming renewable energy investments.

It must be noted that since 2005, renewable energy sector in Karnataka has changed significantly.

- Renewable energy penetration in Karnataka is the highest in the country as it accounts for 38% of the energy consumption (excl. hydro) in the state.
- Since 2016, week ahead and day ahead scheduling of wind and solar generation has been institutionalized under the forecasting and scheduling regulations of the KERC[3].
- Procedures and processes around metering and billing, especially for open access and captive have been codified for 1 MW and above consumers.
- With rapidly falling prices for RE, especially solar and wind, power from new projects is available at a rate (< Rs.3/unit) less than the average procurement cost of the ESCOMs. Thus, new projects are in a position to thrive on the basis of its own economic proposition, rather than being driven by concessions/waivers.
- With rising cost of supply of the ESCOMs and increasing viability of open access and captive procurement through renewables, Karnataka has seen an increase in open access sales by 52% between 2016 and 2019[4].

Despite these changes, the banking period as well as the banking charge have not changed since 2005. Further, there has been no changes in concessional wheeling provided as well. This is significant as many other states with significant RE investments have revised their banking framework and wheeling charges significantly in recent years. For more details, please see Annexure 1.

Noting the rapid growth and maturity of the RE sector in the state, there have been proceedings before the Commission since 2014 to revise the banking framework. These are summarized in Annexure 2.

Similarly, there have been multiple proceedings in the recent years to relook at the concessions provided for wheeling and to revise the banking charges based on assessment of cost to ESCOMs due to provision of banking facility. The timeline of these proceedings is summarized in Annexure 3.

Notable in the timeline is the KERC order[5] dated 9.1.2018 wherein KERC stipulated a reduction in banking period from one year to six months and restricted drawal in peak ToD time-slots to power banked only during peak ToD slots. This order was challenged before APTEL and was set aside[6]. Another significant development was when KERC, in its order[7] dated 14.05.2018 stipulated

[3] https://kptclsldc.in/KERC_Forecasting_Scheduling_Regulation_2015.pdf

[4] Prayas (Energy Group) estimate based on various petitions filed by ESCOMs before KERC.

[5] https://kerc.karnataka.gov.in/storage/repo/Banking%20period%20for%20the%20Non-REC%20route%20based%20RE%20Projects.pdf

[6] https://aptel.gov.in/judgements/Judg2019/Final%20%20Judgment%20of%20A.42%20of%202018%20&%20batch%20%2022.2.2019_29.03.19.pdf

[7] https://karunadu.karnataka.gov.in/kerc/Documents/Dated%2014.05.2017-Order%20Wheeling%20and%20Banking.pdf

reduction in concessions on transmission and wheeling charges and also instated revision of banking charges. The order was quashed by the Karnataka High Court[8].

In the above mentioned APTEL and High Court judgements, the following were emphasised:

- Premature withdrawal of concessional charges on wheeling and banking in concluded wheeling and banking contracts is not allowed.
- KERC can determine charges and banking facility for future years based on analysis to show impact on ESSCOMs.

The APTEL judgement has been challenged before the Supreme Court in an ongoing matter and there is a writ appeal to stay the operation of the High Court order.

In the meanwhile, KERC in a letter dated, 25.11.2021, directed that a detailed study has to be carried out by a third party to assess the impact on the finances of KPTCL/ESCOMs due to concessional wheeling and banking charges. In compliance with these directions, in December 2021, Prayas (Energy Group) was appointed to conduct this study.

1.1 Objective of the Study

The study, conducted by Prayas (Energy Group), in compliance with KERC directions is to assess impact of current banking arrangement and concessional wheeling charges on the finances of the ESCOMs.

Based on data submitted by the ESCOMs, KSLDC and PCKL and considering the provisions in existing regulations and agreements, current arrangement for metering and billing, impact of proceedings in the matter before various fora, the study focusses on:

- Estimation of impact of present banking arrangement on ESCOM finances.
- Estimation of impact of concessions in transmission and wheeling on ESCOM finances.
- Proposals for alternative framework for energy banking and charges for RE projects.

[8] https://karnatakajudiciary.kar.nic.in/karjud/case_details_hck.php?params=UFdkQmZjM3lKOGY2TFZkZjkvNkVUdDJwWnVUZTFyOW9sSEgzYjdNcDNOaS9MemNqVC8zbGgxc0ZQZHhnazhWZUUrcDN3cVlHaHJFMGh4cEFnanRjRXc9PQ==

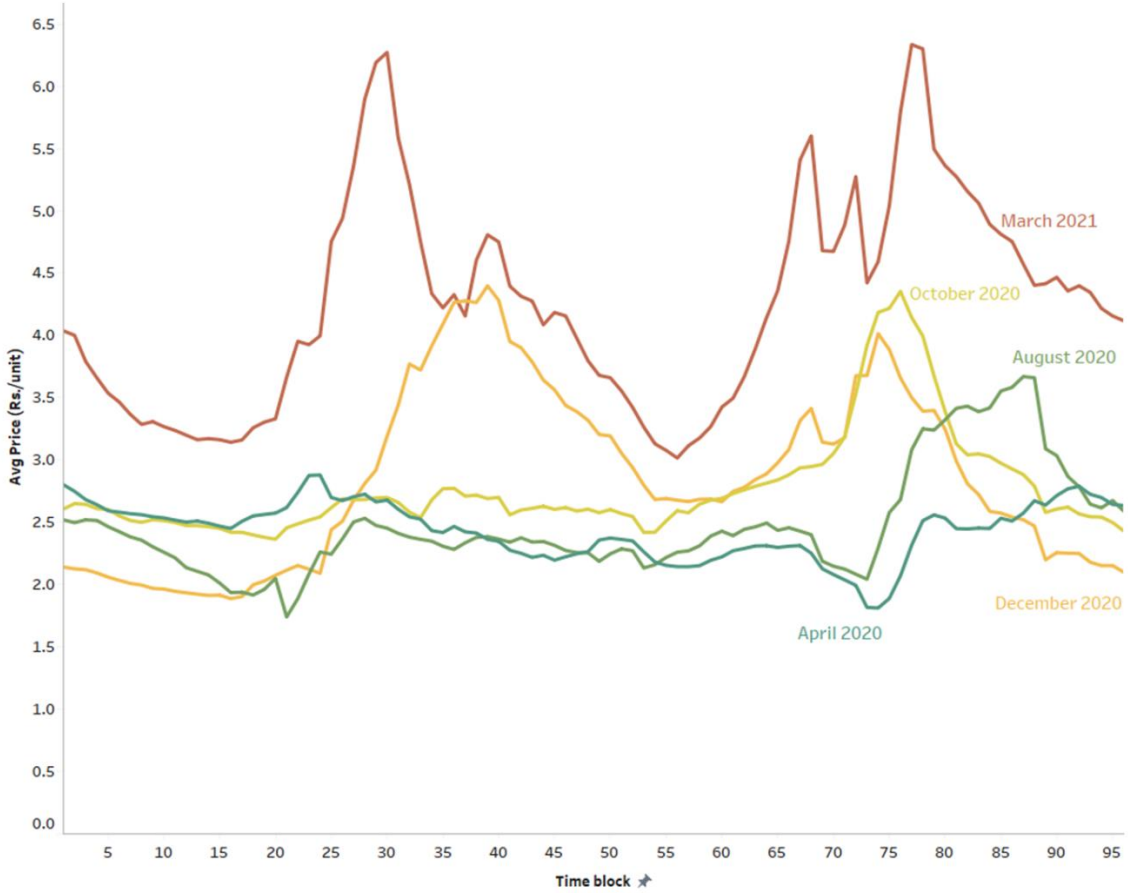
2 Methodology for estimating financial impact of banking services on ESCOMs

2.1 Intra-day and seasonal variation in value/price of energy

Cost of power, for ESCOMs as well as Open Access (OA) consumers changes significantly across time. This is true not just for power procured from markets, but also from long term contracted thermal power given the inter-play of demand and supply and the subsequent Merit Order Dispatch (MoD). Figure 4 shows average block wise market price for the S1 bid area of India Energy Exchange (IEX) for 5 months in FY 2020-21[9]. Each line of the chart represents the average price for that particular block for that particular month. For example, in March 2021, during morning peak time, average price was over 6 Rs/unit, which reduced to nearly half during the daytime whereas for December 2020 peak price in the morning was 4.5 Rs/kWh which reduced to about 3 Rs/unit during day time. Such significant variation is also observed across days as shown in Figure 5. This chart shows the price trend across days of a month. Here again, it can be seen that the price of power at different points of the day is vastly different for April 2020 and March 2021. Such significant variation in price of power at different time periods within a year impacts ESCOMs that provide annual energy banking service to different generators and consumers.

[9] In this report we have used IEX prices as reference of market rate as IEX DAM accounts for 99.6% of total DAM.

Figure 4: Variation in average 15-minute (block-wise) Day Ahead Market (DAM) prices for S1 region for few months in FY 2020-21.



Source: Prayas (Energy Group) analysis based on data from India Energy Exchange.

Note: Karnataka state lies in the S1 region in IEX (DAM market).

Figure 5: Variation in 15-minute (block-wise) Day Ahead Market (DAM) prices for S1 region for all days of April 2020 and March 2021.

Source: Prayas (Energy Group) analysis based on data from India Energy Exchange.

2.2 Overview of Banking Arrangement

Figure 6 shows the three important parameters that need to be analysed for assessing impact of energy banking services, namely time period, banking quantum and cost as well as revenue implications of the same.

Figure 6: Illustrative schematic showing parameters affecting energy banking

Time period	Generation	Consumption	Banking (units)		Value to system / Cost to ESCOMs for each time period (Rs./unit)
			Injection	Drawal	
1	200	150	50		4
2	150	200		50	3
3	200	200			2
4	150	125	25		2
5	50	75		25	2

Source: Prayas (Energy Group)

The first factor is the time period for which analysis can be carried out. As per the Indian Electricity Grid Code (IEGC)[10], scheduling and balancing of generation and demand is carried out for each time block of 15 minutes. This implies that ideally the generation and consumption should match for each 15-minute block.
Any difference in the quantum of generation and consumption in each 15-minute time block would imply either surplus injection into the grid (generation > consumption), or drawal from the grid (generation < consumption).

Valuing injection or drawal of power for each of such 15-minute blocks at the price of power for that particular block would give the financial impact of banking, i.e., injection in one time block and drawal in another time block. The summation of such impact for all blocks in a given settlement period (day, month or year) would capture the total impact of different prices of power at different points of time during the said settlement period. In addition to this, as discussed in Section 5, additional parameters such as various charges (e.g., transmission loss, wheeling charges) and certain components of tariff which may be applicable depending on the source of power also need to be considered.

2.3 Current banking arrangement in Karnataka

Figure 7: Current banking arrangement provided by ESCOMs in Karnataka.

Time Period	Annual	• Financial year for solar and wind • Water year for micro hydro
Quantum	Injection/drawal based on monthly consumption and wheeling, and surplus carried forward month on month for the respective year (financial or water)	
Valuation	• Banking charge @ 2% (in-kind) of wheeled energy • Annual purchase of surplus at 85% of generic RE tariff	
Settlement	Annual	

Source: Prayas (Energy Group)

Under the current arrangement as shown in Figure 7, the banking or settlement period is considered as a financial year for solar and wind generators, while it is a water year (June to May) for micro-hydro generators. In this arrangement energy generated and wheeled in a month is first counted towards consumption in that month without any consideration of time of generation or time of consumption. Any surplus generation at the end of the month is carried forward and

[10] https://cercind.gov.in/Regulations/Signed-IEGC.pdf

could be utilised in any month of the year when generation is less than consumption for the particular month. Any surplus / balance at the end of the year is purchased by the ESCOM at 85% of generic renewable energy feed in tariff for that year. Thus, generation in any time block of the financial year beginning from 1st April can be utilised in any time block of the year until 31st March. ESCOMs levy a flat nominal 2% of wheeled energy (in-kind) as banking charge on RE generators.

There are two main limitations of the current arrangement namely,

1. The present framework does not capture the quantum of banking at different time periods, that is, evening or morning peak, night time and seasonal variations are not considered.
2. The current arrangement also does not capture value / cost of power at the time of injection and at the time of drawal.

In order to assess the impact of banking arrangement it is necessary to first analyse the quantum of injection and drawal at different time periods. Figure 8 shows the available data with the ESCOMs to enable this analysis.

Figure 8: Data availability for the system level banking study for FY 21

Consumer level data

- For ~ 120 consumers across 5 DISCOMs
- Monthly ToD Slot wise (12 X 4 = 48 slots) consumption DISCOMS
- Annual wheeled energy

Generation data

- 15 min wind and solar PSS level data (~ 68 PSS)

Cost and revenue data

- Month-wise variable cost of contracted capacity
- 15 min block-wise DAM area clearing price in S 1 bid area of IEX
- Applicable tariff and charges as approved by ERC. (Energy charge, CSS, AS)
- Applicable Transmission and Wheeling losses and charges
- Renewable energy generic tariffs

The data used in the analysis and the source for each of the data sets is detailed in Table 1. We appreciate the efforts of ESCOMs, KSLDC and PCKL in collating and sharing the required data in a time-bound manner.

Table 1: Data used in the analysis and its source

No	Data used in the analysis	Source
1	Renewable Energy Generic Tariffs	Karnataka Electricity Regulatory Commission orders and regulations
2	Additional Surcharge and Cross Subsidy Surcharge	
3	Consumer Energy Charge	
4	ToD slots and charges	
5	Transmission charges and losses	
6	Wheeling charges and losses	
7	Monthly highest marginal thermal generator variable cost as per MoD	KSLDC, ESCOMs
8	15-min Day Ahead market (DAM) prices for S1 region	Indian Energy Exchange (IEX)
9	15-min wind and solar generation for 68 pooling sub-stations	KSLDC
10	Monthly slot-wise consumption data	All ESCOMs
11	Monthly / Monthly slot-wise wheeled energy for consumers	
12	RE Generators (IPPs) and consumer mapping	
13	Disaggregated (by ESCOM, RE source, IPP, consumer) monthly energy wheeled	PCKL
14	POC charges and losses	Central Electricity Regulatory Commission orders

While the 15-minute analysis would have shown results at the most granular level, as can be seen from Figure 8, only Time of Day (ToD) slot wise monthly consumption data is available. i.e., consumption in a particular ToD slot during the month. Currently there are four ToD slots namely,

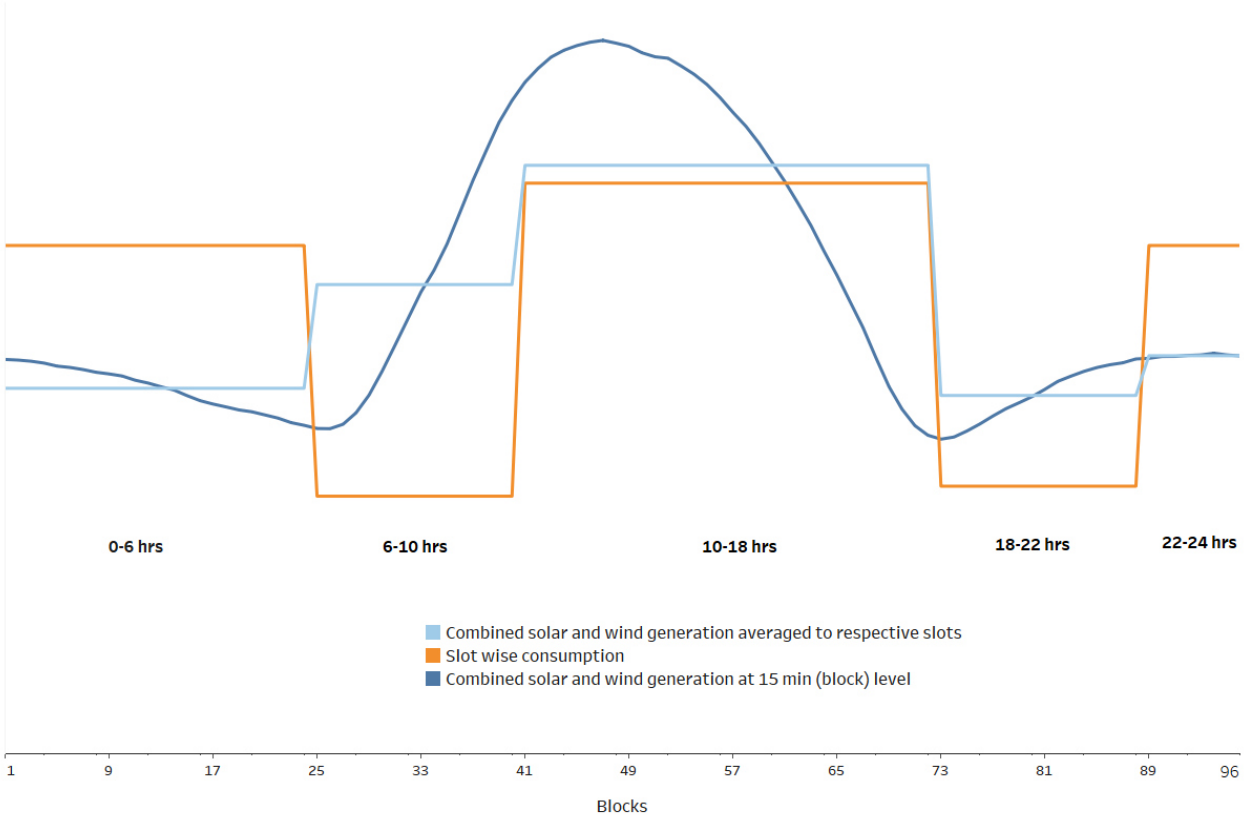
- Slot -1 (6 to 10 Hrs)
- Slot -2 (10 to 18 Hrs)
- Slot -3 (18 to 22 Hrs)
- Slot -4 (22 to 6 Hrs).

As there is no specific regulatory requirement, ESCOMs do not compile annual 15-minute block wise consumption of consumers[11]. This is presently limited to keeping such records for 35-45

[11] While there is no specific regulatory requirement, the Commission in multiple proceedings have emphasised the need to capture 15 min block-wise information for open access consumers. This is clear from the repeated directives provided by the

days. Wind and Solar generation data from about 68 pooling sub-stations (PSS) was provided. As a result, only monthly slot-wise estimation of generation and consumption was possible. For this purpose, as shown in Figure 9, total month wise generation in each ToD slot is calculated from 15-minute block-wise aggregate generation of these pooling stations. This enables comparison of consumption and generation for each ToD slot of the year (4 slots per month times 12 months resulting in 48 slots).

Figure 9: Aggregating 15-min block wise solar and wind generation into slots for comparison with consumption in same slots.



Source: Prayas (Energy Group)

Commission since 2017 where the Commission directs *"to ensure preparation of energy bills on monthly basis by considering the 15 minute's time block period in respect of EHT/HT consumers importing power through power exchange under Open Access. The BESCOM shall implement the directive forthwith and the compliance regarding the same shall be submitted monthly from May, 2017 onwards, to the Commission, regularly."* Similar directives were given to all ESCOMs.

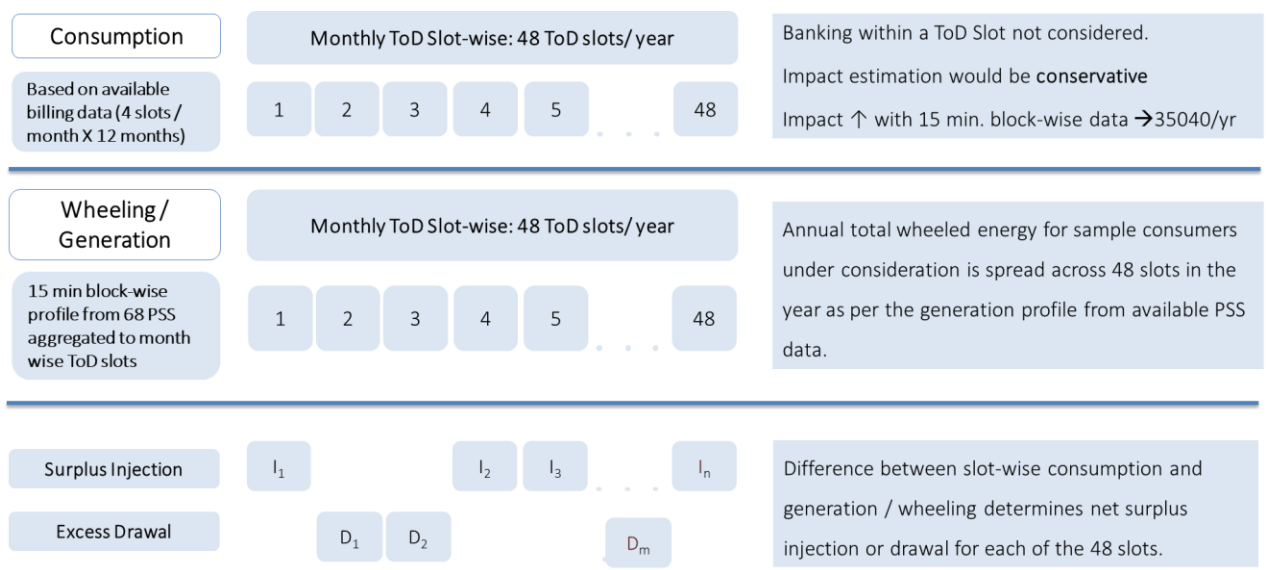
3 Study Methodology

The study involves three main components.

- Component 1: Estimation of Slot-wise Banking Quantum based on available data.
- Component 2: Assessment across three different banking arrangements (Case A, B, C)
- Component 3: Estimating cost and revenue for ESCOMs in each case of banking period detailed in Component 2.

Component 1 (Figure 10) is to estimate the quantum of banking for different time periods, i.e., 48 time slots of the year. Each individual generator and consumer will have different generation and consumption profiles which will lead to different banking quantum (either injection or drawal) for each consumer for each time slot. But the ESCOM will experience aggregate impact of all consumers on its power procurement and other costs and revenue. For example, in a certain slot, one consumer may be injecting surplus power in the grid, while another consumer may be drawing same quantum from the grid. Hence for that particular slot, at the aggregate ESCOM level, combined consumption and generation from both these consumers will match and there will be no banking. Hence it is essential to undertake aggregate analysis of consumption and generation profiles and quantum to find time and quantum of banking.

Figure 10: Component 1 - Estimation of Slot-wise Banking Quantum based on available data.

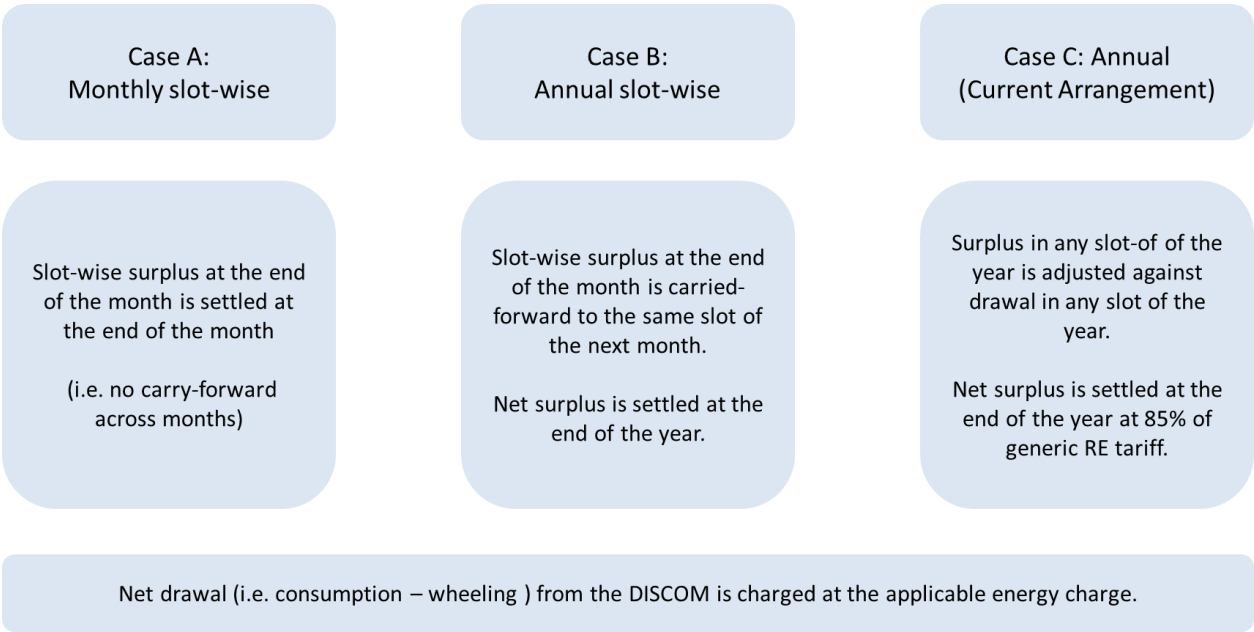


Source: Prayas (Energy Group)

The present analysis considers aggregate consumption pattern for FY 21, i.e., consumption in 48 slots of 120 renewable energy OA / captive consumers spread across all five ESCOMs for which slot wise data was made available[12]. Similarly, generation from different generators (IPPs) wheeling power to RE OA / captive consumers needs to be aggregated to calculate overall banking quantum and time for ESCOMs. Available 15-min generation from 68 wind and solar pooling stations is first aggregated into 48 time slots separately for wind and solar generation. Next, this generation data is used to create monthly slot wise wind and solar generation profiles. Finally, these profiles are weighted in proportion to actual wind and solar shares in the total wheeled energy of all WBA consumers and then scaled up to the total annual wheeled energy for the 120 consumers considered in the analysis. Thus, the total annual wheeled energy is now available in the aggregate wind-solar generation profile which enables assessment of slot-wise aggregate injection and drawal at the ESCOM level.

Component 2 of the study (Figure 11) considers different options for banking periods or settlement periods.

Figure 11: Component 2 – Banking Period.

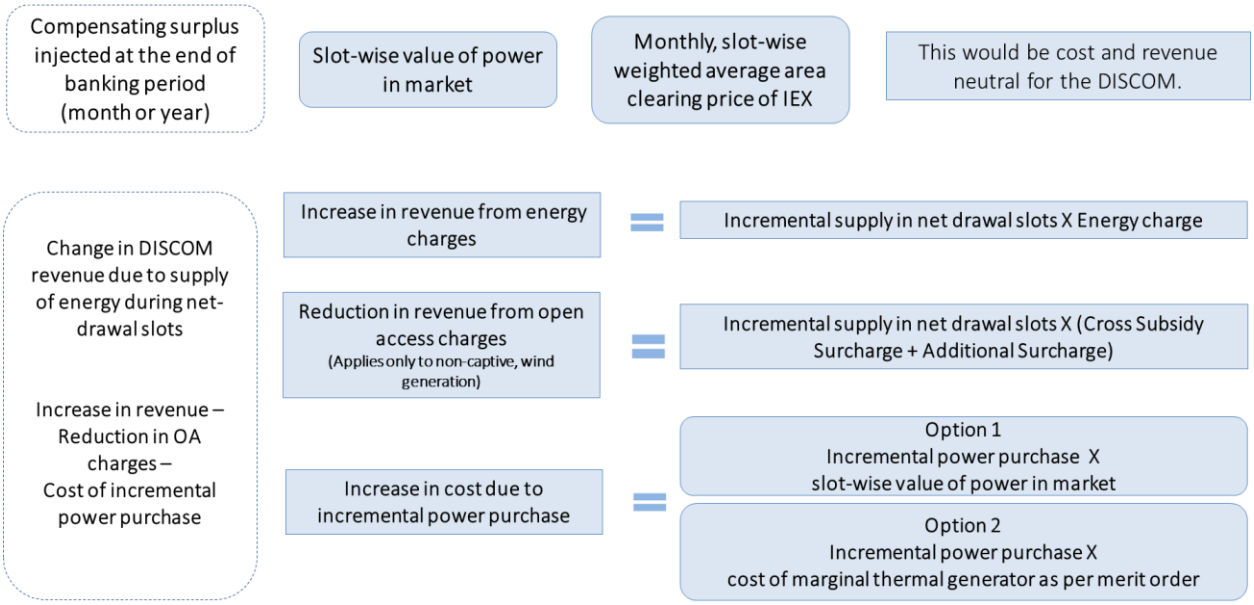


[12] All consumers for which complete data was available for the duration of the study (2 years) have been considered in the analysis. The study covered 120 consumers in FY 21 which is around 20% of the total WBA consumers. This is a significant sample size. Also, the consumer mix considered in the study includes industries like foundry, iron works, cement manufacturing, dairy food, pharmaceutical companies and Aluminum manufacturers, Tech parks and Commercial consumers like hotels, IT/software companies and Hospitals. All these represented various sub-categories under HT-2 tariff category and hence, can be considered as a reasonable subset of consumers availing wheeling and banking arrangement in the state.

In **Case A** we consider **monthly slot-wise banking**. i.e., any surplus (i.e., when generation > consumption) in any slot at the end of the month is purchased by the ESCOM and is not carried forward to the next month. Similarly, net drawal (when generation < consumption) in any slot at the end of the month is charged at the applicable energy and other charges by the ESCOM.
A variation of this case is **Case B**, **annual slot-wise banking** in which any slot-wise surplus in any month is carried forward to the next month and surplus if any at the end of the year is purchased by the ESCOM. **Case C is the current arrangement** of annual banking where generation in any slot can be utilised to offset consumption in any slot of the year.

Component 3 of the study (Figure 12) estimates cost and revenue for ESCOMs in each case of banking period i.e., Case A, Case B and Case C. Case C, i.e., the current banking arrangement is considered as the baseline and changes in surplus and drawal are calculated with respect to this baseline.

Figure 12: Component 3- Estimating cost and revenue for ESCOMs in each case of banking period



Source: Prayas (Energy Group)

We consider that compensation for surplus injection at the end of the banking period (either month or year) to be paid by ESCOMs to the generators would be at the applicable market rate, i.e., ESCOM will essentially pass on the actual market price (DAM) for that time-slot (averaged over the month or year) for the effective surplus quantum to the generator. **This way, such procurement / purchase of surplus power at the end of the settlement period would be revenue or cost neutral for the ESCOM and the generator will also get compensation linked to the market rate.**

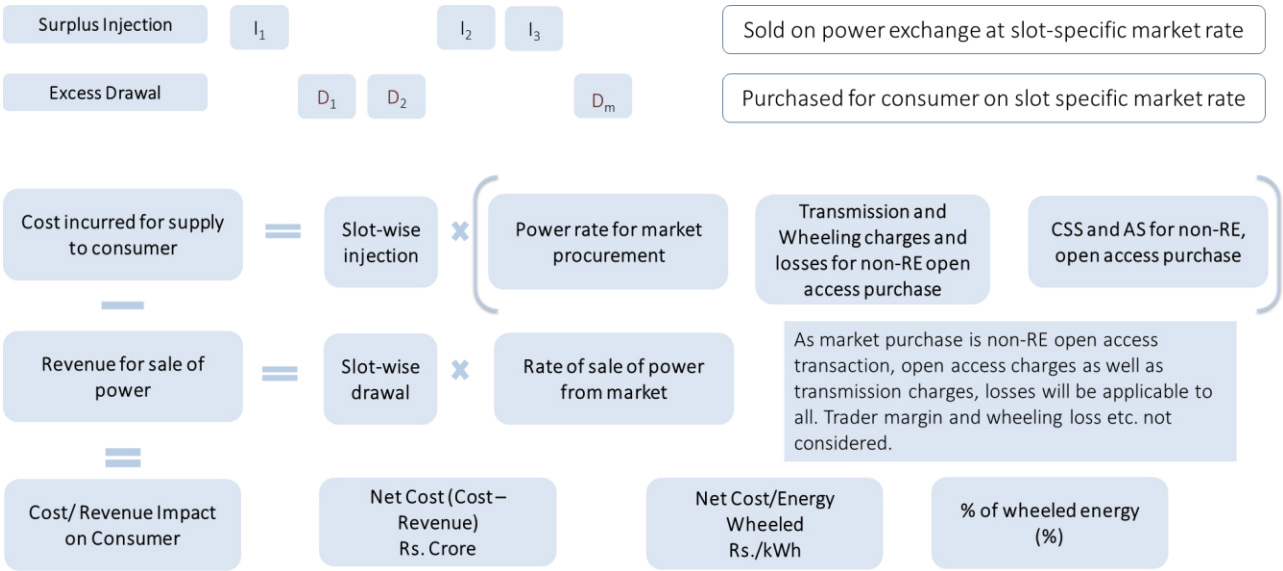
This leaves computation of cost and revenue impact on ESCOMs due to change in drawal by consumer during slots in which generation is less than consumption. This requires calculating three elements.

- First, **increase in ESCOMs revenue due to increased drawal from ESCOM**. This is calculated at the applicable energy charge (without any ToD) as determined by the regulator.
- Second, is the **reduction in open access (OA) charges revenue**. Increase in drawal from ESCOM implies reduction in OA quantum to that extent and as such ESCOM will lose OA charges from such reduction in OA quantum. Currently, only wind OA consumers have to pay OA charges, while all captive and solar OA consumers are exempted from such charges. For the purpose of this analysis, we assume that 60% of total wheeled energy is in the captive route and 40% is sale to third party (OA). Of the third-party sale, we assume an equal share for both wind and solar. Thus 20 % of the total wheeled energy is from third party sale (OA) wind for which OA charges are applicable. Hence, reduction in OA revenue to the extent of 20% of incremental drawal is considered.
- As consumers drawal from ESCOMs increases in Case A and Case B, the ESCOM incurs incremental cost of power to supply this additional drawal by consumers. To assess the cost of such incremental power purchase two options are considered.
    - **In option 1**, we consider that incremental power procurement happens at the applicable market rate, i.e., Power Exchanges DAM price for respective slots.
    - **In option 2**, we consider that the incremental power procurement happens at the variable cost (month-wise) of marginal thermal generator in the contracted pool of ESCOMs.

Case A and Case B discussed above consider that ESCOMs are providing the energy banking service.

Alternate Case: In addition to Case A and B, we also analyse an **alternate case** in which generators / consumers use the market, i.e., Power Exchanges DAM via Open Access to avail banking service. This case is shown in Figure 13. This would imply that surplus will be sold in the power exchange while power will be procured from the power exchange at the time of drawal. To estimate the impact of such a scenario we calculate revenue and cost to consumers based on applicable market rates and all applicable charges.

Figure 13: Alternate Case: Monthly slot-wise banking provided by a trader (market rate).



Source: Prayas (Energy Group)

The next section of the study describes analysis and results based on this methodology.

4 Analysis and Results

In this section we present the analysis and results based on the above methodology. While we have done the analysis for FY 2019-20 and FY 2020-21, in the sections below we describe the results for FY 2020-21 in detail while the corresponding results and analysis data for FY 19-20 is tabulated in the Annexures 4-8.

4.1 Estimation of banking quantum

The Table 2 shows summary of inputs while Table 3 shows the calculation of banking quantum across different time slots and for three cases mentioned above.

Table 2: Summary of inputs for FY 2020-21

Analysis Period	FY 2020-21
Number of Consumers considered	120 across 5 ESCOMs
Total Annual Consumption	1,184 MU
Total Annual Wheeled Energy	1,003 MU
Wind and Solar generation	From 68 Pooling Sub-Stations

Aggregate annual generation (wheeled energy) and consumption for the sample 120 consumers across five ESCOMs for FY 20-21 was 1,003 MUs and 1,184 MUs respectively.

Table 3: Slot-wise banking, net purchase from ESCOMs shown at the annual level for FY 2020-21 for different banking arrangements (Case A, B, C)

ToD Slots	Slot wise consumption	Slot wise wheeling (as per PSS generation profile)	Net drawal / (Surplus)		
			Case A (Monthly slot wise banking)	Case B (Annual slot wise banking)	Case C (Annual banking, baseline)
Slot -1 (06 to 10 Hrs)	190	179	27/(16)	11	Not Applicable
Slot -2 (10 to 18 Hrs)	410	531	4/(125)	(121)	
Slot -3 (18 to 22 Hrs)	197	98	99/(0.2)	98	
Slot -4 (22 to 06 Hrs)	387	195	192	192	
Total	1,184	1,003			180
Net drawal / purchase from ESCOMs			322	301	180
Surplus at the end of settlement period			142	121	0

Note: All values in Million Units (MUs). In case A and B, values in brackets are surplus energy while values outside brackets is net drawal.

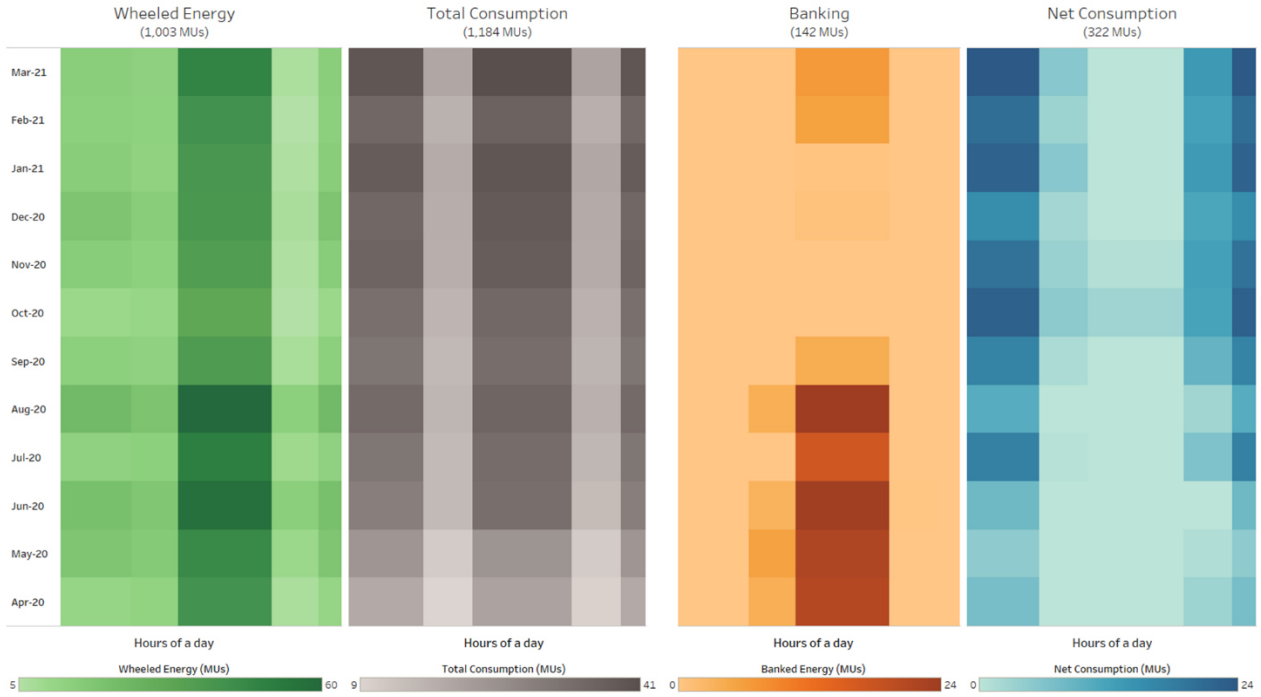
As per the current arrangement of annual banking (Case C), this would imply zero surplus at the end of the year, as total wheeled energy is less than consumption, and net drawal from ESCOMs was 180 MUs.

In Case B, annual slot-wise banking, there is surplus wheeling (banking) of 121 MUs in slot 2 (10 - 18 Hrs), and to that extent drawal from ESCOMs increases in remaining three slots, as this surplus cannot be adjusted in other slots.

In Case A, monthly slot-wise banking there are some months (e.g., April, May and June) when there is surplus in slot 1 and slot 2. In this case of monthly slot-wise banking, surplus at the end of the month is not carried forward and is settled at the end of the month. Hence, in this case total surplus as well as drawal from ESCOMs is more than in Case B. This amounts to surplus of 16 MUs, 125 MUs and 0.2 MUs in slot 1, 2 and 3 respectively (total 142 MU). This surplus is to be monetised as per market rate for respective slots and months. In some months wheeling is less than consumption for these slots as well, which leads to total drawal of 27 MU, 4 MU and 99 MU in slot 1, 2 and 3 respectively (total 130 MU).

For the case of monthly banking, Figure 14 shows the monthly slot-wise wheeled energy, consumption, surplus injection and drawal from grid. It clearly shows the pattern of banking and net withdrawal from the grid.

Figure 14: Wheeled energy, consumption, surplus injection and drawal from grid at slot-wise granularity for monthly banking.



Source: Prayas (Energy Group)

4.2 Cost and revenue implications of different banking arrangements

Table 4 shows the input data used in the analysis and Table 5 captures the change in ESCOM revenue across different banking arrangements.

Table 4: Data and Change in ESCOM revenues across different banking arrangements in FY 2020-21.

Charge / Price considered	Rate	Unit
Consumer Energy Charge[13]	7.75	Rs/kWh
Cross Subsidy Surcharge	1.79	Rs/kWh
Additional Surcharge (non-RE)	1.65	Rs/kWh
Additional Surcharge (RE)	0.20	Rs/kWh
Slot-wise market rate	Monthly slot wise IEX average DAM price for S1 region[14]	
Average Generic wind & solar tariff for FY 20-21	3.17	Rs/kWh

Table 5: Change in ESCOM revenues across different banking arrangements in FY 2020-21

Allocation of wheeled energy	Units	Formula	Case A	Case B	Case C
			Monthly slot wise	Annual slot wise	(Current Arrangement)
Energy Drawal from ESCOMs	MU	A	322	301	180
Reduction in Banked Energy / Change in drawal w.r.t Case C	MU	B	142	121	-
Energy Charge for consumer	Rs/kWh	C	7.75		
ESCOM Billed Revenue	Rs crore	D = A X C	249	234	140
Increase in ESCOM revenue	Rs crore		110	94	

As shown in the Table 5, drawal from ESCOM is valued at an energy charge of 7.75 Rs/unit. As noted in section 3, in case of increased drawal from ESCOM, ESCOM will lose revenue from CSS and AS, which is assumed to be applicable to 20% (wind OA) of increased drawal. Applicable CSS of 1.79 Rs/unit and AS of 0.2 Rs/unit are considered for this calculation. As can be seen from the table, ESCOMs revenue in Case A is more than Case C (current arrangement) by Rs. 110 Cr. and in Case B it is more by Rs. 94 Cr.

[13] We have determined the weighted average tariff for the HT-2 consumer category for the state, after considering the average tariff and sales for each consumer category (HT-2 (a), (b) & (c)) for all 5 ESCOMs of the state. This comes to Rs 7.75/kWh for FY 21. Apart from the energy charge, the KERC determines Fuel Adjustment Charges (FAC) for each quarter, which is usually different for each DISCOM. FAC charges have not been considered in the study, as they vary for each quarter and will increase complexity in the calculation.

[14] The prices from IEX have been used as 99.6% of the Day Ahead Market Transactions on the two operational power exchanges take place on IEX. For more details, please see: https://cercind.gov.in/2021/market_monitoring/Annual%20Report%202020-21.pdf

The next step in the analysis is to calculate the increase in cost of ESCOMs towards power procured for drawal by consumers. For this calculation two options are considered.

In **option 1**, it is assumed that ESCOMs would need to purchase incremental power from market and hence Power Exchanges DAM rate for respective slot (when incremental drawal takes place) is considered as power procurement cost.

In **option 2**, it is assumed that ESCOMs marginal thermal generation will increase output to meet the incremental drawal and hence variable cost of marginal thermal generator for that slot in each month is considered for calculating incremental power procurement cost.

Table 6 details these calculations.

Table 6: Estimating cost and revenue for ESCOMs under different banking arrangements for FY 2020-21.

Particulars	Units	Formula	**Case A:** Monthly slot-wise		**Case B:** Annual slot wise	
Reduction in Banked Energy (Change in drawal w.r.t Case C)	MU	B	142		121	
ESCOM Billed Revenue	Rs crore	D	249		234	
ESCOM Billed Revenue in Case C	Rs crore	E	140			
Options for rate of incremental power purchase			**Option 1**	**Option 2**	**Option 1**	**Option 2**
Option 1: Slot-wise market rate						
Option 2: Cost of marginal thermal generator as per merit order						
Incremental power purchase cost	Rs crore	F = B X Purchase rate	42.7	52.8	36.5	45.2
Reduction in revenue from OA charges (CSS+AS)	Rs crore	G = B X (CSS+AS)	5.6	5.6	4.8	4.8
Revenue loss to ESCOMs due to annual banking (Case C) compared to slot-wise banking	Rs crore	H=D-F-G – (E)	61.3	51.3	52.6	44
% Revenue loss to ESCOMs due to annual banking (Case C) compared to slot-wise banking	%	I = H/ (E)	44%	37%	38%	31%
Cost of banking per unit of wheeled energy	Rs/kWh	J= H / Wheeled energy	**0.61**	**0.51**	**0.52**	**0.44**
Cost of banking as % of wheeled energy	%	K = J / Generic RE tariff	**19.3%**	**16.1%**	**16.5%**	**13.8%**

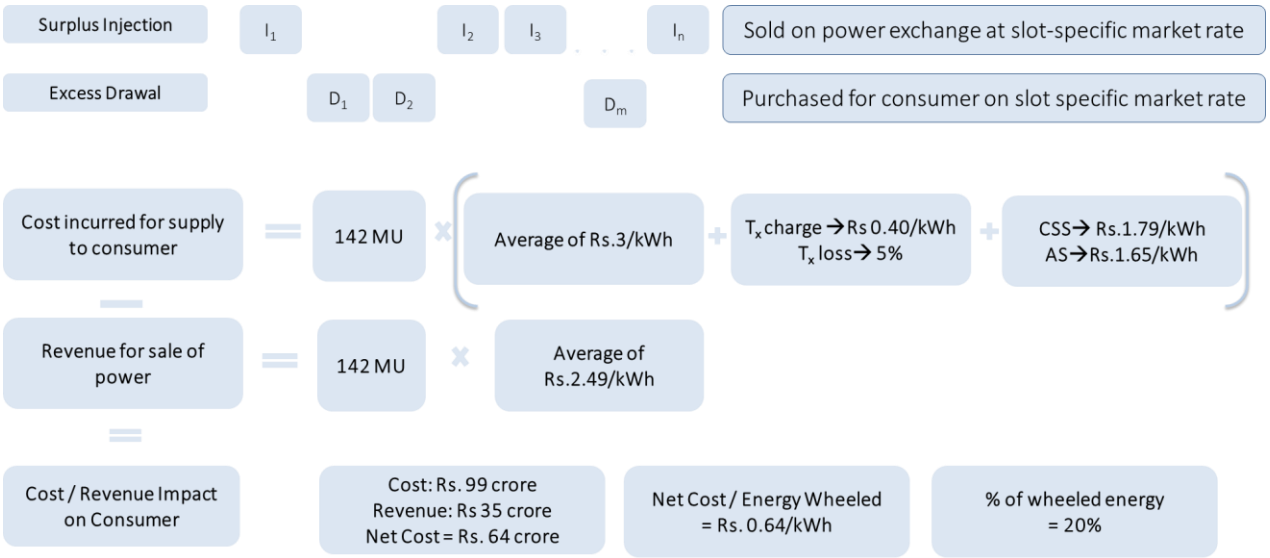
Table 6 also shows total revenue loss to ESCOMs due to current banking arrangement compared to Case A of monthly slot-wise banking and Case B of annual slot-wise banking. Loss to ESCOM is calculated as incremental revenue less cost of incremental power procurement less loss of CSS and AS revenue less revenue in current arrangement of annual banking. This loss to ESCOMs expressed in Rs/unit of wheeled energy is between 0.44 Rs/unit and 0.61 Rs/unit. Considering average generic wind and solar tariff of 3.17 Rs/unit, this translates to 14 % to 19 % of wheeled energy against existing in-kind banking charge of 2 % of wheeled energy.

4.3 Results for Alternate Case

As noted in section 3, we also considered an alternate case in which the consumer relies directly on the market to avail banking service, i.e., selling surplus energy to the market and purchasing the same quantum in other net-drawal slots to meet incremental consumption. Methodology and calculations of this case are shown in Figure 15.

Thus, the consumers sell 142 MU in the market at an average price of Rs 2.49/kWh and gain a revenue of Rs. 35 crores, while they purchase 142 MU from the market in net-drawal time slots at an average price of Rs 3/kWh. On this purchase from the market, they pay non-concessional transmission charges and losses as well as CSS and AS. Thus, their total cost for this procurement is Rs 99 crore. Adjusting for the Rs. 35 crores gain in revenue, their net increase in cost is Rs 64 crore which translates to 0.64 Rs/kWh of wheeled energy or 20% of wheeled energy.

Figure 15: Alternate Case: Monthly slot-wise banking provided by a trader (market rate) for FY 2020-21.



Source: Prayas (Energy Group)

As is evident from these calculations, in this alternate case, at 20% of the wheeled energy, the cost of banking for consumers is even higher than annual slot-wise or monthly slot-wise banking. This is because, in addition to the difference in price of power at the time of injection and drawal,

consumers need to bear transmission charge and transmission loss on power procured through the market (power exchange). Consumers also need to pay full CSS and AS on the entire power procurement from the market as CSS and AS concessions are only for captive and solar generators and not for market purchases. Thus, apart from additional transaction costs and efforts to buy and sell power from market in each 15 min block in the year, the overall cost of banking service would be higher compared to availing banking service from ESCOM. Further in this case each consumer will have to manage selling and purchasing at the individual level and would not be able to avail advantage of aggregation of generation and consumption at respective slot.

In Case A, B and the Alternate case, it is essential to note that due to data limitations, this study only considers ToD slot-wise banking. More accurate calculation of ESCOM loss would be feasible if 15 min block wise analysis using similar methodology is carried out. Considering that ESCOMs are making significant loss due to annual banking compared to slot-wise banking, it is expected that 15 min block wise analysis would reveal much higher loss to ESCOMs which is not captured in this analysis due to data limitations. Thus, the results presented here could be treated as conservative. As an illustrative case, **to understand the impact of banking within a ToD slot**, we applied the methodology at a 15-min granularity as shown in **Box 1**.

Box 1: Illustrative block-wise analysis of banking for FY 2020-21

The following steps and data were used in this calculation.

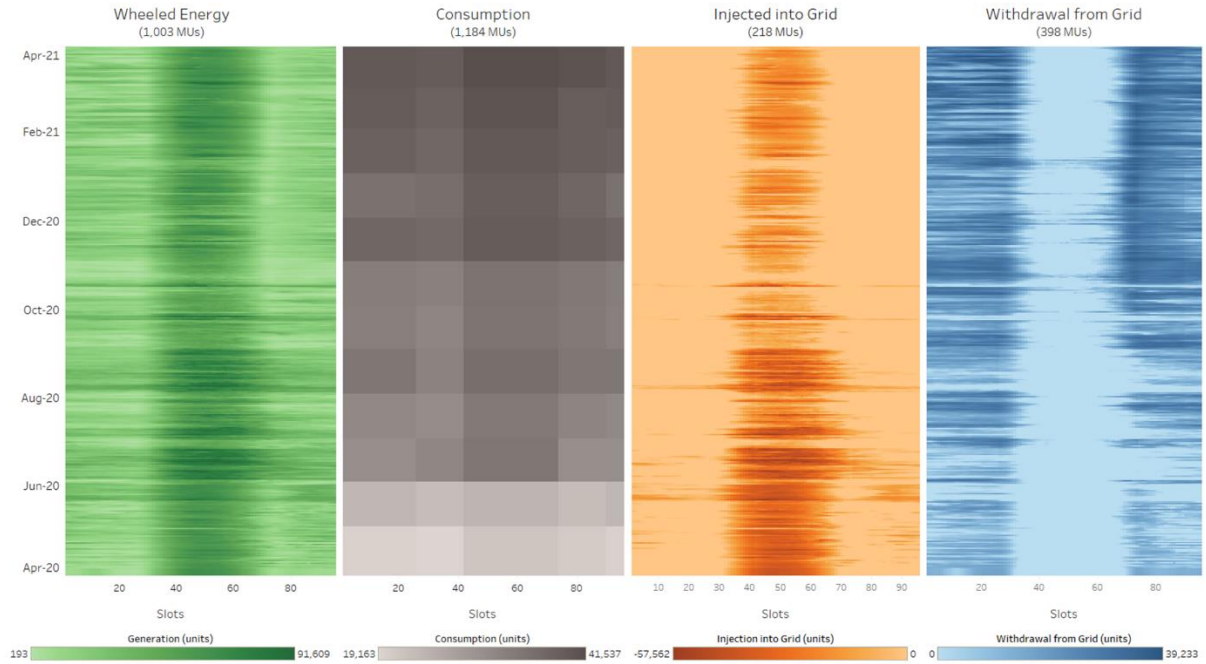
Consumption Data: We converted the monthly slot-wise consumption data into 15-min consumption data for FY 2020-21. For example, if the monthly consumption for slot 3 (18-22 Hrs) is 100 MU. There are 30 (days) X 4 (hours in slot 3) X 4 (blocks per hour) = 480 blocks (15-min) in which this 100 MU were consumed. Thus, the average consumption in each block in slot 3 is 100/480 = 0.208 MU/block in slot 3 for that month. Hence, we have considered the same consumption value for each 15-min block in that slot for each day of the month. Doing this for each slot and each month results in a complete 15-min consumption profile for those consumers.

Wheeling Data: We have the 15-min level generation data from the 68 PSS which was scaled to the total wheeled energy in FY 2020-21.

Using these two sets of data, for each 15-min block, we calculate whether there is injection in the grid (generation>consumption) or withdrawal from the grid (generation<consumption). The results show that there is a total surplus injection into the grid of 218 MU (as compared to 142 MU in Case A, i.e., aggregated monthly slot-wise analysis) and there is a withdrawal of 398 MU from the grid (as compared to 322 MU in monthly slot-wise analysis). **Thus, banking increases by nearly 50% in the 15 min case as compared to the monthly slot-wise analysis (Case A) and 80% as compared to the annual slot-wise analysis (Case B). As such the cost of banking service would be proportionately higher.**

Out of the total 1,003 MU wheeled energy, 785 MU is consumed instantaneously (within a 15 min block). The 15-min profile of consumption, surplus injection and drawal from the grid in shown in Figure 16. The impact can be better ascertained with actual block-wise consumption data.

Figure 16: Wheeled energy, consumption, surplus injection and drawal from grid at 15-min granularity.

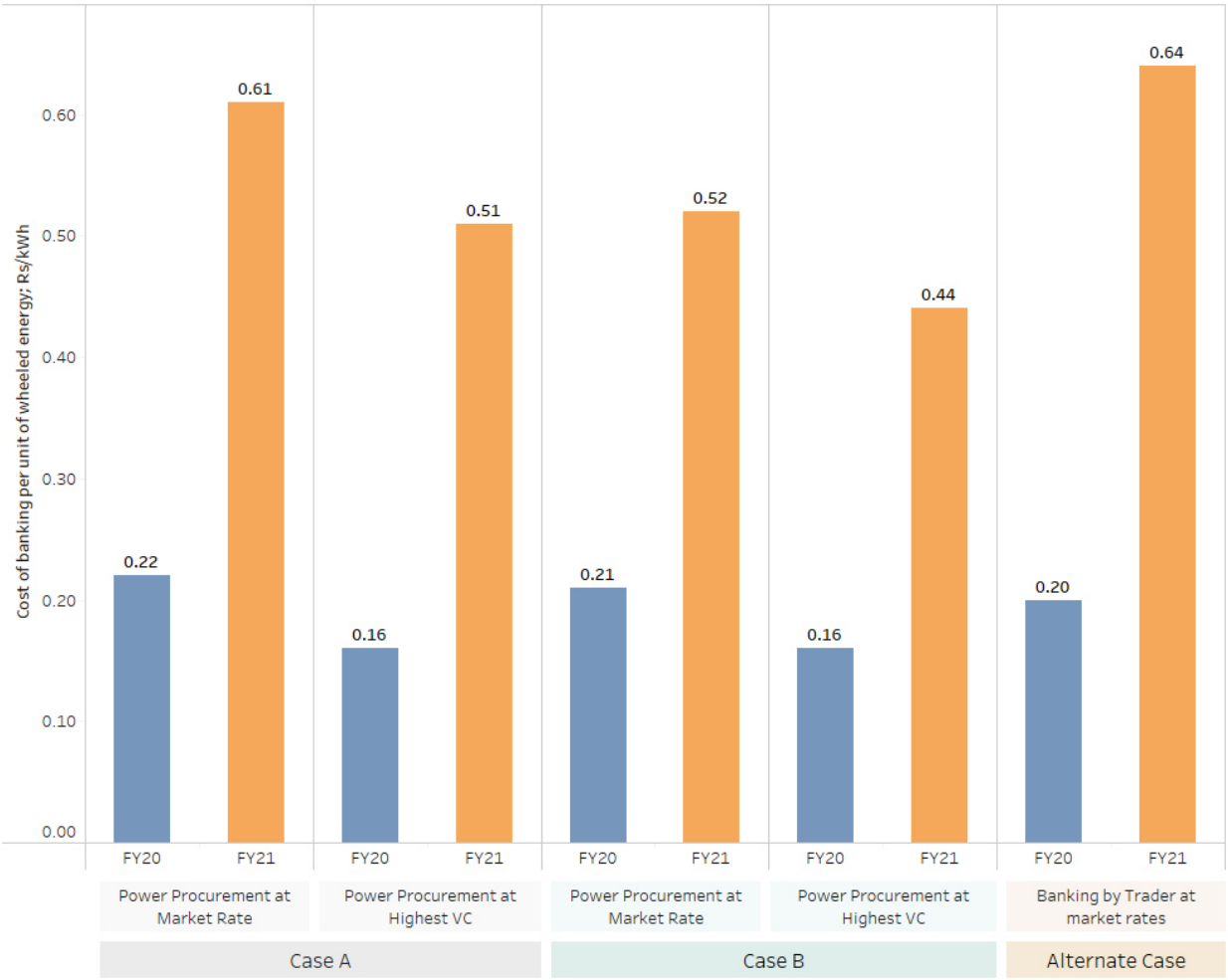


Source: Prayas (Energy Group) analysis

4.4 Impact of energy banking on ESCOMs

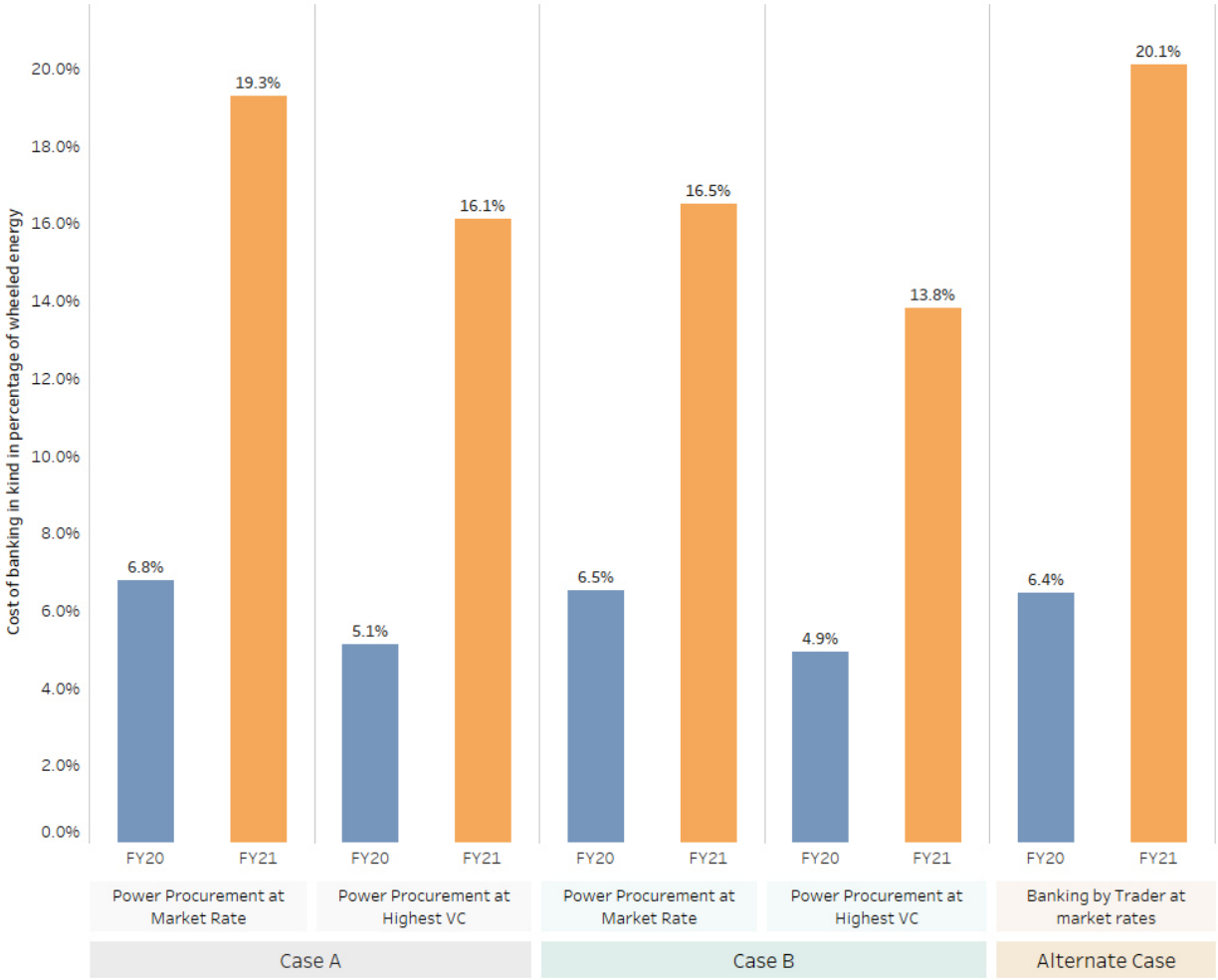
Figure 17 and Figure 18 depict these results in terms of loss to ESCOMs due to current banking arrangement (annual banking) compared to different banking periods considered in the study. These results are for FY 2019-20 and FY 2020-21 and how the potential impact of banking in terms of Rs/unit of wheeled energy and percentage of wheeled energy.

Figure 17: Banking cost (expressed in Rs/kWh per unit of wheeled energy) to ESCOMs due to the current banking arrangement for FY 2019-20 and FY 2020-21.



Source: Prayas (Energy Group)

Figure 18: Loss (expressed in percentage of wheeled energy) to ESCOMs due to the current banking arrangement for FY 2019-20 and FY 2020-21.



Source: Prayas (Energy Group)

The earlier section has already described the results for FY 2020-21 in detail. As is evident from the two graphs above, the impact for FY 2019-20 is much lower than that of FY 2020-21. As is clear from the methodology, the final banking impact is a result of various parameters, namely scale and profile of generation (wheeled energy), scale and profile of consumption and the cost/price of power at each time periods when there is injection (generation > consumption) and drawal (generation < consumption).

For FY 2019-20, as can be seen in Table 7 below, the ratio of wheeled energy to consumption is at 70% at the annual level compared to 85% in the subsequent year. Further, the slot-wise break up of this ratio clearly shows that there is hardly any banking taking place in Slot-2 (106% vs 130%). This explains the difference in results in the two years.

For both years, it is evident that the ESCOMs are financially impacted due to the current banking arrangement. Here, it needs to be noted that ToD slot-wise calculation of banking carried out in this study is an underestimate of the banking quantum compared to 15 min time block wise analysis which would be as per the IEGC.

Table 7: Ratio of slot-wise wheeled energy to consumption for all FY 2019-20 and FY 2020-21

Wheeled Energy / Consumption		
Year	2019-20	2020-21
Slot -1 (6 to 10 Hrs)	81%	94%
Slot -2 (10 to 18 Hrs)	**107%**	**130%**
Slot -3 (18 to 22 Hrs)	40%	50%
Slot -4 (22 to 6 Hrs)	41%	50%
Total	70%	85%

Source: Prayas (Energy Group)

5 Financial Impact of existing wheeling and transmission concessional charges

This section covers the methodology and results of the analysis to assess impact of removal of existing concessions provided to open access and captive consumers on wheeling, transmission charges as well as line losses. For this, ESCOMs provided data on:

- Month-wise contracted capacity and energy generation from renewable energy open access and captive projects for FY20 and FY21.
- Applicability of concessions on wheeling, transmission charges and line losses for FY20 and FY21.

Applicable charges and losses approved by KERC were collated from ESCOM and KPTCL tariff orders for the respective years.

The applicable non-concessional as well as concessional charges are summarised in Table 8.

Table 8: Applicable non-concessional as well as concessional charges for wheeling, transmission and losses.

FY20	Unit	BESCOM	MESCOM	CESC	HESCOM	GESCOM
Wheeling charge	Rs/kWh	0.20	0.32	0.33	0.29	0.30
Wheeling loss	%	3.59%	4.29%	3.95%	5.18%	4.51%
Concessional wheeling for RE projects		5% of wheeled energy in lieu of charges and losses				
KPTCL LTOA charges	Rs/MW/month	1,31,711				
KPTCL losses	%	3.10%				
Concessional transmission for RE projects		Approved losses applicable but charges are exempt				
FY21	**Unit**	**BESCOM**	**MESCOM**	**CESC**	**HESCOM**	**GESCOM**
Wheeling charge	Rs/kWh	0.24	0.37	0.34	0.32	0.37
Wheeling loss	%	3.42%	3.76%	3.04%	4.93%	4.01%
Concessional wheeling for RE projects		5% of wheeled energy in lieu of charges and losses				
KPTCL LTOA charges	Rs/MW/month	1,55,114				
KPTCL losses	%	3.04%				
Concessional transmission for RE projects		Approved losses applicable but charges are exempt				

Source: Compilation from KERC orders and from ESCOM data.

To assess the financial impact, losses as well as existing in-kind charges on wheeling were expressed as a rate (Rs/kWh) using the generic RE tariff approved by the Commission for the assessment year. Data provided by the ESCOMs on open access and captive consumption were used to estimate the weighted average wheeling charge and losses for the years. Long term transmission open access charges and losses were only applied to the capacity and energy generation which was visible at SLDC level (i.e., - connected to KPTCL network). Based on the data provided, the revenue from wheeling and transmission charges as well as revenue accounting for wheeling and transmission losses was estimated for the existing case (with concessions) and for a

case where all concessions are removed. The difference in revenue billed for transmission and wheeling between the two cases is the financial impact of existing concessions. The inputs used and the results are reported in Table 9.

Table 9: Financial impact of concessional wheeling and transmission

Particulars	Unit	FY20	FY21
Total Generation/Export	MU	6,326	6,171
Average Wind and Solar Generic RE tariff	Rs/kWh	3.17	3.17
Distribution (Wheeling) charge, weighted average across ESCOMs	Rs/kWh	0.24	0.27
Distribution (Wheeling)Wheeling loss, weighted average across ESCOMs	%	3.86%	3.57%
	Rs/kWh	0.12	0.11
Concessional RE distribution (wheeling) charge (5% in kind)	Rs/kWh	0.16	0.16
Revenue from distribution/wheeling (Existing concessions)	Rs. Cr	100	98
Revenue from distribution/wheeling (Without concessions)	Rs. Cr	227	237
Revenue foregone due to concessions on wheeling	**Rs. Cr**	**126**	**139**
Average capacity connected to KPTCL network	MW	740	740
Total Generation/ Export from capacity at KPTCL network	MU	1455	1419
Monthly Transmission charges (LTOA)	Rs/MW	131,711	155,114
Transmission loss	%	3.10%	3.04%
	Rs/kWh	0.10	0.10
Concessional Monthly RE transmission charge	Rs/MW	0	0
Revenue from transmission charges, losses (Existing concessions)	Rs. Cr	15	14
Revenue from transmission charges, losses (Without concessions)	Rs. Cr	132	152
Revenue foregone due to concessions on transmission charges	**Rs. Cr**	**117**	**138**
Total transmission and wheeling revenue foregone due to concessions	**Rs. Cr**	**243**	**277**
% Revenue foregone due to concessions on wheeling and transmission	**%**	**212%**	**248%**

Source: Prayas (Energy Group).

Presently, the ESCOMs lose Rs.243 to Rs. 277 crore per annum due to concessions on wheeling and transmission charges. Thus, revenue from transmission and wheeling could have been 212% to 248% higher than revenue from existing concessional charges. Transmission charge waiver is a major contributor to this revenue loss accounting for 50% of the revenue foregone. With increased group captive options, there will be more instances of consumers and generators being located with areas of supply of different ESCOMs, necessitating use of KPTCL's network. Over the years the revenue foregone or losses will only increase. Thus, there is an urgent need to discontinue wheeling and transmission concessions for future projects.

6 Conclusions and Recommendations

1. From 2007 to 2022, RE capacity (excl. large hydro) in Karnataka has grown from 1 GW to 16 GW. Over 80% of this capacity is from wind and solar resources. RE generation has increased from 9.7 TWh in FY 15 to 28.6 TWh in FY 22. Thus, in FY 21, RE (excl. large hydro) contributed ~30% of total power procurement in the state. RE capacity with Wheeling and Banking (WBA) agreements has also increased from 182 MW to 3,492 MW from FY 11 to FY 22. Generic solar tariffs reduced over 371% from Rs 14.50 to Rs 3.08/kWh from 2010 to 2021. Similarly, generic wind tariffs reduced over 25% from Rs 4.5 to Rs 3.26/kWh from 2015 to 2021. Tariffs discovered through competitive bidding are even lower.

2. **In spite of RE capacity with WBA growing 17 times in last 11 years and the dramatic fall in RE prices (even lower than ESCOM avg. procurement costs), the concessional wheeling and banking arrangement for RE has remained unchanged in the last 17 years. This calls for a revamp of the existing wheeling and banking concessions.**

3. As seen from the results presented in the study, the current practice of annual energy banking and concessional wheeling has a significant financial impact on ESCOMs.
    a. For FY 20-21, under various scenarios, the cost of banking ranges from **Rs 0.44-0.61 Rs/kWh of wheeled energy.** Thus, the total wheeled energy of 5,770 MU implies a loss of **Rs. 253-353 crores for ESCOMs.** It should be noted that the scale of the impact depends on the quantum and time of banking. In FY 2019-20, as the quantum of banked energy was less, the impact on ESCOMs was **Rs. 91-125 crore** considering the wheeled energy of 5,814 MU. Here it needs to be noted that impact on ESCOMs for both FY 20 and FY 21 is an underestimate as the quantum of banking is calculated only on a slot-wise basis (2 slots of 4 hours and 2 slots of 8 hours each) and not at 15-min block level which is the scheduling and balancing requirement as per IEGC. Indicative 15-min block level analysis (as shown in Box 1) shows that the quantum of banking could be over 50% higher than slot-wise computation for FY21 and 140% for FY20.
    b. The concessional wheeling and transmission charges and losses result in ESCOMs and KPTCL foregoing revenue of **Rs. 243 and 277 crores** in FY 2019-20 and FY 2020-21 respectively**.** Transmission charge waiver is a major contributor to this revenue loss accounting for 50% of the revenue foregone.
    c. Thus, the total loss to the ESCOMs for FY 2019-20 and FY 2020-21 from energy banking and concessional wheeling and transmission is **Rs. 334-368 crores and Rs. 530-630 crores respectively**.

4. Considering these financial impacts on the ESCOMs, which are borne by the entire ESCOM consumer base, we recommend the following,
    a. **Immediately shift to monthly slot-wise banking from the existing annual banking.**
    b. Considering the results shown in Figure 18 (loss of 14-19% of wheeled energy in FY 20-21 and loss of 5-7% of wheeled energy in 2019-20) we recommended **increasing banking charge to 10-12% of wheeled energy (as against the existing 2% charge) or 0.3-0.4 Rs/kWh of wheeled energy to adequately compensate ESCOMs for their losses.**
    c. **As RE based OA/CPP transactions will continue to grow in coming years, it is necessary to move to 15-min accounting to correctly account for the quantum of banking. We recommend moving to this framework within two years.**
    d. Along with moving to 15-min accounting, the banking charge should be levied as a Rs/kWh charge per unit of banked energy so that there is a clear economic signal to the cost of banking which would directly incentivise consumers to align their consumption and generation patterns to the extent possible.
    e. **Discontinue all wheeling and transmission concessions on charges as well as losses beyond existing applicability**.

5. In order to ensure regulatory certainty, these changes should be made applicable to all new projects and projects for which Wheeling and Banking agreements (WBA) are due for renewal and for projects for which WBA were made subject to changes in wheeling and banking arrangement to be approved by the regulator.

6. To enable this periodic assessment using more granular data, 15 min. block-wise data of consumption and RE generation should be recorded and stored in a standardised format. Such data (esp. 15-min consumption data) should be archived and used for further analysis. This should be part of respective agreements and metering arrangements with generators and consumers. Open access regulations in the state could also be amended to specify banking framework as well as capturing and reporting of such data on a periodic basis.

In the coming decade, RE is set to become the mainstay of the generation mix and deservedly so. Our recommendations are aimed at strengthening this shift by providing an appropriate framework to facilitate reliable grid integration. The proposed framework will provide right price signals and incentives for minimising balancing costs through measures such as demand aggregation, energy storage, increased market participation, better forecasting and scheduling and demand flexibility. These actions would be necessary for the sustained growth of RE at the scale envisaged.

* * * * *

7 Annexures

Annexure 1: Revision in transmission, wheeling and banking charges in other states

State	Category	Transmission charges	REC	Losses	Banking charges
Tamil Nadu	Solar	50% of charges applicable to conventional power	100%	Actual	Peak hour generation can be adjusted to normal hour of off-peak hour consumption of the billing period and normal hour generation can be adjusted to off peak hour consumption of the billing period - 75% of the solar tariff paid for the balance energy
	Wind	50% of charges applicable to conventional power	100%	Actual	**Projects commissioned prior to 1.4.2018** - The energy generated during a month is adjusted against consumption of that month and the balance if any is reckoned as the banked energy - 75% of the applicable wind energy tariff rate. **Projects commissioned from 1.4.2018** - Any new WEG machines commissioned from the date of applicability of the order in the normal category or REC scheme shall have facility of banking of energy for a period of one month. There shall be no banking charges - 75% of pooled cost of power purchases as notified **The order of TNERC was challenged by Tamil Nadu Spinning Mills Association in the APTEL and APTEL in the order dated 28.1.2020 has set aside the order**
Andhra Pradesh	Solar, Mini hydel& wind	Normal wheeling charges and losses	100%		Banking is allowed all the 12 months of the financial year with the banking charge of 2% in kind. Drawal from banked energy is not permitted during the 5 months period from Apr to 30th June and 1st Feb to 31st March of each financial year. Drawal of banked energy during the time of the day applicable during peak hours as specified in the Retail Supply Tariff - unutilised energy will be settled at 50% of the pooled cost of power purchase.
Telangana 2020-2024	Solar, Mini hydel& wind				Banking charges is to be adjusted in kind @ 21% from April to March. Banked united cannot be consumer / redeemed in the peak months (i.e., from 1st April to 30th June and 1st Feb to 31st March of the banking year under consideration) and also the peak hours as ordered by the Commission in the Retail Supply Tariff order of the relevant year.
Gujarat	Small, mini and micro hydro stations	Normal transmission charges, wheeling charges		Normal	REC - Monthly set off SHP - Energy for meeting its RPO - 15 min time block

State	Category	Transmission charges	REC	Losses	Banking charges
	Small, mini and micro hydro stations Captive	66 kV and above -Normal transmission charges 66kV and below - 50% wheeling charges & 50% Distribution losses Injection @ 11 kV &Drawal @ 11 kV - 50% wheeling charges & 50% Distribution losses			
	Wind and Solar	Wind 1.Captive: a. 66 kV and above: Normal Transmission charges b. Below 66kV: Normal Transmission charges, 50% of Wheeling Charges and 50% of Distribution Losses 2. 3rd party sale: Normal Transmission Charges, Wheeling Charges 3. Wheeling to more than one location: Additional 5 paise per unit Solar 1. Normal Transmission charges 2. Captive: 50% of Wheeling charges			Wind Captive consumption - 1-month Banking - settlement shall be on the basis of peak and normal hours Solar projects – 1-month banking. However, peak charges shall be applicable for consumption during peak hours

State	Category	Transmission charges	REC	Losses	Banking charges
		3. 3rd party sale: 100% of the Wheeling Charges 4. Wheeling to more than one location: Additional 5 paise per unit			
Rajasthan	Captive	50% concession on transmission, wheeling charge for first 7 years.			Banking for captive and open access on annual basis (April to March). Currently, banking is only allowed for captive, that too on a monthly basis. Banking charge: 10% of banked energy.
Maharashtra		Normal charges			Banking of energy shall be permitted only on monthly basis. Provided that the credit for banked energy shall not be permitted to be carried forward to subsequent months and the credit for energy banked during the month shall be adjusted during the same month as per the energy injected in the respective time of day (TOD) slots determined by the Commission in its orders determining the tariffs of the distribution licensees. Provided further that the energy banked during peak TOD slots may also be drawn during off-peak TOD slots, but the energy banked during off-peak TOD slots may not be drawn during peak TOD slots. Illustration: Energy banked during • Night off-peak TOD slot (2200 hours – 0600 hours) may only be drawn in the same TOD slot • Off-peak TOD slot (0600 hours – 0900 hours and 1200 hours – 1800 hours) may be drawn in the same TOD slot and also during night off-peak TOD slot. Unutilised banked energy at the end of the month, limited to 10% of the actual total generation by such renewable energy generator in such month, shall be considered as deemed purchase by the Distribution Licensee at a rate equivalent to that stipulated under yearly Generic RE Tariff Order. Against the APTEL order dated 27.4.2021, MSDECL filed civil appeal before Supreme Court and Court directed MERC to decide the matter expeditiously within 3 months in the light of the observations made by it.

State	Category	Transmission charges	REC	Losses	Banking charges
UPERC					Banking of energy 100% ALLOWED Withdrawal of banked power shall be allowed only as per TOD system i.e., withdrawal of power of power in the peak/off-peak hours shall not be more than the power banked in that respective TOD slot. Renewable energy generating power plants (except for SHP and MSW plants) shall be allowed to withdraw power that was banked during a particular quarter within two subsequent quarters i.e. power banked in Qth quarter shall be allowed to withdraw within (Q+2)th quarter. The banked power remaining unutilized on the expiry of that period is defined herein would be treated as sale and the financial settlement shall be made at Rs 2 per unit or the rate approved in the PPA entered with the distribution licensee, whichever is less. However, banking charges shall be deducted from such unutilized banked energy. Banking charges shall be 12% of the energy banked except for solar and wind power for which it shall be 6% of the energy banked and should be adjusted against the banked energy before withdrawal. b) In case of captive non-RE, the settlement is year (Y)+1.

Source: Compilation by PCKL from various orders shared with Prayas (Energy Group) as background to the study

Annexure 2: Matters related to banking arrangement in Karnataka

Date	Description	Details
04.07.2014	KERC order on Commission's discussion paper dated 20.06.2013	• KERC Order allows annual banking facility for non-REC RE projects. • The banked energy unutilized at the end of the year shall deemed to have been purchased by the Distribution Licensee of the area where the generator is located and shall be paid for at 85% of the latest generic tariff determined by the Commission.
9.1.2018	KERC Common Order in OP Nos.90/2016, 100/2016, 104/2016, 47/2017 and 130/2017	KERC order stipulated: • Reduction in banking period for all non-REC route based RE Projects from one year to six months. • Unutilised banked energy at end of 6 months deemed to be purchased by the ESCOMs at 85% of the applicable generic RE tariff approved by the Commission • Energy banked by non-REC route based RE projects during peak ToD time slots alone can be drawn during peak ToD slots This is applicable on all RE projects under non-REC route under existing wheeling and banking agreements from the date the new norms for banking come into force.
29.03.2019	APTEL Judgment of A.42 of 2018 & batch	APTEL judgement dated 29.03.2019 and 05.08.2019 set aside the impugned order passed by Karnataka Electricity Regulatory Commission Thus, reduction of banking period and restrictions on banking and drawal for existing WBAs was set aside.
05.08.2019	APTEL order in IA NO. 962 of 2019 in APPEAL NO. 42 OF 2018 & IA No. 1370 of 2019 & IA No. 214 of 2018	
20.12.2019	Civil Appeal No.9619 - 9637 / 2019 before the Supreme Court	APTEL judgement has been challenged before Hon'ble Supreme Court by ESCOMs.

Source: Compilation by PCKL from various orders shared with Prayas (Energy Group) as background to the study

Annexure 3: Matters related to wheeling and banking charges in Karnataka

Date	Description	Details
04.07.2014	KERC order on discussion paper dated 20.06.2013	• Order allows annual banking facility for non-REC RE projects. • The banked energy unutilized at the end of the year shall deemed to have been purchased by the Distribution Licensee of the area where the generator is located and shall be paid for at 85% of the latest generic tariff determined by the Commission. • In lieu of transmission and wheeling charges, wheeling charges at 5% of net energy injected applicable for a period of 10 years from the data of commissioning of RE projects for all projects commissioned before 31.03.2018
18.08.2014	KERC order on discussion paper dated 07.07.2014	• All Solar Projects (other than REC Captive) with CoD between 01.04.2013 and 31.03.2018 using captive power for self-consumption and selling power via open access in the state shall be exempt from wheeling, banking, CSS charges for 10 years from date of commissioning.
14.05.2018	KERC order on Discussion Paper dated 20.01.2018	• All RE projects, (other than REC Captive) which have not completed 10 years as on 31.03.2018 shall pay 25% Transmission, Wheeling Charges and bear applicable line losses. All RE projects mentioned above shall also pay banking charges at 2% in kind on wheeled energy • However, the following projects can avail the following concessions: a. Solar projects commissioned on or earlier to 31.03.2017 are given existing concessions on wheeling and banking b. Wind projects commissioned between 10.10.2013 and 03.09.2017 are only exempt from line losses c. Mini Hydel Projects commissioned between 01.01.2015 and 31.03.2018, pay 50% for line losses d. Biomass and cogeneration projects only pay 5% of net energy injected in lieu of transmission, wheeling charges and do not pay for line losses. • RE projects completing 10 years as on 31.03.2018, have no concessions on Transmission, Wheeling Charges, applicable line losses, banking charge. • Order shall come into effect from 01.04.2018 and shall be in force till 31.03.2020 or until further Orders in this regard.
13.03.2019	High Court Judgment of W.P No.23158/2018 and Batch	Karnataka High Court quashed the order of KERC dated 14.5.2018. It held that KERC can determine wheeling and banking charges prospectively.
11.04.2019	High Court Proceedings in WA 1061/2019	BESCOM has filed Writ Appeal to stay the operation of High Court order on 11.04.2019. Matter is pending.
17.6.2020	Government of Karnataka Letter with File No. ENERGY/444/VSC/2020-JD-ENERGY	Directed KPTCL enter only wheeling agreement as per KERC standard format removing banking facility for the Renewable projects for those selling power under third party/ open access consumer. Order challenged in following ongoing proceedings: • WP No 722 of 2021 before Hon'ble High Court M/s Rai Bahadur Seth Shreeram Narasingdas private Limited Vs GoK, KPTCL, BESCOM and GESCOM OP No 21 of 2121 before KERC M/s Graphite India Ltd against KPTCL, BESCOM and CESC
28.01.2021	Appeal Nos. 191, 195 & 265 of 2018 and Appeal No. 406	In matter involving Tamil Nadu Spinning Mills Association Vs TANGEDCO & Tamil Nadu Electricity Regulatory Commission, regarding wheeling and banking charges, APTEL requested Central Government to call upon the Central Electricity Authority to undertake the necessary study and recommend fair and

	of 2019 before APTEL	equitable solutions balancing the competing interests bearing in mind the legislative scheme and public policy of the State such that all State Commissions are properly guided.
21.06.2021	High Court vide W.P No.11142/2020	In the matter of Bhoruka Power Corp. Ltd., Vs Government of Karnataka, High Court held that Government of Karnataka should consider issue afresh by issuing a notice to the petitioner regarding why banking was taken away, consider reply and pass *appropriate orders in accordance with law*.

Source: Compilation by PCKL from various orders shared with Prayas (Energy Group) as background to the study and Wheeling and Banking orders issued by various State Regulators applicable for RE generator.

Annexure 4: Summary of inputs for FY 2019-20

Analysis Period	FY 2019-20
Number of Consumers considered	95 across 3 ESCOMs
Total Annual Consumption	1,050 MU
Total Annual Wheeled Energy	740 MU
Wind and Solar generation	From ~60 Pooling Sub-Stations

Source: Prayas (Energy Group)

Annexure 5: Quantum and time of banking, net purchase from ESCOMs shown at the annual level for FY 2019-20 for different banking arrangements (Case A, B, C)

ToD Slots	Slot wise consumption	Slot wise wheeling (as per PSS generation profile)	Net drawal / (Surplus)		
			Case A (Monthly slot wise banking)	Case B (Annual slot wise banking)	Case C (Annual banking, baseline)
Slot -1 (06 to 10 Hrs)	164	133	31(0.3)	30	Not Applicable
Slot -2 (10 to 18 Hrs)	373	399	13(39)	12(38)	
Slot -3 (18 to 22 Hrs)	175	70	105	105	
Slot -4 (22 to 06 Hrs)	339	138	200	200	
Total	1,050	740			310
Net purchase from ESCOMs			349	348	310
Surplus at the end of settlement period			39	38	0

Source: Prayas (Energy Group)

Note: All values in Million Units (MUs). In case A and B, values in brackets are surplus energy while values outside brackets is net drawal.

Annexure 6: Data and Change in ESCOM revenues across different banking arrangements in FY 2019-20.

Consumer Energy Charge	7.59[15]	Rs/kWh
Cross Subsidy Surcharge	1.72	Rs/kWh
Additional Surcharge (non-RE)	1.17	Rs/kWh
Additional Surcharge (RE)	0.15	Rs/kWh
Slot-wise market rate	Slot wise IEX average DAM price for S1 region	
Generic wind & solar tariff for FY 19-20	3.17	Rs/kWh

[15] We have determined the weighted average tariff for the HT-2 consumer category for the state, after considering the average tariff and sales for each consumer category (HT-2 (a), (b) & (c)) for all 5 ESCOMs of the state. This comes to Rs 7.59/kWh for FY 20. Apart from the energy charge, the KERC determines Fuel Adjustment Charges (FAC) for each quarter, which is usually different for each DISCOM. FAC charges have not been considered in the study, as they vary for each quarter and will increase complexity in the calculation.

Annexure 7: Change in ESCOM revenues across different banking arrangements in FY 2019-20

Allocation of wheeled energy	Units	Formula	Case A	Case B	Case C
			Monthly slot wise	Annual slot wise	(Current Arrangement)
Energy Drawal from ESCOMs	MU	A	349	348	310
Reduction in Banked Energy / Change in drawal w.r.t Case C	MU	B	39	38	-
Energy Charge for consumer	Rs/kWh	C	7.59		
ESCOM Billed Revenue	Rs crore	D = A X C	265	264	235
Increase in ESCOM revenue	Rs crore		30	29	

Annexure 8: Estimating cost and revenue for ESCOMs under different banking arrangements for FY 2019-20.

Particulars	Units	Formula	Case A: Monthly slot-wise		Case B: Annual slot wise	
Reduction in Banked Energy (Change in drawal w.r.t Case C)	MU	B	39		38	
ESCOM Billed Revenue	Rs crore	D	265		264	
ESCOM Billed Revenue in Case C	Rs crore	E	235			
Options for rate of incremental power purchase Option 1: Slot-wise market rate Option 2: Cost of marginal thermal generator as per merit order			Option 1	Option 2	Option 1	Option 2
Incremental power purchase cost	Rs crore	F = B X Purchase rate	12.4	16.3	11.9	15.7
Reduction in revenue from OA charges (CSS+AS)	Rs crore	G = B X (CSS+AS)	1.5	1.5	1.4	1.4
Revenue loss to ESCOM due to annual banking (Case C) compared to slot-wise banking	Rs crore	H=D-F-G – (E)	15.9	12	15.3	11.5
% Revenue loss to ESCOM due to annual banking (Case C) compared to slot-wise banking	%	I = H/ (E)	6.77%	5.12%	6.50%	4.91%
Cost of banking per unit of wheeled energy	Rs/kWh	J= H / Wheeled energy	0.22	0.16	0.21	0.16
Cost of banking as % of wheeled energy	%	K = J / Generic RE tariff	**6.79%**	**5.13%**	**6.51%**	**4.92%**

Source: Prayas (Energy Group)

Annexure 9: RPO Compliance status for FY21 In percentage terms

	Solar RPO		Non-solar RPO		Total RPO	
ESCOM	Target	Achieved	Target	Achieved	Target	Achieved
BESCOM	8.50%	20.14%	12.00%	15.09%	20.50%	**35.23%**
MESCOM	8.50%	16.74%	13.00%	17.14%	21.50%	**33.88%**
HESCOM	8.50%	16.56%	11.00%	28.40%	19.50%	**44.97%**
GESCOM	8.50%	18.03%	8.00%	29.04%	16.50%	**47.08%**
CESC	8.50%	20.91%	12.00%	10.68%	20.50%	**31.59%**

(Source: Tariff Order for various ESCOMs for FY2022-23)

Annexure 10: RPO Compliance status for FY21 in energy terms

	Consumption	Solar RPO		Non-solar RPO		Total RPO		
ESCOM	Net consumption (without large hydro)	Target	Achieved	Target	Achieved	Target	Achieved	Total RPO compliance
BESCOM	25,628	2,178	5,162	3,075	3,866	5,254	9,028	35.23%
MESCOM	4,690	399	785	610	804	1,008	1,589	33.88%
HESCOM	10,431	887	1,728	1,147	2,963	2,034	4,691	44.97%
GESCOM	6,715	571	1,211	537	1,950	1,108	3,161	47.08%
CESC	5,356	455	1,120	643	572	1,098	1,692	31.59%
Total	**52,820**	4,490	10,005	6,012	10,155	10,502	**20,160**	**38.17%**

(Source: Tariff Order for various ESCOMs for FY2022-23)

Annexure 11: Results of illustrative 15-min analysis for FY 2020-21

Parameter	Total Consumption	Total Wheeled / Generation	Instantaneous consumption	Banked Energy (Excess injected into grid)	Drawal from grid (market)
April 2020	59	74	45	-30	14
May 2020	70	92	58	-34	12
June 2020	93	112	78	-33	14
July 2020	96	89	67	-22	30
Aug 2020	103	118	87	-31	17
Sep 2020	97	73	63	-10	35
Oct 2020	101	58	52	-6	49
Nov 2020	110	73	64	-8	46
Dec 2020	111	81	71	-10	39
Jan 2021	116	74	66	-9	50
Feb 2021	106	76	64	-12	43
Mar 2021	121	84	71	-12	50
Total	1184	1003	785	**-218**	398

Note: All values in MUs.

Annexure 12: Results of illustrative 15-min analysis for FY 2019-20

Particular	Consumption	Generation	Instantaneous consumption	Banked Energy (Excess injected into grid)	Drawal from grid (market)
April 2019	95	54	52	-2	43
May 2019	95	60	59	-1	37
June 2019	94	79	69	-9	24
July 2019	90	78	67	-11	24
Aug 2019	88	84	71	-13	16
Sep 2019	84	69	58	-11	27
Oct 2019	80	45	39	-6	42
Nov 2019	81	48	42	-6	40
Dec 2019	79	54	47	-6	32
Jan 2020	89	60	50	-10	39
Feb 2020	91	55	49	-6	43
Mar 2020	83	56	45	-12	38
Total	1050	740	647	**-94**	404

Note: All values in MUs.

Renewable Energy based Wheeling and Banking (WBA) agreements in Karnataka have increased from 182 MW to 3,492 MW (17 times) from FY 11 to FY 22. In spite of this high growth coupled with the dramatic fall in RE prices, the concessional wheeling and banking arrangement for RE has remained unchanged in the last 17 years. The issue has also been quite litigious in the state. In response to a KERC directive to conduct a third-party study, PCKL appointed Prayas (Energy Group) to assess the impact of concessional wheeling and banking charges on the finances of KPTCL/ESCOMs.

This study analysed RE generation and consumption patterns to assess the quantum of banking across different banking frameworks and financial impact of the same on ESCOMs. The study recommends modification to the existing banking framework to facilitate reliable grid integration and provide right price signals and incentives in the coming years.

Prayas (Energy Group)