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UNLOCKING ROOFTOP SOLAR PV TRANSITION IN PAKISTAN

1- Introduction

Pakistan holds one of the largest unserved populations globally and so has genuinely high potential for bottom-up solar photovoltaic (PV) technological leapfrogging. Furthermore, owing to multiple failures surrounding utility-scale energy system (low electrification, technical inefficiencies, load-shedding as well as high cost of grid provided energy), the reliance on decentralized energy backups in the country is already wide-spread. Around 68% of end-users alone in the country rely on alternative back-up energy systems (mostly UPS and fossil-fuel fired generators) (Saleh and Sara 2020). Hence, strong demand and social acceptance for decentralized configurations exists among users. However, high carbon content back-up appliances such as diesel generators and UPS (battery storage) have become mainstream technologies, and the uptake of cleaner options such as rooftop solar still remains limited in the region.

Pakistan is one of the few countries with very high solar energy potential but relatively low PV penetration so far. According to Alternative Renewable Energy Policy, 2500 MW of solar PV has been imported in the country over the last 5 years, of which 430 MW has been installed at utility scale. Whereas the recent data on net-metering shows that the cumulative net-metered solar PV capacity has reached 200 MW by end of June 2021 (AEDB 2021). This contrasts quite poorly with the broader regional picture such as India reaching 4.4 GW of rooftop solar at the end of 2019, Bangladesh—an emerging hotspot of the global off-grid solar installations reaching over 18 million people through 4.1 million systems in 2017 (IEA 2020; Heinemann et al. 2019).

If we look at Pakistan's solar potential, the country is blessed with ample solar power reception. According to World Bank, utilization of just 0.071% of the country's area for solar photovoltaic power generation would be enough to meet the entire country's present demand for electricity. Overall, the average specific production of solar power ranges between 1,250 and 1,850 kWh/kWp per year, with capacity factors of up to 22%, which is considered ideal (World Bank 2021). These irradiation levels also vary across the country — for instance the southern provinces of Baluchistan and Sindh are receiving relatively much higher levels compared to northern parts.

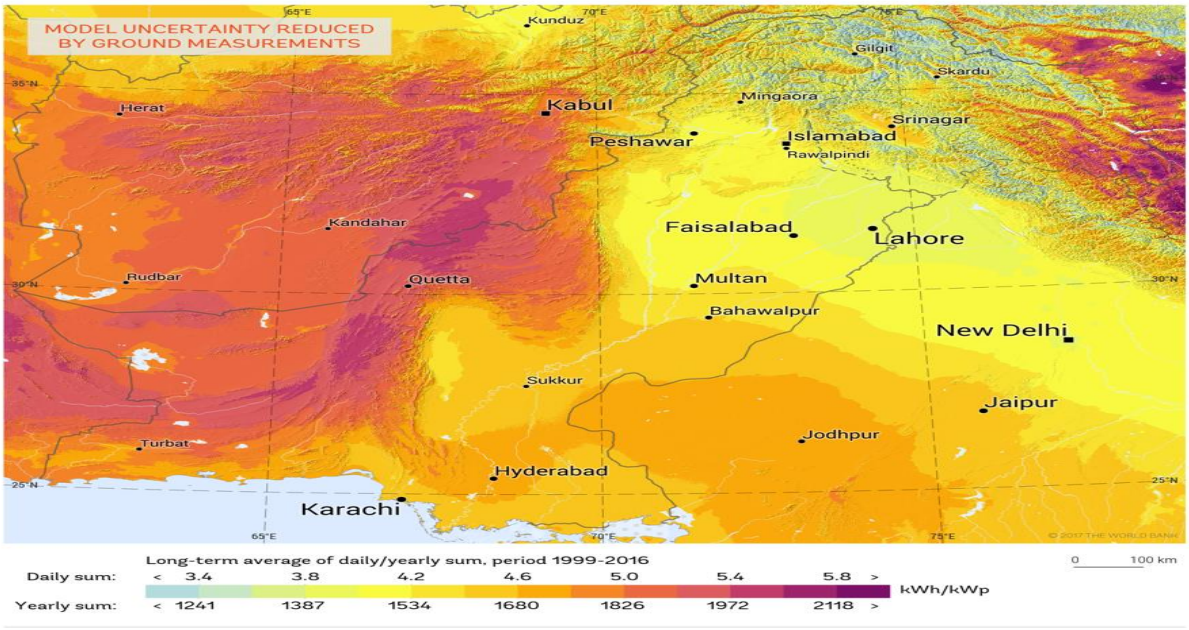


Figure 1 Solar Resource Map Pakistan

Solar PV has also reached grid parity in Pakistan. This means that the technology no longer needs subsidies or government support for its growth. For instance, a recent study on net-metered solar PV systems showcases that the average generation cost of small net-metered system (depending on system size) can cost a consumer between PKR 3.7/ kWh and PKR 5.77/kWh (Naeem and Saleh 2021). Fig.2 shows simplistic illustration of net-metered solar PV grid parity. [1]

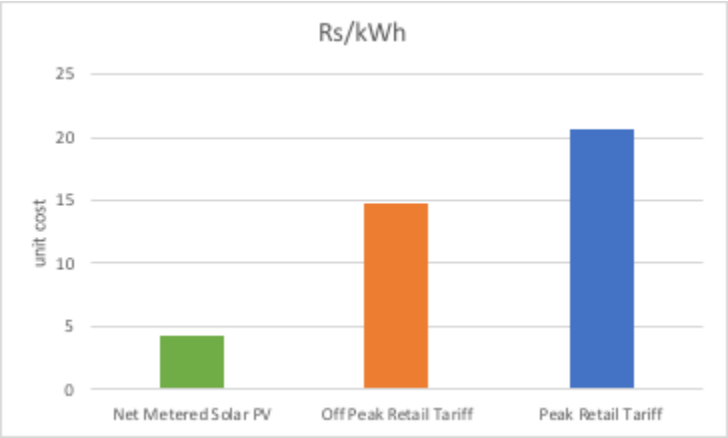


Figure 2 Net-metered Solar PV Grid Parity

[1] In Pakistan, the retail tariff for three phase meters and single-phase meters is different. However, since three-phase meter is mandatory requirement for net-metered applications, this analysis reflects the retail tariff for this type of meter only.

Why is it then, that despite promising potential, strong demand forces and even after reaching grid parity, we see a widespread reliance on alternative back-ups and not solar PV in Pakistan. The next section takes stock of key challenges and barriers hindering solar PV development in the country.

2- Policies, Regulations and Financial Issues

Pakistan is ambitious to transform its energy sector. The incumbent government has set a target of reaching 60% of power generation from renewable energy by 2030. In the context of rooftop solar or decentralized renewable energy, several policies and regulations exist. For instance, net-metering regulations were rolled out in 2015 (NEPRA 2015). These regulations allowed for on-site solar and wind generation to all sectors including residential, commercial, industrial and agricultural. Furthermore, to financially support renewable uptake, State Bank of Pakistan (SBP) introduced a tailored re-financing scheme providing concessionary loans to borrowers (State Bank of Pakistan 2016).

However, despite the stated ambition and several enabling regulations and schemes, several barriers are holding back the rooftop solar drive. Among other factors, high upfront cost of technology, financial impediments, absence of *facilitative organization models*; and overall gaps in policy, planning, and coordination explains the overall negligible growth. We look at some of these barriers in-depth—outlined below.

2.1- Financial Impediments

Financing is critically important for transition toward capital intensive technologies such as solar characterized by high upfront cost and lower operating costs. In recent years, decreasing cost of solar PV systems and related devices have spurred general interest in the adoption of the technology—yet limited access to low-cost financing continues to be a key impediment to its wide-scale diffusion.

As stated earlier, with a broader aim to help address climate change in the country, while meeting Pakistan's growing electricity demand through renewable energy, and promoting clean energy projects as part of Sustainable Development Goals, the State Bank of Pakistan also introduced a tailored 'scheme' providing concessionary financing for solar and wind technology called **SBP Financing Scheme for Renewable Energy** (Scheme).[2] It offers varied financing options ranging from PKR 400 million to PKR 6 billion for a range of entities and persons. This includes captive energy units as well as commercial projects and individual consumers who may share excess production with the national grid. Under the currently applicable conditions, the scheme operates under three different categories; *Category I* deals with larger system with a capacity ranging from 1 MW up-to 50 MW; *Category II* provides financing to borrowers for installation of renewable energy-based projects of up to 1MW, while *Category III* deals with vendors/suppliers certified under AEDB for installation of wind and solar systems on lease basis or selling of electricity to ultimate owners/users. Under *Category-II* of the scheme—which applies to small-scale systems and rooftop solar—eligible borrowers could access 100% borrowing with a maximum 10-

[2] Initially launched in 2009, later revised in 2016 and 2019.

year term for repayment at 6% interest rate.[3] Some banks are advancing loans for solar systems under their independently designed schemes or regular financing. The interest rate for loans, salient features, and the terms and conditions vary from bank to bank (see *table.2*).

Features	**Category I**	**Category II**	**Category III**
Maximum Loan	6 billion Pakistani Rupee (PKR) for a single project	400 million PKR (for a single borrower)	2 billion PKR (for a single vendor/supplier/company)
Maximum Tenor/Duration Period for Loan	12 years	10 years	10 years
Interest Rate (Tot 6%)	SBP service charge: 3% Bank spread: 3%	SBP service charge: 2% Bank spread: 4%	SBP service charge: 3% Bank spread: 3%
Maximum Credit Line	100% of total financing for projects up to 20 MW. 50% of total financing for projects between 20-50 MW	100% of total financing	100% of total financing

Table 1 Salient Features of SBP Re-financing Scheme

Bank	Markup Rate	Max Loan Amount (PKR)	Equity (Minimum)	Financing Tenor (Maximum)
Habib Metropolitan Bank	1-year KIBOR +3%	Case dependent: 10- 30 million	10%-30%	7 years
Zarai Taraqiati Bank limited (ZTBL)	6-months KIBOR Offer Rate + 5%	1 million	10%	10 years
Bank of Khyber	Floating markup rate 1-year KIBOR plus 600 pbs	Category A: *200,000/.* Category B: *500,000/.* Category C: *2,000,000*	25%	5 years
Faysal Bank	Shariah compliant facility based upon Musawamah	2 million	First installment as a down payment	2 years
Bank of Punjab	1-year KIBOR +5%	5 million	20%	7 years

Table 2 Salient Features of Solar Financing under individual schemes by Banks

Despite this concessionary scheme and other lending options, solar financing is characterized by several demand-side and supply-side barriers. According to latest data, as of February 2021, only around 400

[3] Out of the six percent service charges (paid by borrowers), the spread of charges is four percent to the commercial bank and two percent to the SBP.

projects have been financed in the past four years under *Category II*. [4] Majority commercial banks continue to be wary of small-scale renewable installations due to high perceived risks and other concerns. Given this, banks are slow to adopt the tailored financial scheme by SBP. Presently only 13 commercial banks are advancing finance under the scheme.[5] Not a single micro-finance institute has yet embraced the Scheme.

In addition to this, most banks have designed the 'loan terms' in terms of eligibility criterion, debt to equity ratio, payback tenor, equity etc. in ways that it fails to cater to the needs of many applicants—also marginalizing majority. This explains the demographically skewed concentration of solar PV adoption among the more affluent sections of society. For instance, a key feature of the *SBP Financing Scheme for Renewable Energy* has been its concessionary scope in terms of mark-up rate; tenor (length of loan) and debt to equity requirements etc. The provisions outlined under *Category II* of the Scheme mentions the following:

- ✓ *Mark-up Rate*: The rate of service charges is fixed at 6% for the entire duration of the loan.
- ✓ *Loan Tenor*: Financing under the Scheme shall be available for up to a maximum period of 10 years, including maximum grace period of three months.
- ✓ *Debt to Equity requirements*: 100% of financing may be provided to the eligible borrowers subject to adherence of other rules and regulations.
- ✓ *Other*: The energy generated from these projects may be for own use or for supply to the distribution company as per the rules set by NEPRA.

Against these criterions, while mark-up rate is standard for all banks, they, however, enjoy the discretion to design the remainder features of financing, structure terms, or impose conditions, as they consider appropriate following their lending rules and policies. Based on this, 'loan terms' for solar PV financing varies from bank to bank. This variability is reflected in minimum equity requirements, maximum loan tenor/length, collateral requirements, and eligibility requirements. We gathered and classified this information to ascertain individual bank requirements for availing financing under the Scheme.

Against the allowed tenor of a maximum period of 10 years outlined under the SBP circular for Category II borrowers, commercial banks prefer short tenor periods for their clients. The shorter the tenor period, the higher the monthly payments for borrowers. Banks also usually prefer a higher equity, which also lowers the equitable spread of gains from the Scheme. In addition to loan length, and equity, banks also follow different 'level of security' for various loan products. Since solar PV financing is a new market for majority bankers, there is so much more concern about default risks in relation to it. Majority banks are hence very cautious while financing solar products. Furthermore, these loans are also accompanied by a cumbersome documentation process of establishing a mortgage over property, increasing the transaction cost for applicants.

Last but not least, majority banks have also put in place certain qualifications and eligibility criterions for solar PV loan recipients. For this, the underlying objective remains—additional measures for secure financing. These eligibility criterions significantly vary from bank to bank and are quite stringent in nature. The general hard and fast rule here remains to offer loans tied to highly rated customers with a

[4] Data extracted from a webinar, 'State Bank of Pakistan and Unilever Pakistan join hands to promote Renewable Energy', May 05, 2021.
[5] The statistic cited in this issue are based on RDPI's undergoing project, yet to be published.

strong profile in terms of income scale, job security and debt-to-income ratio etc. The interviews with banks indicated that quite frequently customers interested in solar financing are declined based on insufficient eligibility qualifications. *Table.3* shows eligibility criterions of a few banks which we extracted from their brochures (either available online or gathered from the banks individually). As it can be seen, majority banks have age, income and experience related benchmarks. A few banks have also imposed property ownership and city-related conditionalities. For instance, the two key banks presently most active in solar financing i.e., JS Bank and Allied Bank have made it mandatory for the applicants to own the property where the system is to be installed. Allied and Samba Bank have also restricted the scope of their financing to a few major cities. Meezan Bank has imposed an additional condition of first availing *Mera Pakistan Mera Ghar* scheme.

Bank	Qualification/Eligibility Criterion
Bank of Khyber	• Income: Minimum monthly Net Income of PKR 25,000/-. Average verifiable net income should be 3 times of proposed facility installment. • Age: From 22 years to 58 years; 65 Years for Businessman-Engaged in business or in service for more than 2 years • Applicants scoring Credit Risk Rating from 1 to 5 will only be eligible for this facility
JS Bank	• Applicant must be the owner of the property • Bank statements of business or personal account with account maintaining certificate
Meezan Bank Limited	• Must be qualified for and has availed Mera Pakistan Mera Ghar from Meezan Bank. • Aggregate monthly payments on approved solar financing must not be more than 45% of net income assessed by the bank
Alfalah Bank	• Clean e-CIB report Income proof / salary slips / bank statement • Non-objection certificate from all owners in case of joint property • Installment amount should not exceed 20-30% over and above 3-month peak bill average
Allied Bank limited	• Applicant must be the owner of the property • Income: Salaried individuals: Minimum length of employment of 2 years and minimum net monthly salary of 40,000; Self-employed individuals: Minimum length of business/profession should be 3 years and minimum net monthly salary should be 100,000. • Approved cities: Karachi, Lahore, Rawalpindi/Islamabad, Gujranwala, Sialkot, Multan, Hyderabad and Faisalabad.
Bank of Punjab	• Age: 25-60 years for salaried applicants; 25-65 years for self-employed applicants • Minimum monthly gross salary: 40,000 • Minimum experience: 1 year for govt employees, 3 years for contractual employees and self-employed candidates; net income of 50,000 for self-employed people • Bank statements of last 6 months
Samba Bank	• Pakistani nationals residing and working in Karachi, Lahore, Islamabad, Rawalpindi, Wah Cantt and Peshawar • Age: 25 years and 30 years for salaried and self-employed individuals respectively • Must not be aged older than 65 years (or retirement age, whichever comes earlier) at the time of maturity of loan • Income: Minimum monthly income of PKR 45,000 and PKR 225,000 for salaried and self-employed individuals, respectively • Salaried applicants must be working at their current employer for a minimum period of 6 months or have total continuous experience of 12 months

	• Self-employed applicants must have a minimum tenure of 2 years in their current business

Table 3 Eligibility Criterions for availing solar financing

Few banks have also distanced themselves from battery and off-grid solar financing. Due to unreliable power supply, batteries constitute an important element of decentralized energy drive in Pakistan. Moreover, they are also quite costly and constitute around 20-35% of the total system cost. These certain additional restrictions on solar financing on the part of the banks, further confines the scope of the lending facility.

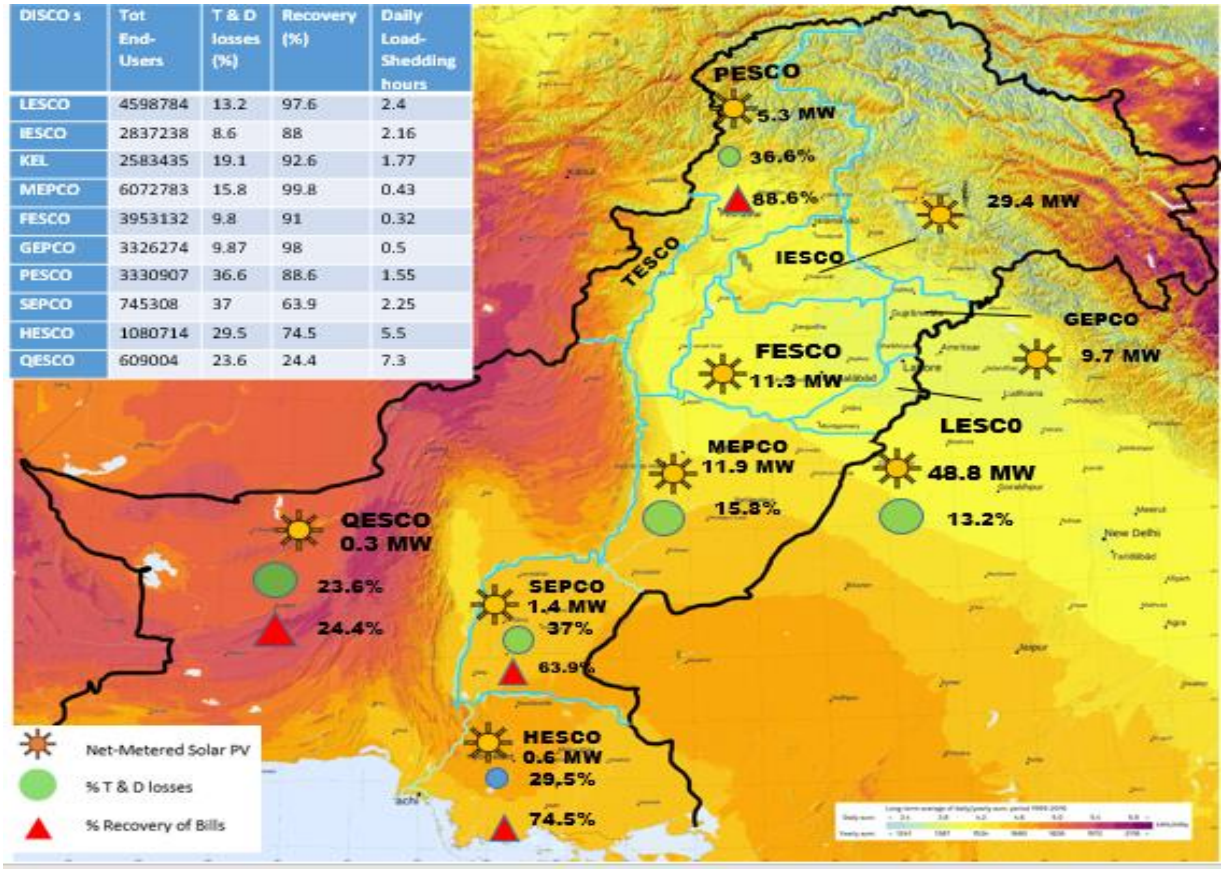
As the underlying objective of the Scheme in general remains to mobilize environmentally sustainable and socially just transition, 'Business as Usual' capitalism and lending practices hence have largely undermined the socially equitable transformation challenges. Based on these several challenges, the financing for rooftop systems is almost nil.

2.2- Uneven Geographic Growth and Administrative Challenges

The electricity distribution sector of Pakistan has long been trapped in extensive inefficiencies and losses. There are eleven power Distribution Companies (DISCOs) in Pakistan—all state-owned (except for KEL). These utilities are characterized by high technical losses, electricity theft and poor bill recoveries—costing the national exchequer billions of losses annually. In 2019 alone, DISCOs contributed losses of Rs 171 billion due to less recovery of bills; and another Rs 38 billion due to technical losses (NEPRA, 2019). These inefficiencies remain more intense in certain specified utilities. For instance, except for three DISCOs, all are experiencing technical losses in double digits. Likewise, six utilities have less than 80% bill recoveries. QESCO, HESCO, SEPCO and PESCO particularly have the worst performance (**see Fig.3**). While this builds a compelling case for solar PV diffusion–which could minimize the 'losses' in DISCOs and address the interlinked problem of load-shedding in the high loss zones facing revenue-based loadhedding, we are witnessing a geographic uneven growth of Distribution Generation (DG) where the high loss utilities lag way behind in the net-metering drive. Although the data in the case of off-grid systems is uneven and mostly not available, this could, however, be seen in the DISCO-wise DG growth which shows that more than 80% of DG growth is concentrated in three DISCOs namely IESCO, LESCO and KEL.

So, while economically, solar uptake makes a more potential case for diffusion in high loss utilities, yet due to active or passive inertia in these jurisdictions, it has failed to take off. Several administrative barriers are responsible for this uneven drive. The DISCOs have a key role in driving the solar prosumage growth in the country. They are the primary intermediaries in this entire process, responsible for implementing net metering regulations within their respective jurisdictions. Any active or passive resistance at their end could influence the DG growth. For instance, presently the inter-connection process has been designed such that it is quite cumbersome. Furthermore, some DISCOS have been testing a range of delaying strategies at the inter-connection phase, some also blocking applications—all of this bearing a high transaction cost for applicants. The delays can reach up to eight months, which

discourages consumers. Unavailability of bi-directional meters and time lapses involved in changing meters are some other resistance strategies used. Consequently, the share of installed capacity under net metering overall and especially in majority DISCOs in south, remains miniscule.



DISCOs	Tot End-Users	T & D losses (%)	Recovery (%)	Daily Load-Shedding hours
LESCO	4598784	13.2	97.6	2.4
IESCO	2837238	8.6	88	2.16
KEL	2583435	19.1	92.6	1.77
MEPCO	6072783	15.8	99.8	0.43
FESCO	3953132	9.8	91	0.32
GEPCO	3326274	9.87	98	0.5
PESCO	3330907	36.6	88.6	1.55
SEPCO	745308	37	63.9	2.25
HESCO	1080714	29.5	74.5	5.5
QESCO	609004	23.6	24.4	7.3

Figure 3 Mapping DISCO-Wise net-metered PV installations till 2020; T& D losses, bill recoveries and load-shedding hours in the year 2019.[6]

While DISCOs have greater financial and political resources than the DG applicants, they could easily restrict its growth by creating challenges at the inter-connection stage or not entertaining applications at all. Against these challenges, no mechanism exists which could effectively address any attempted administrative barriers aimed at slowing down the growth of distributed generation.

2.3- Absence of Facilitative Business Models

New radical technologies such as solar are interlinked with a set of mainstream processes—including regulatory, technical and financial—which play a critical role in stimulating their dissemination (Smith and Raven 2012; Grin, Rotmans, and Schot 2010). Following this insight, the ownership and delivery models surrounding micro-generation are also changing significantly. Innovative market-oriented

[6] Data has been taken from latest available public reports published by National Electric Power Regulatory Authority, Pakistan.

business models are emerging as a powerful tool to stimulate De-centralized Renewable Energy (DRE)—principally drawing on strategic networking and cooperative strategies (mediating between the production and the consumption side of niche technologies) aimed at alleviating the multi-dimensional obstacles hampering socio-technical transition. Compared to dealer models, 'Fee for service', also called 'OPEX' models[7], are also increasingly associated with overall larger economies of scale—such as regulatory efficiency, technology durability, information asymmetry, and overall reduction of customer transaction cost (Amit and Zott 2001; Reim, Parida, and Örtqvist 2015). Also most importantly, these models' centers upon customers' needs—premised around optimizing strategies aiming at best meeting end-users needs (Teece 2010). These models also provide equal opportunities to customers who may not have financial resources and are otherwise unable to install the technology—a major barrier associated with developing countries (Mont, Dalhammar, and Jacobsson 2006; Teece 2010). Besides, additional services such as extended warranties, consultancy, free advice, and maintenance services further reduces adoption barriers, perceived performance risks and uncertainties (Tukker 2004).So overall analyzing, hospitable institutional/business models provide the much needed 'protective space and enabling environment' for the configuration and development of new technologies (Schot and Geels 2008).

In Bangladesh, the organization model based on public-private partnership called 'Infrastructure Development Company Ltd' (IDCOL) has been highly successful accounting for more than 4.1 million solar systems in the country (Heinemann et al. 2019). Likewise, in India, rooftop PV reached 14% of the country's total installation in 2018, supported by a mix of CAPEX and OPEX models facilitating dissemination of the technology. Hence, we can see that a new wave of supportive frameworks, business and finance models are playing an important role in stretching prosumerism and catalyzing the bottom-up transition. However, Pakistan is characterized by absence of such emerging models, especially in the residential sector. This 'absence' has been one of the major preventing factors restricting 'bottom-up solar energy transition' in the country. The existing net-metering regulations in Pakistan are designed for end-users. It does not allow for corporate sector engagement since as per the regulations the system owner should be the meter owner. Also, the renumeration scheme and agreement tenor are designed for self-generation, whereas in the off-grid sector, no focused regulations exist for encouraging private sector engagement. For any desired transition, a deep analysis is needed on how innovative business models could be aligned with broader bottom-up energy investment to ensure that solar PV uptake among communities is not further delayed.

2.4- Inadequate Attention Toward Off-grid Sector

A major overlooked discourse in specific case of Pakistan is how decentralized renewable energy (DER) configuration offers an 'irresistible' and 'necessary' alternative to electrifying the last mile and simultaneously address the longstanding technical and inter-linked financial losses in the power sector. Decentralized off-grid solutions directly supplying electricity to the consumers have grown from a niche

[7] Under OPEX model, customers lease their roof to a third-party vendor to install PV systems. In this case, the developer makes the initial investment, which is later paid by consumers in the form of a monthly charge, often sourced from savings on the electricity bill or electricity sales to utility. In the OPEX model, the developer is responsible for ensuring uninterrupted operation of the rooftop solar system and its maintenance.

solution to wide-spread dissemination and are increasingly recognized speedy solutions for renewable energy uptake. The energy access gap left by the grid could be effectively plugged by off-grid solar solutions.

Pakistan has a vast hard-to-reach geographic location, i.e., sparsely located rural communities located at long distance from each other with higher costs of laying down transmission lines. It is mostly communities belonging to these regions that are living off the grid. Strikingly, these communities are also geographically positioned in the highest solar insulation zones. Decentralized approaches in terms of off-grid energy infrastructure hence offer promising solutions for both increasing electrification and increasing renewable energy deployment. This could also potentially address the issue of energy poverty in the country, where the access to clean, reliable and sustainable energy will also open paths to the economic prosperity of the grid disconnected areas. Further as discussed earlier, energy deprivation and blackouts in Pakistan have also stirred a social change where a momentum toward off-grid renewable applications is underway. So, a willingness to adopt alternative technologies for meeting energy needs is quite unique in the context.

Despite this natural compatibility, decentralized solar expansion has remained frequently overlooked in the country's national policies resulting in its chronic underinvestment. Though the renewable energy policy of 2006 required the relevant authorities to enact measures for the promotion of off-grid renewable energy including mini-grids, insignificant progress has been made so far. An enabling policy and regulatory framework hence remain a necessary pre-condition for this transformation. Above analysis hence underlines the need for a favorable landscape towards DRE, especially in remote unelectrified areas. For governments, this translates into changing the structure of existing centralized regulations on power supply.

3- Policy Recommendations

Solar rooftop could be poised for exciting growth in Pakistan. This growth will not just reduce carbon emissions but will simultaneously help in speedily electrifying the last mile and reducing the ballooning financial arrears in the power sector. A successful transition toward a solar revolution would, however, not only require a supportive regulatory and policy framework, but also the alignment of favorable conditions such as enabling regulations, facilitative business and finance models, and awareness campaigns. We propose the following recommendations that will make a difference:

- ***Improving access to finance options for consumers*:** SBP has launched an important scheme to unlock finance aimed at scaling up low-carbon energy infrastructures. Despite this concessionary and useful Scheme, very few banks are advancing loans under the facility. Further, opposing logics are at work in the design of "schemes" where banks who have designed the features and loan terms of solar financing such that it has largely confined its scope to a handful section of society. The securitization vis-a-vis stringent terms for accessing finance are hence allegedly undermining the larger social and environmental gains of the Scheme. The adoption of the scheme by a financial institute is the first and essential step for enabling smooth capital flow under the lending facility. To enhance willingness of banks to enable solar product financing—different measures could be

introduced. This could be done either via additional incentives or pressure. The loans terms and conditions need to be calibrated such that it goes beyond the prevalent operational lending practices centered on 'risk mitigation'. This could be done in different ways. One way could be to standardize loan terms such that they are co-aligned with the features as laid out in the SBP circular. This would increase the maximum loan tenor to 10 years and eliminate the down payment benchmark. The collateral requirements should be tied to the system—and this collateral requirement should be fixed for all institutes. Moreover, the eligibility requirements should also be relaxed and risk tolerance should be increased on a limited scale etc. to avoid negative screening. In a nutshell, the Scheme will play a vital role in allocating capital for decentralized renewable energy transition. Nonetheless, the scale of its success will remain dependent on its 'diffusion among relevant institutes' as well as 'lending practices' by these institutes. Based on this, more work is needed to fully integrate and overcome obstacles to solar PV financing under the facility.

- ***Effective monitoring system to ensure balanced growth of net-metering:*** Increased self-consumption of electricity from net-metering has the potential to decrease extensive technical losses which presently characterize the power sector of Pakistan. However, presently many DISCOs have not embraced distributed generation, while those who have—are not interested in promoting it and as such there is no will at DISCOs' end to make the system more user-friendly. In the wake of this inertia, the prospect of potential net-metering drive could be daunting. Based on the context, there is a strong need only to overcome the passive opposition from DISCOs but also to replace it with appropriate regulations vis-a-vis incentives skewed in favor of distributed generation growth. In this regard, consultative sessions shall be organized with DISCOs; their genuine concerns shall be taken into account; and finally, some form of regulations shall be put in place, which ensure compliance of net-metering regulations and prevent DISCOs or any other entities from excessively leveraging their dominant market position to restrict solar uptake.

- ***Enabling regulations for Solar PPA and Leasing Models***: Different types of solar OPEX models such as roof rental solar power purchase agreements (PPA), solar leasing—which play a vital role in pushing rooftop solar growth—are entirely non-existent in the residential sector of Pakistan. This is due to absence of clear regulation on selling electricity to the end-user by the third party.
  Innovative business models are very attractive particularly for individual consumers who want to install the system but could not afford to pay the upfront investment. They cannot only increase user base but also increase awareness among general public, through advertisement campaigns of companies and peer effect. The government should legislate on enabling regulations that encourage corporate sector engagement to ensure speedy expansion for rooftop solar. For this, the regulatory paradigm needs to be reformed such that it allows the development of new business models for retail distribution and solar commercialization activities.

- ***Conceited efforts to drive rooftop solar***: Finally, and most importantly, a strong political will and state-level enthusiasm favoring rooftop solar could help in tapping the enormous potential that solar prosumage offers for advancing renewable energy in the country vis-à-vis addressing

challenges surrounding an affordable, reliable and sustainable energy supply. This could be done through:

- ✓ Setting explicit targets for rooftop solar in the overall renewable energy goals.
- ✓ Providing special purpose loans and guarantees for rooftop solar, filling the gaps in financing availability.
- ✓ Promoting rooftop solar development in the off-grid sector.
- ✓ Public awareness campaigns on solar technology, and related regulations and financial schemes.
- ✓ Binding regulations for solar PV system installations in public buildings as well as newly constructed buildings.

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