

Research Study

UNLOCKING THE ECONOMIC POTENTIAL OF ROOFTOP SOLAR PV IN PAKISTAN

Produced by - Policy Research Institute for Equitable Development
and Rural Development Policy Institute, Islamabad

Contents

Foreword.....	3
Executive Summary	4
1.1- Introduction	6
1.2- The State of Play	9
2- Objective and Methodology	10
3- Study Findings: Solar PV Finance	11
3.1- Restricted Provision of the Refinance Facility.....	11
3.2- Limited Financing by Majority Banks	12
3.3- Difficulties in Acquiring Finance—Loan Terms	13
3.3.1- Financing Tenor.....	14
3.3.2- Equity	14
3.3.3- Security for Loan	15
3.3.4- Eligibility Criterion.....	16
3.4- Concerns Related to Batteries and Off-grid Systems.....	17
3.5- Major Concerns of Banks	18
4- Study Findings: Business Model Lags	20
4.1- Barriers and Concerns related to OPEX models at domestic level	20
4.2- Financial Risks	20
4.3- Operational Barriers.....	21
4.4- Regulatory Gaps.....	22
5- Conclusion and Recommendations	23
References	26
Annexure A: Bank Wise List of Institutes Based on Existing Status on Solar Product Financing	27
List of Solar Companies Interviewed	29
Annexure B: Interview Questions for Commercial Banks on Solar PV Financing	32
Interview Questions for Solar Vendors on OPEX business model	36

'Unlocking the economic potential of rooftop solar PV in Pakistan'

Produced by

Policy Research Institute for Equitable Development (PRIED)

&

Rural Development Policy Institute (RDPI)

Foreword

Rooftop solar and decentralized clean configurations supported by technological breakthroughs have unleashed myriad of benefits for a country like Pakistan. It does not only offer ‘irresistible’ alternative for end-users seeking alternative systems to meet their energy needs, but also for relevant public authorities to minimize the losses in the energy sector whilst helping reduce decades of terrible impacts of climate change. However, transition to green economy requires massive re-allocation of capital towards low-carbon technologies, as well as enabling business models. In this report we carry out a systematic review of available solar lending instruments and business model lags in context of small-scale solar systems.

The study builds on a combination of desktop research, primary data collection based on interactions with several key stakeholders/experts — to do the groundwork of preparing an actionable step-by-step implementation roadmap for enabling decentralised solar transition in Pakistan. It also endeavours to plug literature gaps by providing empirical insights. The broader objective remains to propose an intervention framework based on gained insights, which could address/remove the identified barriers and challenges in relation to solar PV uptake.

This report is produced jointly by Policy Research Institute for Equitable Development (PRIED) and Rural Development Policy Institute (RDPI). The data for the study was collected during April-June 2021. The lead person of the project as well as lead author of the report is Naila Saleh. Special credit goes to Maryam Umer Khayam, Qurat-ul-Ain and Muhammad Talha Rashid who played a key role in collecting data, conducting interviews, and analyzing data. Overall, the analysis paints an unequal picture of the landscape on both solar products financing and operational business models—skewed heavily toward a handful section of society who have the means to bear upfront cost of the technology.

RDPI and PRIED would like to thank all participants, most importantly the interviewees from financial institutes, for participating in the study and providing enriched data based on their experiences and insights.

Disclaimer: This project is largely informed by insights/data provided by interviewees chosen for the study. Although special care was taken to double-check the evidence provided where possible, however, we do not accept responsibility for any inaccuracies or as such consequence of their use.

Executive Summary

Despite the established need and desire for renewable energy advancement and implementation of sustainable clean energy supply, green lending remains an overlooked area. Technologies such as solar and wind are capital intensive. Major share of their life-cycle cost has to be incurred upfront. Financing thus plays a key enabling role to its wide-scale deployment, wherein easy access and user-friendly direct financing for solar PV customers from financial institutions (commercial banks, micro-finance institutions) are seen as central to influencing increased responsiveness from potential borrowers.

Furthermore, a new wave of supportive frameworks, business models are playing an important role in stretching prosumerism and catalyzing the bottom-up transition. These models are increasingly associated with overall larger economies of scale—such as regulatory efficiency, technology durability, information asymmetry, and overall reduction of customer transaction cost. And most importantly, they center upon customers' needs—premised around optimizing strategies aiming at best meeting end-users needs. Besides, additional services such as extended warranties, consultancy, free advice, and maintenance services further reduce adoption barriers, perceived performance risks and uncertainties. So, overall analyzing, hospitable institutional/business models provide the much needed 'protective space and enabling environment' for the configuration and development of new technologies. Without right models for commercialization, the diffusion of technological innovations might be slow or even not happen.

Pakistan holds one of the largest unserved populations globally and so have genuinely high potential for bottom-up solar photovoltaic (PV) technological leapfrogging. Further owing to multiple failures surrounding utility-scale energy system (low electrification, load-shedding as well as high cost of grid provided energy), the demand forces for such kind of systems have considerable potential. However, so far, solar PV has restricted usage in the country.

Against the context, we probe the challenges/barriers available in the existing socio-technical regime responsible for 'restricted financing for rooftop solar/small-scale PV systems'. With an aim to address climate change in the country and facilitate renewable energy uptake, the State Bank of Pakistan (SBP) also introduced a tailored 'scheme' providing financing for solar and wind technology called **SBP Financing Scheme for Renewable Energy**. This is a very concessional scheme compared to market-based financing—and provides loans at very low interest rate and easy terms. Additionally, few banks are also advancing loans for solar systems under their independently designed schemes or regular financing. The interest rate for these loans, salient features, and the terms and conditions vary from bank to bank. Despite these lending options, solar financing is still in its infancy and is characterized by several demand-side and supply-side barriers. Our analysis reflects the current state of analyses in relation to *Category II* of the SBP scheme—which covers small-scale and rooftop solar systems (systems up to 1 MW). We specifically provide an updated overview of some barriers and challenges undermining a more equitable spread of gains of the State Bank's scheme among different groups of society—warranting urgent attention. We also critically review *how and why* different business models have failed to emerge in Pakistan.

The analysis paints an unequal picture of solar financing landscape, also heavily skewed toward handful of society who could fulfill the eligibility qualifications. The following is a summary of the key findings and conclusions.

- **Restricted adoption of SBP RE Finance scheme** — Presently only 13 banks are advancing loans under this scheme. Moreover, only limited branches of commercial banks are providing these services, which create a rush of people and causes troubles for the consumers.
- **Limited scope** — Several demand-side and supply-side barriers are present in the existing socio-technical regime, which create difficulties in availing finance. Banks have designed the salient features of solar lending in terms of ‘securitization’ in such ways that it restricts its eligibility scope to a handful of society. This allegedly undermines equitable gains of the scheme. Furthermore, few financial institutes are also not advancing loans to ‘all areas’, ‘off-grid sector’ and certain solar related equipment’s such as ‘batteries’.
- **Banks concerns** — Majority of the commercial banks continue to be wary of small-scale renewable installations due to high perceived investment risk, low return and administrative cost of processing applications etc.
- **Low awareness and demand** — Overall the general knowledge about solar PV financing is quite low among public. With no concerted efforts to increase user awareness on available financing options, its demand is low among the general public.
- **Lagging business models** — Pakistan is not only characterized by absence of emerging OPEX models but also the literature reflects very poorly on this ‘absence’ as the major preventing factor, substantially slowing down the otherwise immense potential held by ‘bottom-up energy transition’ in the country. 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.
- **No adoption of OPEX business models at domestic level** — Presently not even a single solar company is using OPEX business model at domestic level due to many barriers and lack of awareness.
- **Solar companies’ concern** — Majority solar companies are reluctant to adopt OPEX business model at domestic level due to high perceived financial risk, low return on investment, long payback period and change of technology etc.

Finally, since broader objective of the study remained to propose an intervention framework based on gained insights, *Section 5* of the report recommends a framework which could help diffuse adoption of SBP scheme as well as address/remove the identified barriers and challenges in relation to solar PV financing.

1.1- Introduction

Pakistan holds one of the largest unserved populations globally and has high potential for bottom-up solar photovoltaic (PV) technological leapfrogging. Furthermore, owing to multiple failures surrounding utility-scale energy system (low electrification, load-shedding as well as high cost of grid provided energy), the demand forces for such kind of systems are high. Nonetheless, so far, solar PV has restricted usage in the country.

Financing is critically important for transition toward capital intensive technologies such as solar PV characterized by high upfront cost and lower operating costs. In recent years, decreasing cost of solar PV systems and related appliances 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. To overcome this cost barrier, financial institutes and commercial banks, therefore, perform a crucial role. They are in a unique position to fast track the energy transition process by increasing access to renewables financing. 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 SBP also introduced a tailored ‘scheme’ providing concessionary financing for solar and wind technology called **SBP Financing Scheme for Renewable Energy**.¹ It offers varied financing options ranging from a maximum of 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 Alternative Energy Development Board (AEDB) for installation of wind and solar systems on lease basis or selling of electricity to ultimate owners/users. Overall, the refinance facility is very concessional in nature compared to market-based financing (see *Table 1*). The scheme provides loans at very low interest rate and offers up to 100% financing for an extended tenor period.

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%)	State Bank of Pakistan (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	

Table 1 Salient Features of SBP RE Financing Scheme

¹ Initially launched in 2009, later revised in 2016 and 2019.

Category-II of the scheme applies to small-scale systems. Eligible borrowers under the scheme could access 100% borrowing with a maximum 10-year term for repayment at 6% interest rate.² The scheme, however, must be first introduced by a commercial bank/financial institute. Therefore, once a financial institute adopts it and advances loan to applicants, only then they are reimbursed the lent amount by SBP.

State Bank also introduced a Shariah compliant version of this scheme in August 2019, wherein modaraba based '**Islamic Financing Facility for Renewable Energy**' for Islamic Banking Institutions was incorporated. The salient features and concessionary terms of the scheme (system size, financing limit and payback period) are the same as discussed in *Table 1*. Finally, there are also a few other solar PV financing options in Pakistan. 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*).

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
First Microfinance Bank Limited		1.5 lacs	None	3 years
Khushhali Microfinance Bank Limited			None for loans ≤ 5 lacs; 20% down payment for loans >5 lac	5 years
Mobilink Microfinance Bank Limited		3 million	10%	5 years
NRSP Microfinance Bank Limited		1 million for residential; 3 million for agriculture	10% for residential, 20% for agriculture	2 years

² 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.

U Microfinance Bank Limited		1 lac for residential; 1 million for businesses and Agriculture	20%	2 yeas for residential;5 years for agriculture
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Table 2 - Salient Features of Solar Financing under individual schemes by Banks and Micro- Financial Institutes

Furthermore, 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. Following this insight, the ownership and delivery models surrounding micro-generation are also changing significantly. In general, two business models based on ownership of rooftop solar PV systems are prevalent in the global market: self-owned (CAPEX) solar PV systems and third-party owned (OPEX) solar PV systems. In self-owned (CAPEX) system, the roof owner owns the system, funds it and consumes the energy generated, so the consumer is responsible for the risks associated with the operation, management and maintenance of the solar system. Often the consumer finances this through his own pocket or bank funding. The power generated is either used by end-use loads or provided to the utility grid, or a combination of both. In third party owned (OPEX) system, the third party (solar developer) owns the roof top solar PV system and sells electricity either to the roof owner (in case of PPA business model) or to the utility (in the case of rooftop leasing model). Innovative market-oriented OPEX business models are hence emerging as a powerful tool to stimulate decentralized 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 (see *Table 3*).

Market and social barriers	Price distortion	Unaccounted costs of externalities in energy pricing (IEA-RETD, 2012).
	The ‘hassle factor’	Higher transaction costs of gathering information/perceived inconvenience of installing the technology (IEA-RETD, 2012; Rosoff and Sinclair, 2009; Shih and Chou, 2011).
	Split incentives	When the investor who pays for the upfront costs for renewable energy technology (RET) is not the same person who reaps the benefits of the technology (for example in rental properties) (IEA-RETD, 2007)
	Supply constraints	Proper RET markets are not developed: technology/services are unavailable (IEA-RETD, 2012).
Technical Barriers	Lacking knowhow	Limited know how on design and development, installation, operation and maintenance of the technology (Balcombe et al., 2013; McCormick and Kaberger, 42 2007; Ruble and El-Khoury, 2013; Beck and Martinot, 2004)
Regulatory barriers	Bureaucratic hassle	Cumbersome/ lengthy processes of availing technology licences (IEA-RETD, 2012).
	Low (or no) returns on investment	Lower cost of traditional energy technologies (see IEA-RETD (2007)
	Upfront costs	Higher installation cost (IEA-RETD, 2012; Beck and Martinot, 2004).

Financial barriers	Difficult access to finance	Cumbersome/lengthy processes of getting access to external capital for financing RET (IEA-RETD, 2012).
Information failures	Awareness gap	General lack of awareness on RET (IEA-RETD, 2012; Rosoff and Sinclair, 2009; Shih and Chou, 2011; Beck and Martinot, 2004).
	Lack of information on financing	Limited know-how on financing options available for investment in RET (IEA-RETD, 2012).
	Lack of knowledge by installers	Knowledge gap/limited professionals at installation stage (IEA-RETD, 2007).

Table 3 Barriers surrounding adoption of new RE technologies.

Compared to dealer models, ‘fee for service’ business models 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. And most importantly, these models center upon customers’ needs—premised around optimizing strategies aiming at best meeting end-users needs. 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. Besides, additional services such as extended warranties, consultancy, free advice, and maintenance services further reduce adoption barriers, perceived performance risks and uncertainties. Hence, in an overall analysis, hospitable institutional/business models provide the much needed ‘protective space and enabling environment’ for the configuration and development of new technologies.

While the potential of business models in stimulating rooftop solar seems to be undisputed, Pakistan is characterized by the absence of such models. Moreover, the literature also reflects poorly on this ‘absence’ as the major preventing factor, slowing down the bottom-up energy transition in the country. Against this context, in this report we also critically review why different third-party owned (OPEX) solar business models have failed to emerge in Pakistan.

1.2- The State of Play

Despite this concessionary scheme and other lending options, solar financing is still in its infancy and is characterized by several demand-side and supply-side barriers. According to the latest data, as of February 2021, around 400 projects only have been financed in the past four years under *Category II*.³

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. As per our research findings, presently only 13 commercial banks are advancing finance under the scheme (see **Appendix A**).⁴ Not a single micro-finance institute has yet embraced the scheme. Furthermore, most banks have designed the ‘loan terms’ in terms of eligibility criterion, debt to equity ratio, payback tenor and equity etc. in ways that it fails to cater to the needs of many applicants—also

³ Data extracted from a webinar, ‘State Bank of Pakistan and Unilever Pakistan join hands to promote Renewable Energy’, May 05, 2021.

⁴ There are 3 commercial banks about which we are not sure if they have/or have not adopted the scheme. We have marked their status as not sure in Appendix A.

marginalizing majority. This explains the demographically skewed concentration of solar PV adoption among the more affluent sections of society.

Related to business models, currently power purchase agreement (PPA) based business model is successful at industrial level or mega level, but solar companies are reluctant to adopt PPA business model at domestic level in Pakistan. According to interviews conducted in this study, solar companies are reluctant to adopt OPEX business model due to several reasons, and not even a single company is willing to adopt OPEX business model at domestic level. But this situation can be improved by removing the concerns of solar companies regarding PPA business model at domestic level.

The study builds on a combination of desktop research, primary data collection based on interactions with several key stakeholders/experts — to do the groundwork of preparing an actionable step-by-step implementation roadmap for enabling solar prosumerism in Pakistan. It also endeavours to plug literature gaps by providing empirical insights. The broader object of the study remains to propose an intervention framework based on gained insights, which could address/remove the identified barriers and challenges in relation to solar PV uptake.

2- Objective and Methodology

We have undertaken extensive fact-finding research to:

- Document factors responsible for restricted adoption of SBP RE Financing Scheme.
- Document barriers/difficulties to acquire financing under the scheme.
- Probe barriers/difficulties hindering emergence of OPEX business model at domestic level.

Overall the study was divided into two parts. The first two objectives probe challenges in relation to solar PV lending whereas the second part probes barriers in relation to OPEX business models.

For the analysis on solar lending, all commercial banks (national, local private, specialized, Islamic, and foreign) were mapped out. The total study population comprises 44 financial institutes i.e., 33 banks, and 11 micro-finance institutes. We then categorized these financial institutes into three categories.

- I. *Category A* consisted of those banks who have adopted the tailored financial scheme (introduced by SBP) and are providing solar PV financing under the facility.
- II. *Category B* comprised those banks who have not adopted the scheme but are financing solar PV under regular financing or their independent schemes.
- III. *Category C* denoted those institutes which are not financing solar PV entirely.

An additional *Category D* was also formulated. This category included those financial institutes under whose jurisdiction the SBP RE Financing Scheme does not fall.

For document analysis, we thoroughly reviewed all available literature on solar financing in Pakistan. Additional information on solar financing was gathered from brochures of banks available online. For primary data collection, three different types of semi-structured questionnaires were built for these financial institutes (see Annex C). Furthermore, since the total population for this study is quite small, overall we tried interviewing the whole population. However, we were unable to reach out to three institutes and our sample size comprises 41 interviews. We collected the data from May till July 2021. For

interviews, head branches or regional head branches of financial institutes were contacted and either their credit heads or other related senior officials were interviewed. In few cases, where we could not access the head branches or regional head branches, we contacted random branches for interviews.

For the second part of the study i.e. *business model limitations related to rooftop solar*, a semi structure questionnaire was built for solar companies working in Pakistan (*see Annex B*). In-depth interviews from solar companies, which are registered under **V1**⁵ and **V2**⁶ categories of AEDB, were conducted in order to generate valid and reliable data (see Annex A).

For these interviews, we contacted 109 solar companies. Out of these 109 companies, 62 companies are from V2 category and 47 companies are from V1 category of AEDB. However, we received responses from only 30 companies, which is why our sample size consists of 30 interviews. Interviews were mostly carried out with technical heads or other related senior officials from these companies. In few cases, in the absence of technical heads of these companies, we contacted their branches in different cities for interviews. The data collected from solar vendors is mainly focused on the barriers in the way of OPEX business model at domestic level in Pakistan, as well as on barriers and challenges in the way of net metering and SBP RE financing at domestic level.

We have also faced certain limitations during the data collection process. Due to Covid-19 pandemic restrictions, we were not able to visit offices of solar companies and commercial banks. Furthermore, in most instances, we were unable to speak to the relevant technical staff because they were not stationed on their seats. Therefore, in order to obtain information, we contacted these institutes several times, and after booking appointments with the relevant persons, we have interviewed them.

3- Study Findings: Solar PV Finance

In the following sections we describe the main findings of the first part of the study which document barriers and challenges in the context of solar lending and solar finance in Pakistan.

3.1- Restricted Provision of the Refinance Facility

Although the SBP RE Finance Scheme was rolled out in 2016 by the State Bank, only a few banking institutions are presently offering PV financing under the facility. Our findings indicate that by the end of July 2021, 13 commercial banks introduced the 'SBP RE Financing Scheme' and so are presently channeling loans for solar PV products.

Also, the adoption of the scheme by banks has gained traction mostly during the recent years. A vast majority—i.e., five out of the total 13 banks—introduced solar product financing under the SBP facility in 2021. Table 1 below shows the year-wise distribution of scheme's facility adoption.

⁵ V1 category solar companies/ vendors are those certified solar vendors/ installers / service providers for on grid / off grid and hybrid renewable energy projects, who can install solar systems up to capacity of 1000 KW.

⁶ Similarly, V2 category solar companies/ vendors are those certified solar vendors/ installers / service providers for on grid / off grid and hybrid renewable energy projects, who can install solar systems up to capacity of 250 KW.

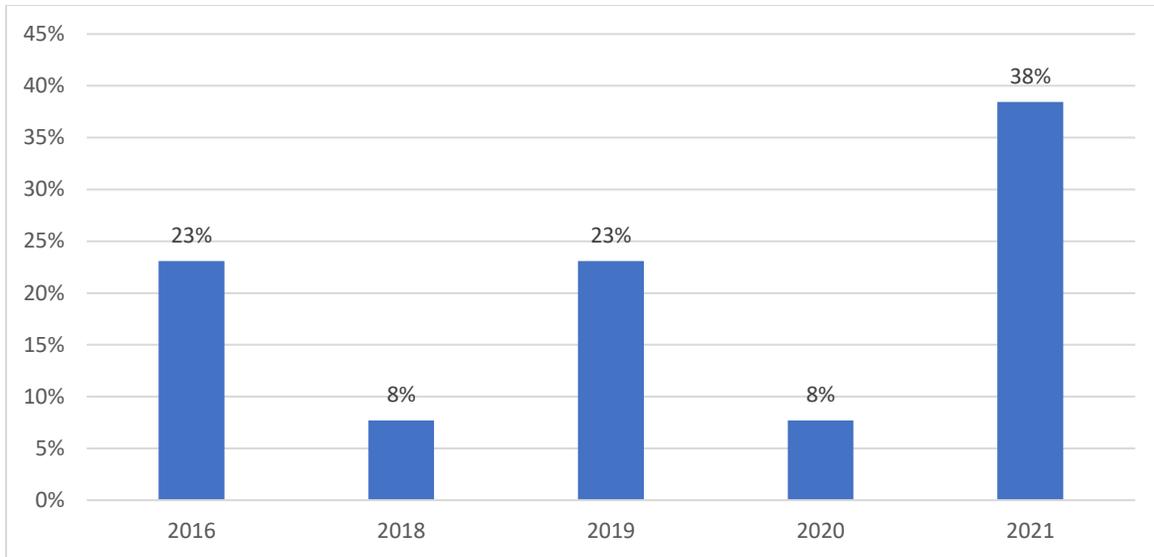


Figure 1 Year-Wise Distribution of Scheme Adoption

3.2- Limited Financing by Majority Banks

Even out of these total 13 banks, two banks stated that although they have introduced the scheme, yet they are still in the process of designing features for solar products—and so the financing facility is not active yet. Further a vast majority indicated that they are financing only few solar products under the facility. For instance, one bank informed that it has not yet financed a single case; three banks stated they have financed only one product; one mentioned that it has financed two cases; and another mentioned financing five solar PV products under the facility. Only three banks mentioned financing many cases—out of this, one indicated financing more than 200 solar products under the facility. Figure 2 gives a quick snapshot on the status of product financing under *Category II* of SBP RE Financing Facility across the banks that have introduced the facility.

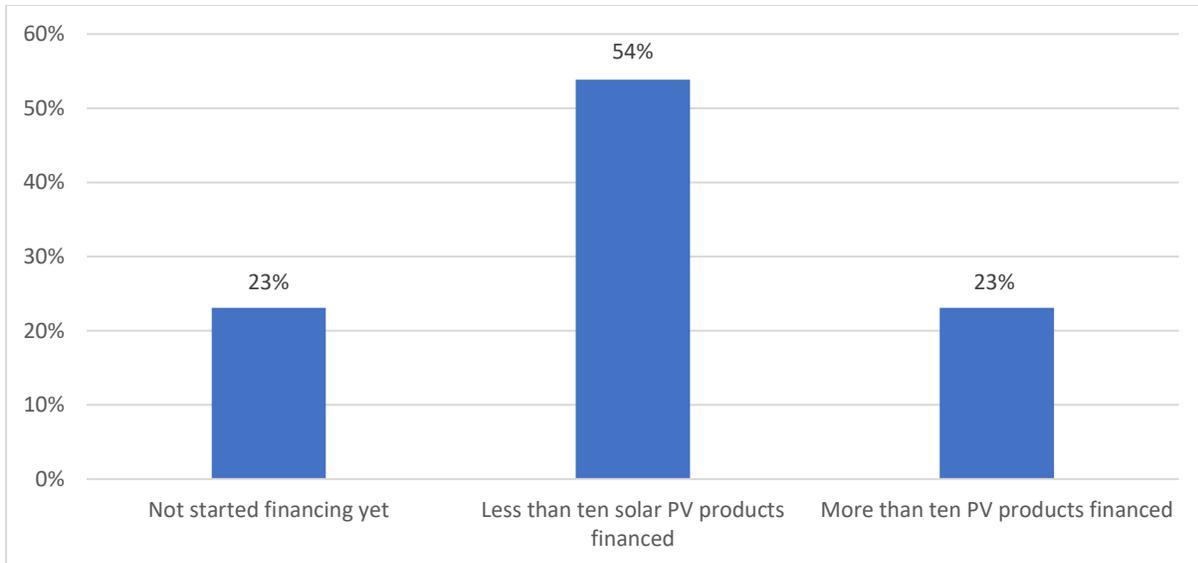


Figure 2 Solar PV products financed under SBR RE Finance Facility

3.3- Difficulties in Acquiring Finance—Loan Terms

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% 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, mark-up rate is standard for all banks. However, banks 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. Subsequent sub-sections showcase bank-wise salient features of solar product financing under the SBP facility.

3.3.1- Financing Tenor

Tenor of the loan is a very important variable since it determines the average monthly payments that a borrower has to make. A shorter tenor increases the amount of each periodic payment, whereas a longer tenor is associated with reduced monthly payments which overall broadens its scope in terms of affordability for a much larger section of society. Solar PV systems have an average life cycle of around 20-30 years, and so it is often advantageous for a PV loan to have a longer tenor.

Against the allowed tenor of a maximum period of 10 years outlined under the SBP circular for *Category II* borrowers, commercial banks have designed different maximum tenor periods for their clients. *Figure 3* illustrates the percentage wise distribution of periodic payment tenor determined by individual banks. The interviews with banks also indicated that majority banks are more inclined toward loans with short tenors since it entails less administrative burden.

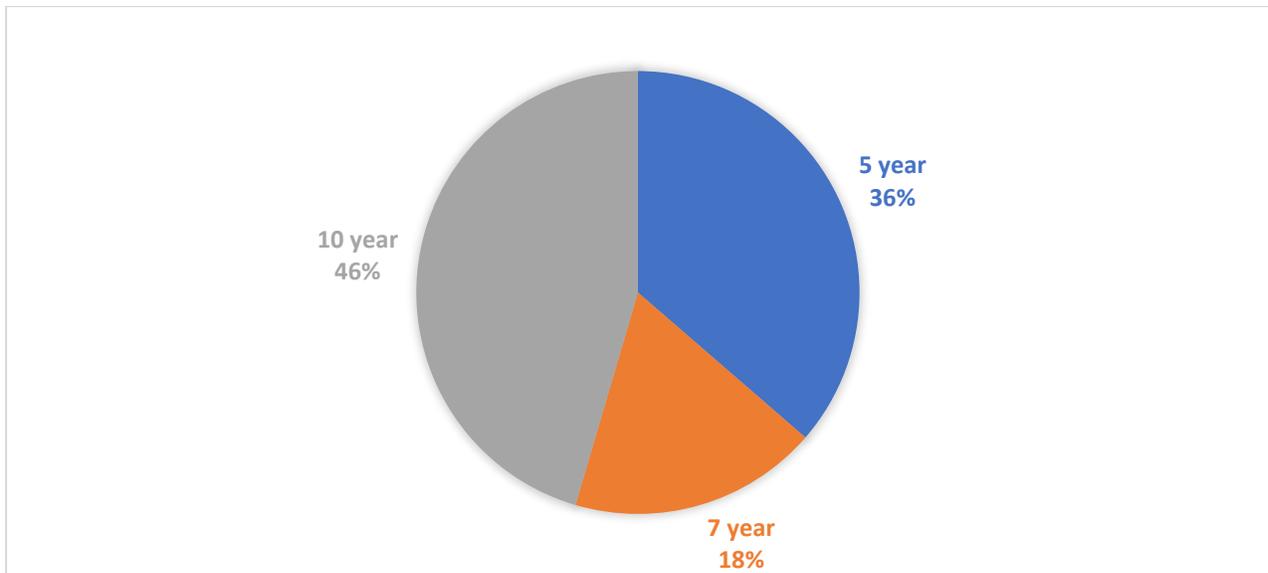


Figure 3 Maximum Length of Loan

3.3.2- Equity

In any finance loan, equity is another important variable. It denotes the difference in value between the 'asset worth' (solar system in this case) and the 'amount of loan'. The equity ratio as required by bank could widen or restrict eligibility scope of a financing facility. Banks usually prefer a higher equity. Higher equity, however, may make the lending facility less attractive to borrowers, also lowering the equitable spread of gains from the scheme. For instance, the average cost of 6-10 KW solar system with and without batteries is around 17 lacs and 14 lacs, respectively. A 20% equity for system with batteries would be around 3.4 lacs, and for system without batteries would be 2.8 lacs.

From our analysis, it has surfaced that almost all banks are advancing solar loans against equity. This payment ranges from 5% to 30%. *Figure 4* shows the bank-wise distribution of minimum down payment as charged by banks presently.

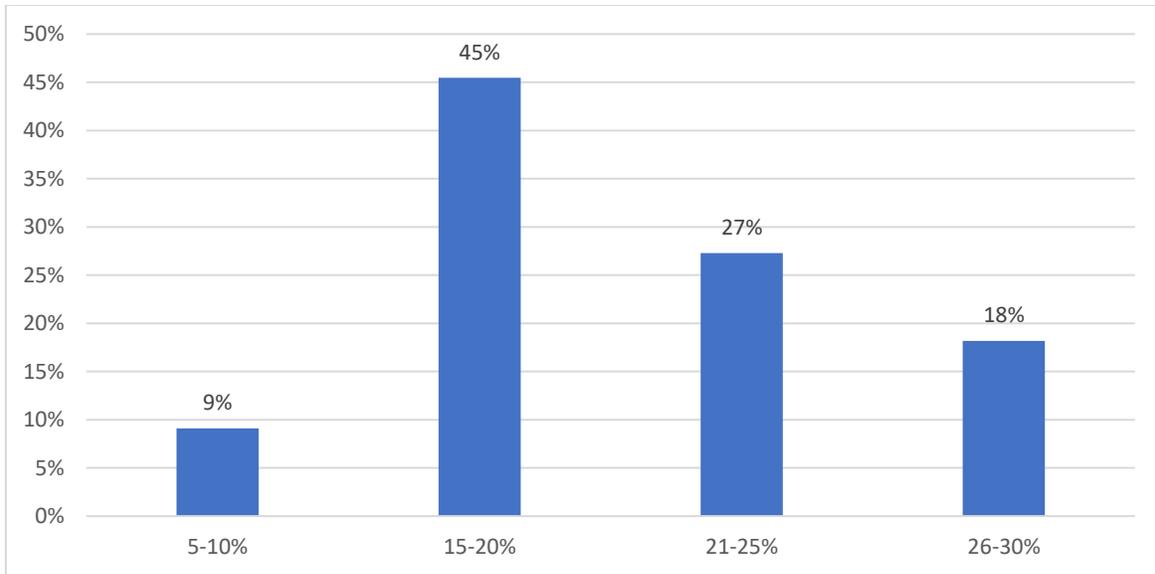


Figure 4 Minimum Equity required

3.3.3- Security for Loan

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.



In case of solar PV, a loan could be (a) unsecured, (b) secured by a solar PV system and (c) secured by real estate. In *unsecured loans* no collateral is required by lender. Rather the loan is advanced based on an individual’s credit quality, income and debt level. In the second category i.e. *loan secured by solar system* itself—in case of default by borrower, banks have the right to repossess the system. Whereas in the last category, the borrower has to provide collateral such as ‘real estate’ to the lender. It is important to note here that a higher degree of security, which in this case is *loan supported by real estate*—restricts the scope of financing facility to a very smaller group. Not only does it require a very cumbersome and lengthy documentation (heavily regulated process), which has a high transaction cost for borrower, but also

majority potential applicants are deterred by it since they might not own such ‘estate’ or have the ‘necessary paperwork’ despite a good financial standing to finance the product and payback the lent amount. Majority banks require the solar loans to be backed by real estate and adequate guarantees. Our analysis on collateral requirements for solar PV by commercial banks is illustrated in Figure 5. Six out of thirteen banks stated that they require adequate collateral such as personal property documents, agricultural land documents etc. for all solar product related cases. Four banks stated that they determine collateral requirements based on case profiles, whereas three banks informed that they simply accept solar system itself as collateral.

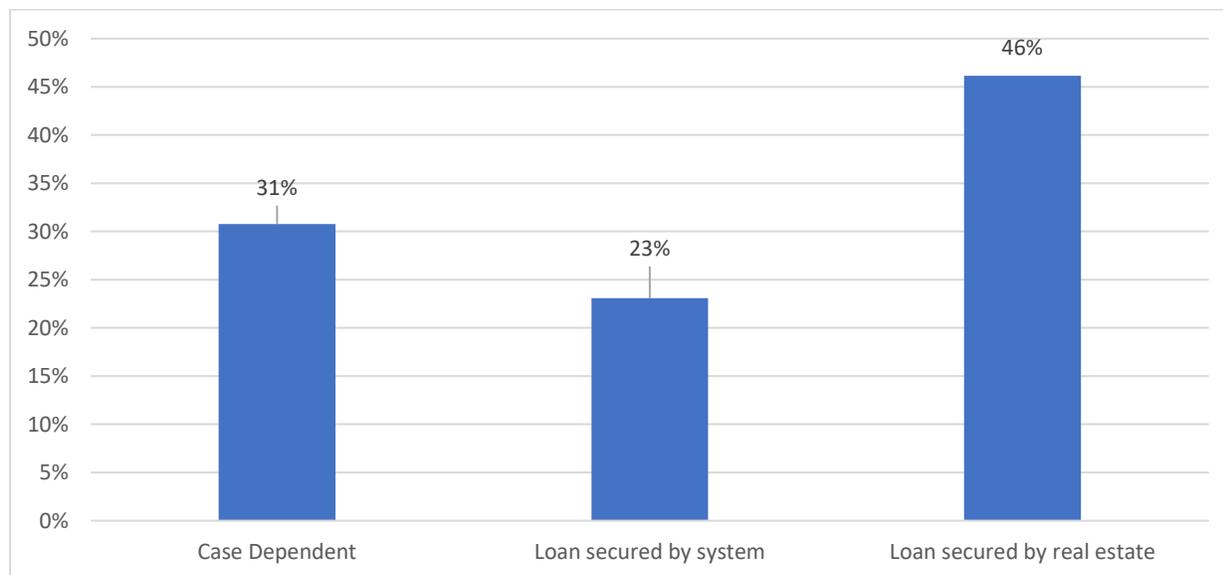


Figure 5 Variation in PV loan by type of security

3.3.4- Eligibility Criterion

Last but not the 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 to high rated customers with a 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 2 shows eligibility criterions of a few banks which we extracted from their brochures (either available online or gathered from the banks individually).

As could be observed, 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, namely 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	<ul style="list-style-type: none"> 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 Applicant scoring Credit Risk Rating from 1 to 5 only will be eligible for this facility
JS Bank	<ul style="list-style-type: none"> Applicant must be the owner of the property Bank statements business or personal account with account maintaining certificate
Meezan Bank Limited	<ul style="list-style-type: none"> Must be qualified for and has availed Mera Pakistan Mera Ghar Scheme 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	<ul style="list-style-type: none"> 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 three-month peak bill average
Allied Bank limited	<ul style="list-style-type: none"> Applicant must be the owner of the property Income: Salaried individuals: Minimum length of employment of two years and minimum net monthly salary of PKR 40,000; Self-employed individuals: Minimum length of business/profession should be three years and minimum net monthly salary should be PKR 100,000. Approved cities: Karachi, Lahore, Rawalpindi/Islamabad, Gujranwala, Sialkot, Multan, Hyderabad and Faisalabad
Bank of Punjab	<ul style="list-style-type: none"> Age: 25-60 years for salaried applicants; 25-65 years for self-employed applicants Minimum monthly gross salary: PKR 40,000 Minimum experience: One year for govt employees, three years for contractual employees and self-employed candidates; net income of PKR 50,000 for self-employed people Bank statements of last six months
Samba Bank	<ul style="list-style-type: none"> 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 two years in their current business

Table 4 Eligibility Criteria for availing solar financing

3.4- Concerns Related to Batteries and Off-grid Systems

Few banks have also distanced themselves from battery and off-grid solar PV financing. Due to unreliable power supply, batteries constitute an important element of decentralized energy drive in Pakistan. Furthermore, they are also quite costly and constitute around 20-35% of the total system cost. Our findings reveal that presently 31% of the banks have excluded batteries from financing. The reason cited for it is the relatively low life cycle of batteries and higher financial risk in case of default. Moreover, few

banks have also tightened restriction for solar systems in the off-grid sector. For instance, three banks clearly stated that presently they are not financing systems located in the off-grid sector. From this it may be inferred that there are certain additional restrictions on solar financing on the part of the banks, which further confines the scope of the lending facility.

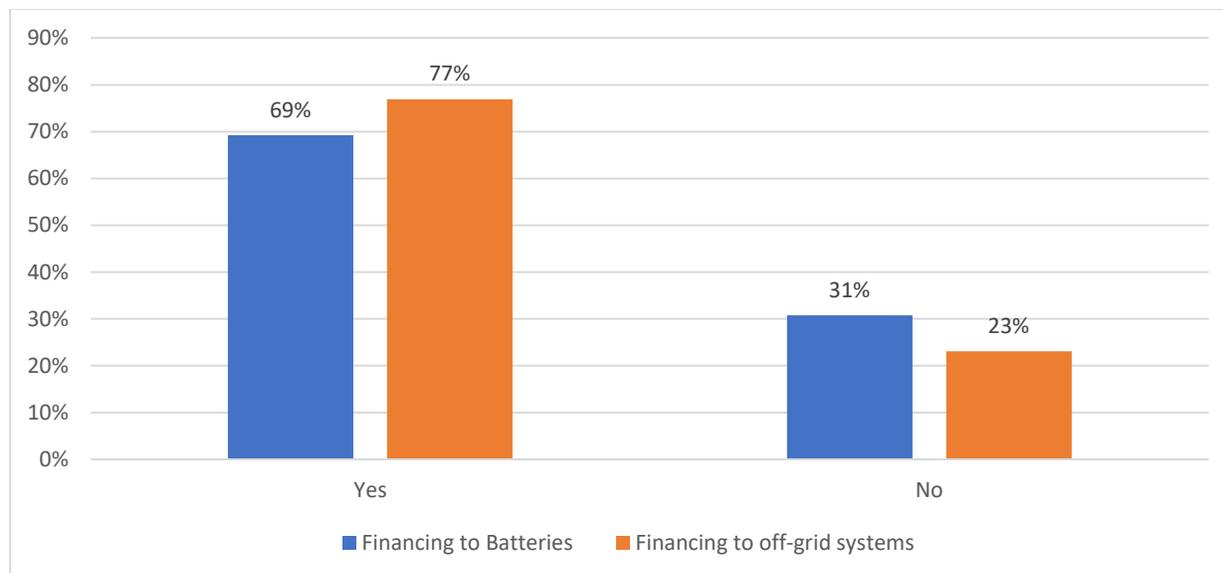


Figure 6 Financing to Batteries and Off-Grid systems

3.5- Major Concerns of Banks

Given the low interest in solar financing, we wanted to probe factors and challenges in relation to solar financing. For this we reached out to all banks including the ones who are presently not considering solar PV financing. *Figure 7* illustrates the responses gathered from the interviews with 22 banks. Out of these, 19 banks were those who had some lending experience either under the SBP Scheme or their individual schemes.

A key concern presently related to solar financing is the ‘financial risks’ in case of default by customers and the resale value of the solar product. The largest concern in case of solar products is the ‘absence of secondary markets for used solar systems’. Three interviewees explained that in contrast with other lending products such as automobiles or heavy machinery, used solar system has little value as there is no established active secondary market for it. Few interviewees also mentioned that even in cases of collateral support in terms of real estate used to secure a loan, the transaction cost in terms of time and efforts consumed for liquidating the collateral is very high. So, despite secure financing, if someone defaults, the mortgage that they have for bigger systems or the collateral that they have for smaller systems does not cover the loss. In the context another interviewee added that given these risks, presently no risk sharing mechanism exists. Since they have to bear the entire cost of any financial risks, this explains their imposed stringent eligibility qualifications against solar financing which excludes majority from availing the facility.

In this context, two interviewees mentioned that since the criterions for solar financing are very strict, this eliminates majority customers. One interviewee said that extensive paperwork is carried out at the time of screening applicants. This includes property ownership documents, income profile and debt profile. Whereas very few applicants have attractive profiles and so are unable to fulfill the banks criterions. Another interviewee added that applicants are not able to avail solar financing due to conditional securities needed as collateral. Whereas one interviewee also mentioned that the applicants frequently seek details on the solar PV financing. However, after exchange of details, most of them never follow-up.

A vast majority also mentioned that their staff is more dedicated toward products which have higher demand and in comparison to vehicles and heavy machinery, solar products have very low demand. This could be due to low awareness or general lack of interest in solar finance at the end of customers. One interviewee mentioned that they introduced the scheme when they received the SBP circular. However, so far, they have not financed even a single case since no eligible clients have reached out yet. One interviewee said that banks prefer those schemes where demand from clients is strong. In case of solar PV, there is no strong demand as such. Another interviewee stated that both demand and return for solar financing is low, adding that they have other re-financing schemes for homes and businesses which are quite successful, so most of their staff is engaged in those products.

Another challenge exacerbating the hesitation to engage in a market was indicated to be the cumbersome process of reimbursement and inter-linked stringent regulations. One interviewee stated that the strict reimbursement conditions of repayment of the loan to SBP and the fines and penalties imposed in cases of delays, demotivates them from introducing the facility. Likewise, another interviewee said that the administrative cost of processing the loan (both in terms of time spent and cumbersome process) is one factor for their low interest in the scheme. Furthermore, one bank which has adopted the scheme and is actively engaged in solar financing stated that the process of refinancing loan from SBP to commercial banks is manual. Overall, the process is associated with a high transaction cost. Based on this, in cases of small systems where the profit margin of banks is low—they rather prefer not to process it due to the negligent net benefit.

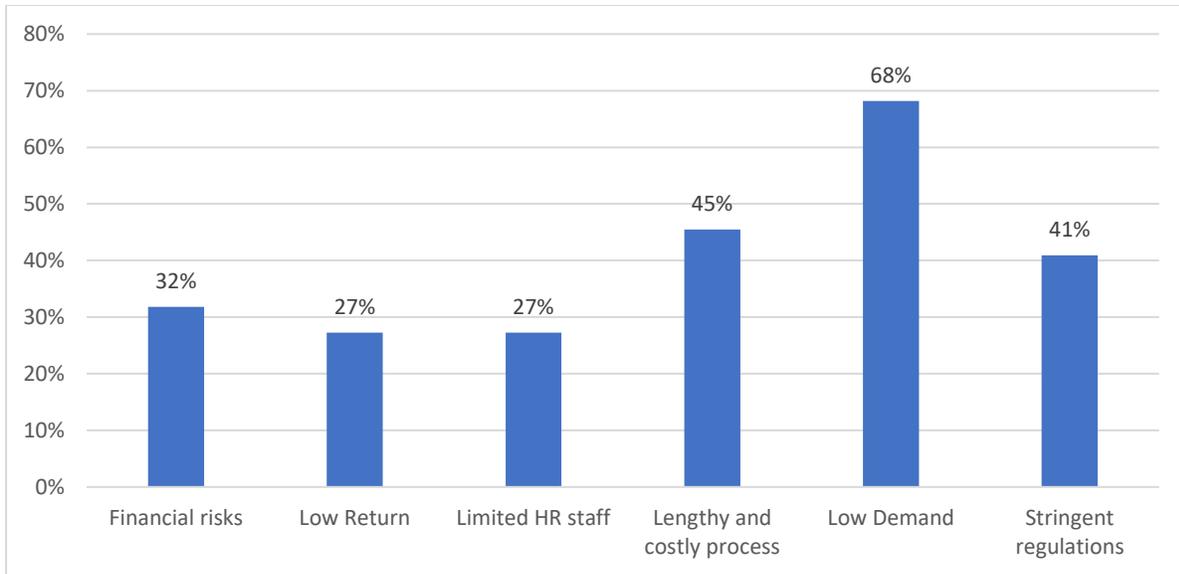


Figure 7 Concerns in relation to Solar PV lending

4- Study Findings: Business Model Lags

The following sections covers the main findings of the interviews carried out with solar vendors. There are a number of solar companies working in Pakistan. We interviewed the companies which were certified under AEDB, either into V1 or V2.⁷ All the companies that we interviewed were quite well aware of SBP RE financing scheme. *Category III* of the scheme is generally based on—financing through vendors and suppliers certified under AEDB certification Regulation 2018 for installation of wind and solar systems on lease basis or selling of electricity to ultimate owners/users.

4.1- Barriers and Concerns related to OPEX models at domestic level

All the solar vendors interviewed for this study explicitly indicated their lack of interest in OPEX business models at domestic level. Following factors were indicated as responsible for this lacking interest.

4.2- Financial Risks

A vast majority of interviewees indicated that ‘finance related risks’ is a major obstruction in the way of OPEX business model. Solar projects are capital intensive and they require a huge upfront cost. In the case of PPA business models at domestic level, solar companies have to invest all the upfront cost. So, key

⁷ V1; with the installation capacity up to 1000 KW. V2; with the Installation capacity of up to 250 KW

concerns in context of OPEX models as indicated by solar vendors were ‘*What if client defaults and is unable to pay monthly bill, who will be responsible for that? And what if someone damages the solar system?*’ In case of irregular instalments of loans or technical faults of the solar system, the financial burden ultimately falls on the parent company.

57% of respondents mentioned that ‘*low yield and low return*’ is another risk that results in low interest towards OPEX business model at domestic level. In case of PPA business model at domestic level, size of solar system will be usually small, which ultimately leads to less power generation. Low yield will result into low energy bills on a monthly basis and profit margin will also be less as compared to engineering, procurement and construction (EPC) projects. Therefore, mostly companies are reluctant to invest at domestic level. Furthermore, the slow investment recovery will end up into long payback period and vendors usually avoid investing for larger duration.

Furthermore, 27% of respondents also stated that the eligibility criteria as set by banks for availing solar financing is quite stringent, and mentioned that in few cases, loans from banks demand collateral/ property mortgage and sufficient income of clients etc.

Around six respondents claimed that processing charges of NEPRA for generation of licence are high and mostly clients resist to pay these charges. In the beginning these charges were reasonable, but after some amendments, it has been significantly increased.

10% of respondents mentioned that financial health of smaller and comparatively newly developed companies is not as strong as compared to old solar companies. They have limited solar funds to invest for PPA model at domestic level. Government should introduce funds for such companies, so that they can easily invest for these projects at all the levels (corporate, industrial and domestic).

4.3- Operational Barriers

Five interviewees mentioned that the limited roof top spaces in urban areas is another challenge faced by them during the installation of the solar projects. Solar projects require a larger space. The rooftop leasing model may succeed in the areas with large open spaces or the buildings expanding horizontally instead of vertical expansion. Although business model may be successful in both rural and urban areas, but the constraints of limited area will still be there due to shading and uneven space in some cases.

Moreover, five interviewees also stated that the ‘*logistic issue*’ is also acting as a barrier for the installation, bill recovery and maintenance of the solar projects at scattered sites. As in the case of OPEX business model, ownership and operation and maintenance has to be done by solar vendor. It would be very difficult for solar vendors to operate, maintain and recover bills at several sites. They will have to allocate bulk of resources for the maintenance and management of installed solar systems at scattered sites. Solar systems in the same society can be maintained easily along with their bills recovery.

Five respondents claim that ‘*privacy issues*’ can be faced by solar vendors at domestic level during system installation and maintenance on their roof tops. Three interviews also expressed concern in relation to improper use of the system and risks of damage to it.

Four respondents also mentioned that there are chances of many problems in rooftop leasing business models. One reason may be a litigation problem. A proper regulatory mechanism should be developed before introducing these models.

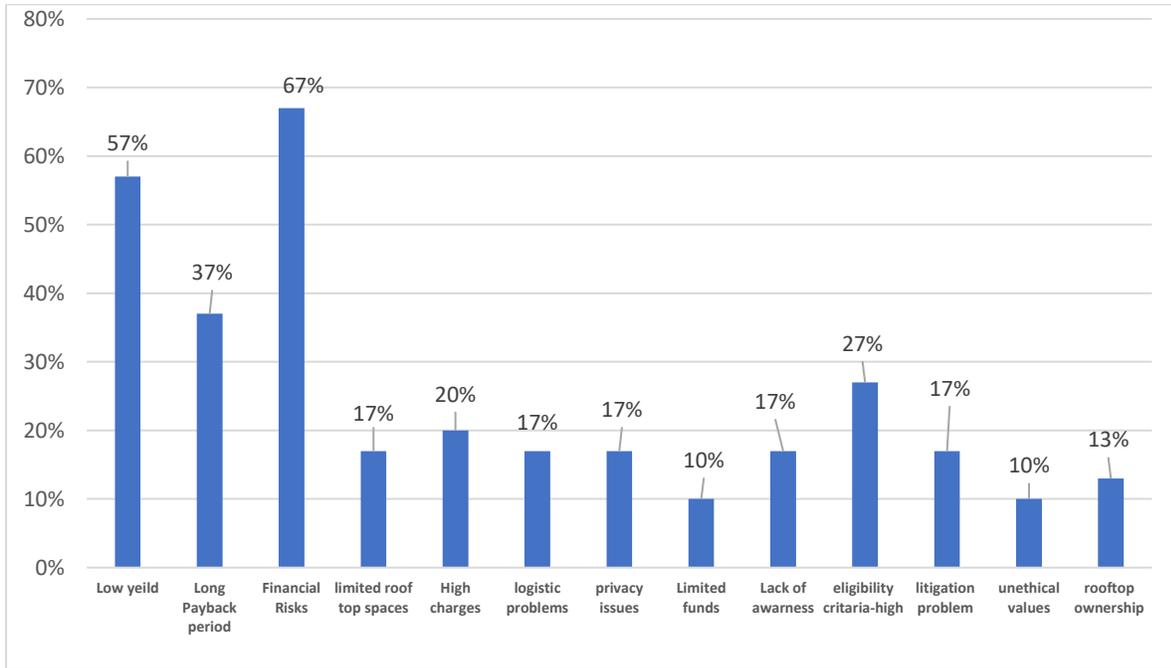


Figure 5 Concerns and Challenges in relation to Solar OPEX Models

4.4- Regulatory Gaps

Pakistan rolled out net-metering regulations in 2015. However, these regulations are only restricted to end-users presently since the meter owner must be the system owner. According to majority solar vendors, most businesses can't participate in net-metering due to this regulatory gap. Furthermore, the cumbersome process of availing licences was another aligned challenge. Twenty six out of 30 respondents claim that the overall processing time as per the existing business model is relatively high, exacting a higher transaction cost for applicants. Fourteen respondents indicated that in order to expedite the process of availing licence, clients have to pay relevant focal persons at Distribution Companies (DISCOs) (even to the lower staff) to complete their paperwork. These extortive practices further undermine a fair system for grid connection. Four respondents highlighted that manual processing for availing licence is quite time consuming as compared to online processing, which is transparent and would make the system more efficient. Majority of interviewees also mentioned that presently most banks have limited interest in solar product financing. Limited staff availability for processing of finance for solar system is also a leading challenge.

5- Conclusion and Recommendations

Meeting national and international energy transition and climate objectives, as outlined under *Alternative Renewable Energy Policy 2019*, *Pakistan Nationally Determined Contributions*, and commitments under *Sustainable Development Goals 7 and 13* will require an accelerated transformation towards new and clean form of energy supply system. The combined efforts of top-down and bottom-up initiatives are needed to shift investments toward such a transition.

SBP has launched an important scheme to unlock finance aimed at scaling up low-carbon energy infrastructures and encourages bottom-up initiatives for tapping into the country's huge renewable resources. Despite this concessionary and useful scheme, solar financing is still in its infancy. Although the scheme was rolled out in 2016, majority banks have not yet introduced financing under this facility. Furthermore, opposing logics are at work in the design of 'schemes' at those banks who have started financing under the facility. The features and loan terms of solar financing have largely confined its scope to a very limited 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.

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 would simply not address the socially equitable transformation challenges. Based on the recognition that finance will remain the key driver for this change to happen—we emphasize strong reforms and efforts for the 'scheme to take-off'. Easy access and user-friendly direct financing for solar PV customers from financial institutions (commercial banks, micro-finance institutions) are seen as central to influencing increased responsiveness from potential borrowers. In parallel, a comprehensive approach, aiming to efficiently integrate all OPEX in the electricity system for significantly larger integration of solar uptake is imperative. Experiences from peer regional countries suggest that reaping the full benefits of decentralized energy resources requires changes in business models such that they ease its diffusion among larger circles. The findings of this study emphasize the urgency for measures and reforms that could be deployed to address the challenges restricting solar PV uptake—and attracting applicants seeking solar systems.

- 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. While State Bank is extending capital to banks, yet due to low markup rate and high transaction cost the stakes, in terms of profit or incentives, are quite low for them. This also explains to a larger extent the passive interest in the scheme by majority banks. The share of financial institutes in banks spread under *Category II* could be increased to incentivize solar product financing at commercial level. Furthermore, binding regulations should be set for all relevant institutes to finance products under the 'lending facility'. In the absence of the right penalties and incentives, the scheme will fail to take off.
- An easing of solar PV financing 'terms and conditions', which could enable large scale access vis-a-vis reduced payments is imperative. 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. A standardized approach should be used to design details of such products, such as tenor, collateral requirements, monthly payments etc.—preferably to be co-aligned with the features as laid out under the SBP circular. This would increase the maximum loan tenor to 10 years and eliminate the minimum equity benchmark. The collateral requirements should be tied to the system—and this collateral requirement should be fixed for all institutes. Furthermore, the eligibility requirements should be relaxed and risk tolerance should be increased on a limited scale etc. to avoid negative screening.

- A key objective of institutions such as financial institutes is ‘secure financing’. Widening the scope of solar financing to broader sections of society would necessitate major relaxations in eligibility criteria and collateral requirements for availing finance. If the commercial banks are to solely bear the cost of any potential customer default and as long as any risks have financial implications for their portfolio—this will reinforce all necessary measures for secure financing resulting in ‘Business as usual’ lending practices. A credit guarantee or risk sharing mechanism will make bankers feel more secure in their investment and extending solar PV financing.
- The procedures to obtain loans under refinancing scheme should be simplified. This will lower the administrative cost for banks and financial institutes. As a first step, the process of reimbursing finance under the SBP scheme should be digitalized. In addition, the regulations on reimbursement should be made more flexible for banks so that any lapses at the end of borrowers do not impose any additional cost on them. To accelerate the processing of applications at borrower’s end, banks could create specialized units for processing applications to improve the efficiency and reduce the transaction cost.
- Lack of access to affordable finance remains one of the biggest challenges for off-grid renewable energy projects. To effectively attract capital into the sector—which also has stronger demand forces—all financial institutes should be compelled towards more concrete commitments to off-grid renewable energy solutions. This will also help in ensuring universal energy access by 2030.
- An effective mechanism needs to be introduced for effective follow up and monitoring of ‘capacity installed’ and ‘financing advanced’ under the scheme.
- Designing is crucial for promoting OPEX solar PV business models. Furthermore, there needs to be a viable business case for private investors when investing in rooftop solar. Facilitative measures that promote businesses’ interest in rooftop solar needs to be introduced, including enabling regulations that allow private sector engagement in net-metering, a fair remuneration for electricity fed into grid and simple taxation mechanisms.
- In case of domestic client default, government institute should have some security and assurance from domestic client before issuing work order to solar vendor (just like banks take some security before issuing any kind of loan to their clients), government should provide security and reduce risk for solar vendors. In order to reduce the risk for solar vendors, government should make a department which will fill the gap between solar vendor and domestic client for OPEX business model.

- Finally, and most importantly, nationwide awareness campaign on the financing scheme and OPEX business model should be carried out. This will help in tapping the enormous potential that solar prosumage offers for advancing renewable energy in the country.

To conclude, 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. A lucrative financial model, which instead of profit-generation or securitization emphasizes more on an environmentally and socially inclusive transformation, is the need of hour. The OPEX business model will also be critical in Pakistan's quick adoption of rooftop solar. However, the scale of its success will be determined by its 'diffusion across relevant institutes' as well as banks' 'lending policies'. For any desired transition, reforms are also needed on encouraging innovative OPEX business models so that solar PV uptake among communities is not further delayed. Accordingly, larger focus of the operational solar lending practices and business models needs to be converged towards these objectives of inclusive transformation.

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Annexure A: Bank Wise List of Institutes Based on Existing Status on Solar Product Financing

	Banks	Category A: Financing solar products under SBP lending facility	Category B: Financing solar products under individual schemes	Category C: Not financing solar products	Category D: Solar products don't fall under the scope of bank
Public Sector Commercial Banks					
1.	First Women Bank Limited	✓			
2.	The Bank of Khyber	✓	✓		
3.	Sindh Bank Limited			✓	
4.	National Bank of Pakistan				✓
5.	The Bank of Punjab			✓	
Specialized Banks					
6.	Zarai Tarqati Bank Limited		✓		
7.	Punjab Provincial Cooperative Bank Limited				✓
8.	SME Bank Limited				
9.	Industrial Development Bank of Pakistan Limited				✓
Local Private Banks					
10.	Habib Bank Limited	✓			
11.	MCB Bank Limited	✓			
12.	Bank Al-Falah Limited	✓			
13.	Habib Metropolitan Bank Limited		✓		
14.	Faysal Bank Limited		✓		
15.	Standard Chartered Bank (Pakistan) Limited			✓	
16.	SILKBANK Limited			✓	
17.	Samba Bank Limited	✓		✓	
18.	United Bank Limited				
19.	Allied Bank limited	✓		✓	

20.	Bank Al-Habib Limited	✓			
21.	Askari Bank Limited			✓	
22.	Soneri Bank Limited	✓			
23.	Summit Bank Limited	✓			
24.	JS Bank	✓			
Islamic Banks					
25.	Meezan Bank Limited	✓			
26.	Bank Islami Pakistan Limited		✓		
27.	Dubai Islamic Bank Pakistan	✓		✓	
28.	Al-Baraka Bank (Pakistan) Limited		✓		
29.	MCB Islamic Bank Limited	✓			
Foreign Banks					
30.	Citi Bank N.A				✓
31.	Industrial & Commercial Bank of China				✓
32.	Deutsche Bank AG				✓
33.	Bank of China Limited				
Micro-Finance Institutes					
34.	First Microfinance Bank Limited		✓		
35.	Khushhali Microfinance Bank Limited		✓		
36.	Pak Oman Microfinance Bank Limited				✓
37.	Mobilink Microfinance Bank Limited		✓		
38.	Advans Pakistan Microfinance Bank Ltd				✓
39.	FINCA Microfinance Bank Limited				✓
40.	NRSP Microfinance Bank Limited		✓		
41.	Telenor Microfinance Bank Limited				
42.	U Microfinance Bank Limited		✓		
43.	APNA Microfinance Bank Limited				✓
44.	Sindh Microfinance Bank Limited				✓

List of Solar Companies Interviewed

S. no.	Solar Vendors	Category of Solar Company	Response
1	Masco Energy Services	V2	
2	E- Cube Solution (Private) Limited	V2	ü
3	M/s SC Technologies Global (Pvt) Ltd.	V2	
4	M/s S.M. Jaffer & Co	V2	
5	M/s Oursun Solar Power Limited	V2	
6	M/s JKS (Private) Limited	V2	
7	M/s MSquare R Engineering Services	V2	ü
8	M/s Fouz International	V2	ü
9	M/s Allied Solar (Private) Limited	V2	ü
10	M/s Inverex Power Solution	V2	
11	M/s Omecta International (Private) Limited	V2	ü
12	M/s Apple Energy Technologies (Pvt) Ltd.	V2	ü
13	M/s Festoon Engineering Works	V2	
14	M/s Feroze Power (Private) Limited	V2	
15	M/s RESOLV (Private) Limited	V2	ü
16	M/s Mianoor Engineering	V2	
17	M/s Cellsol Trade (Private) Limited	V2	
18	M/s Al-Asr Renewable Energies	V2	
19	M/s TAJ SOL	V2	ü
20	M/s MAXELL Power (Private) Limited	V2	
21	M/s Indus Solar International (Private) Limited	V2	
22	M/s Akhuzada Associates (Private) Limited	V2	ü
23	M/s Benchmark Technologies	V2	
24	M/s Total Network Solutions	V2	
25	M/s READ Solar (Private) Limited	V2	ü
26	M/s SAZTEL (Private) Limited	V2	
27	M/s Roomi Engineering Services (Private) Limited	V2	
28	M/s Green Edge Engineering (Private) Limited	V2	ü
29	M/s Zeus Energy (Private) Limited	V2	

30	RH Realty (SMC-Pvt) Limited	V2	
31	M/s Act Engineering Services (Private) Limited	V2	
32	M/s Skypower (Private) Limited	V2	
33	M/s Biotech Fuels (Private) Limited	V2	
34	M/s Quwatt (Private) Limited	V2	
35	M/s Ercon Energy (Private) Limited	V2	ü
36	M/s EPESOL (Private) Limited	V2	
37	M/s R & S Engineering & Services (SMC-Pvt.) Limited	V2	
38	M/s Mehver Technologies (Private) Limited	V2	ü
39	M/s Beyond Green (Private) Limited	V2	
40	M/s Solaris Engineering (SMC-Pvt) Limited	V2	
41	M/s Solar Best Solutions (Private) Limited	V2	
42	M/s Rameen Renewables (Private) Limited	V2	
43	M/s Quantum Mechanics (Private)	V2	ü
44	M/s Watt Tech (Private) Limited	V2	
45	M/s Industrial Aid Services	V2	
46	M/s Penta-H (Private) Limited	V2	ü
47	M/s Technology Links (Private) Limited	V2	
48	M/s Haji Sirajuddin Soomro	V2	
49	M/s Sindh Solar House	V2	
50	M/s Renewable Stars (Private) Limited	V2	
51	M/s UB Solar & Security Solutions	V2	ü
52	M/s Siddiq Renewable Energy (Private) Limited	V2	
53	M/s ATS Engineering Sales and Services	V2	
54	Technical Associates Pakistan (Private) Limited	V2	
55	M/s Ingenuity (Private) Limited	V2	
56	Sun Tech Power System (Private) Limited	V2	ü
57	M/s Sleek Solar International (Private) Limited	V2	
58	M/s Muhammad Iqbal Shaikh & Co	V2	
59	M/s Kaiynat Hitech Services	V2	
60	M/s KST (Private) Limited	V1	

61	M/s RE Nergy Solutions (Private) Limited	V1	ü
62	M/s Skyelectric (Private) Limited	V1	ü
63	M/s Premier Energy (Private) Limited	V1	ü
64	M/s Associated Technologies (Private) Limited	V1	
65	M/s Zi Solar (Private) Limited	V1	
66	M/s HiSEL Power Pakistan (Private) Limited	V1	
67	M/s T.S.K Engineering International (Private) Limited	V1	
68	M/s CSUN Power Pakistan (Private) Limited	V1	
69	M/s ICON (Private) Limited	V1	
70	M/s Green Volts Energy (Private) Limited	V1	
71	M/s Four Brothers Energy (Private) Limited	V1	
72	M/s Adaptive Technologies (Private) Limited	V1	
73	M/s Allied Engineering & Services (Private) Limited	V1	ü
74	M/s Albario Engineering (Private) Limited	V1	
75	M/s DS Global (Private) Limited	V1	
76	M/s Dynamic Green (Private) Limited	V1	
77	M/s Samber Energy (Private) Limited	V1	
78	M/s Alpha Renewables (SMC Pvt) Limited	V1	
79	M/s Catkin Engineering Sales & Services (Private) Limited	V1	ü
80	M/s Orient Energy System (Private) Limited	V1	
81	M/s Solar Tech (Private) Limited	V1	
82	M/s Hadron Solar (Private) Limited	V1	
83	M/s Elite Engineering (Private) Limited	V1	ü
84	M/s Sharif International	V1	
85	M/s IMS Engineering (Private) Limited	V1	
86	M/s Pantera Energy (Private) Limited	V1	
87	M/s Foundation Solar Energy (Private) Limited	V1	
88	M/s Power Highway	V1	
89	M/s H & M Enterprises	V1	

90	M/s Energy Solutions (Private) Limited	V1	ü
91	M/s Green Industrial Solutions (Private) Limited	V1	ü
92	M/s Delta Power	V1	
93	M/s Tesla Industries (Private) Limited	V1	
94	M/s Nizam Energy (Private) Limited	V1	
95	M/s MAK Pumps Company (Private) Limited	V1	
96	JD Aviation Sourcing & Engineering Services	V1	ü
97	Solar Sigma Limited	V1	
98	AE Power Alternative Energy (Private) Limited	V1	
99	M/s Zero Carbon (Private) Limited	V1	
100	M/s EBR Energy Pakistan (Private) Limited	V1	
101	M/s Safron Energy (Private) Limited	V1	
102	M/s Thaheem International	V1	ü
103	M/s Nanx Engineering (Private) Limited	V1	
104	M/s Creative Electronics (Private) Limited	V1	ü
105	M/s Ahmad & Co	V1	
106	M/s Solis Energy Solutions (Private) Limited	V1	
107	M/s MULTILINE Engineering Co.	V2	ü
108	M/s AYK (Private) Limited	V2	
109	M/s Electro Tech	V2	ü

Annexure B: Interview Questions for Commercial Banks on Solar PV Financing

Solar PV Financing interviewees will be initially divided into three groups based on their experience with rooftop solar photovoltaic (PV) financing to date:

Group A. If your institution has adopted SBP RE Finance Scheme, go to *Group A* questionnaire.

Group B. If your institution has not adopted SBP RE Finance Scheme, but advances loans under other arrangements, go to *Group B* questionnaire.

Group C. If your institution does not finance solar PV, go to *Group C* questionnaire

Group A: Have introduced SBP RE finance scheme.

Section I: Background Information

- 1- In which year did you adopt/introduce **SBP RE finance scheme**?
- 2- How did you know about this scheme?
- 3- What motivated you to adopt the scheme? (Probe if necessary: strong demand from existing clients, ability to reach new clients, perceived as very profitable, bank mandate or preference to become involved in green projects, other incentives).
- 4- Do all branches of your bank now provide lending for solar systems under the scheme? If not, which branches does?
- 5- Before this scheme, was your institution involved in other green energy financing? If yes, provide some details.
- 6- Now that you have introduced this scheme, do you finance solar PV under other arrangements (such as regular financing or other green energy financing schemes)? If yes, please provide details.

Section II: Types/Categories of Solar Systems Financed Under SBP RE Finance scheme

- 7- Out of the following, to what types of customers does your institution provides solar PV financing?
 - a. Residential
 - b. Commercial buildings
 - c. Industrial buildings
 - d. Solar developers/installers
 - e. Others
- 8- Roughly, what is the typical size of systems to these groups?
- 9- For each group selected in question **7**, what major terms are involved (collateral, length of loan, down payment, maximum lending value, other eligibility criterion etc.)
- 10- For each group selected in question **7**, roughly how much loans have so far been financed?
- 11- For each group not selected in question **7** above, why have you not financed solar PV projects to that group yet?

12- Do you advance loans to solar systems in off-grid sector? If not, why not.

13- Do you advance loans to batteries (attached with solar system)? If not, why not.

Section III: Opportunities and Challenges

14- How difficult or easy was it to begin solar PV financing?

15- What are specific barriers, risks unique to solar PV financing?

16- Have you experienced to date any risks/challenges in relation to solar PV financing? If yes, please elaborate.

17- What type of support do you need to minimize the barriers/risks (if any) outlined in question 13?

18- In case of default, does SBP (or someone else) share the risks with you?

19- In your opinion, is solar PV financing profitable for residential and/or commercial customers, and under what conditions?

20- Are you aware of credits and other incentives to support solar financing in Pakistan? If yes, please elaborate.

21- Do you think there is a desire by your bank to do more solar financing? If so, is there interest within certain market segments (and which ones)? If not, why not?

22- Do you have any major concerns about financing solar projects? If "yes," please explain.

23- What type of support do you require (if any) to address barriers in relation to solar PV financing?

Group B: Have not introduced SBP RE finance scheme but financing solar PV under other arrangements.

Section I: Background Information

1- Are you informed about **SBP RE finance scheme**?

2- Generally, what barriers have prevented your institution from introducing the scheme?

Section II: Types/Categories of Solar Systems Financed Under SBP RE Finance scheme

- 3- To what types of customers does your institution provides solar PV financing?
 - a. Residential
 - b. Commercial buildings
 - c. Industrial buildings
 - d. Solar developers/installers
 - e. Others

- 4- Roughly, what is the typical size of systems to these groups?

- 5- For each group selected in question 3, what major terms are involved (collateral, length of loan, down payment/equity, maximum lending value, other eligibility criterion etc.)

- 6- For each group selected in question 3, roughly how much loans have so far been financed?

- 7- For each group not selected in question 3 above, why have you not financed solar PV to that group yet?

- 8- Do you advance loans to solar systems in off-grid sector? If not, why not.

- 9- Do you advance loans to batteries (attached with solar system)? If not, why not.

Section III: Opportunities, Risks and Challenges

- 10- How difficult or easy was it to begin solar PV financing?

- 11- What are specific barriers, risks unique to solar PV financing?

- 12- Have you experienced to date any risks/challenges in relation to solar PV financing? If yes, please elaborate.

- 13- What type of support do you need to minimize the barriers/risks (if any) outlined in question 11?

- 14- In case of default, does any third party share the risks with you?

- 15- In your opinion, is solar PV financing profitable for residential and/or commercial customers, and under what conditions?

- 16- Are you aware of credits and other incentives to support solar financing in Pakistan? If yes, please elaborate.

- 17- Do you think there is a desire by your bank to do more solar financing? If not, why not?

- 18- Do you have any major concerns about financing solar projects? If “yes,” please explain.

19- What type of support do you require (if any) to address these barriers?

Group C: Does not finance solar PV.

- 1- Are you informed about SBP RE finance scheme?
- 2- Generally, what barriers have prevented your institution from introducing the scheme?
- 3- Do you have any major concerns about financing solar projects? If “yes,” please explain.
- 4- Generally, what barriers have prevented your institution from financing solar PV projects? How would those barriers be overcome?
- 5- How do you think these barriers could be addressed?
- 6- In your opinion, is solar PV financing profitable for residential and/or commercial customers, and under what conditions would you consider solar PV financing?

Interview Questions for Solar Vendors on OPEX business model

Following interview questions were asked from solar vendors to assess the solar PV business model landscape in Pakistan and identify areas for future development, including possible solutions to identify the business model lags.

- 1- In which year did you start operating in Pakistan?
- 2- Are you accredited with *Alternative Energy Development Board*? If no, skip Q 3.
- 3- The **Category III** of State Bank of Pakistan RE Finance Scheme to vendors and suppliers (certified under AEDB Certification Regulation 2018) for installation of wind and solar systems on lease basis or selling of electricity to ultimate owners/users. Are you familiar with this scheme? If yes, have you considered or are considering benefitting from this scheme? (If yes, any challenges that you are facing, If no, why not).
- 4- As of today, there are different kind of *Fee for Service/ OPEX* models prevalent globally (Third party Investors, Corporate PPA, Solar Leasing). Are you familiar with these models?
- 5- Have you ever considered expanding your business through using any of the models as discussed under Q 4? If no, skip Q 6.

- 6- If yes which model, what were some of the barriers (probe further: administrative, regulatory, policy, financial) in the way of expansion?
- 7- In your view, what measures need to be taken to address these barriers? What recommendations would you propose for relevant agencies/organizations in this regard?

*** This was a semi-structured questionnaire. The underlying objective was to minimize barriers in relation to OPEX model solutions in Pakistan. Besides these stated question, solar companies were also asked, that they can provide us any information—overlooked in the questionnaire—for a comprehensive understanding on the stated challenges.**