Design of Islamic Financing Product for Residential Solar PV Systems- The case of Pakistan

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Abstract
Pakistan is posed with energy crisis with ever increasing demand, import dependent and dirty fuel-mix, unsustainable costs, transmission losses, leading to mounting revenue deficits a.k.a circular debt. Diffusion of residential solar generation is viewed as an economically efficient pathway for driving a transition to clean energy sources. The country is facing slow uptake of residential solar generation, despite of superior solar resource, government incentives, and steep decline in equipment cost. The primary reason of slow growth in adoption of PV generation systems is lack of awareness among the stakeholders including policy-maker, households and the financiers. Also, given the high upfront cost, the lack of financing facilities is a major impediment towards wide-scale adaption of residential solar generation. In this pretext, this paper aims to inform the household and financial institution by presenting the (i) the locational Solar PV generation potential by computing levelized cost of electricity (LCOE) for 130 districts across 6 provinces in Pakistan; and subsequently (ii) design and evaluate a financing product for residential solar PV Systems for Islamic Banks operating in the country. First, we review the financing mechanism for residential solar as practiced across the world. Second, based on our survey and interviews with solar vendors and bankers, economic payoffs (payback period, NPV and IRR) both for household (borrower) and banks (lender) are modelled. The Shari'ah structure target market, marketing strategies, vendor integration, and cost-benefit analysis for the proposed financing product is also presented. Finding suggests monetary benefits for both bank and households. Modelled cashflows from bank's perspective favors an unsecured product, contrary to that of household borrower who is better-off with a secured/collateralized product. Evaluation of latent parameters like the 'Risk-adjusted return on capital (RAROC) resolves the bank-borrower paradox and favors a secured financing product.

Keywords*: Islamic Financing, Pakistan, Shari'ah, Islamic Banks, Renewable energy, Consumer lending, Solar photovoltaic, Cash flows, Financing product, Levelized cost of electricity (LCOE), ,*

1. Introduction

In 1911 American entrepreneur, Frank Shuman wrote in Scientific American journal:
"The future development of solar power has no limit. Where great natural water powers exist, sun power cannot compete; but sun-power generators will, in the near future, displace all other forms of mechanical power over at least 10 per cent of the earth's land surface; and in the far distant future, natural fuels having been exhausted it will remain as the only means of existence of the human race." (Jones & Bouamane, 2012)

Solar Photovoltaics (SPV) has been the world's leading source of power generating capacity in 2016[1]. Asia, among all other markets worldwide, accounts for about two-thirds of global additions for four consecutive years. China, United States, Japan, India and the United Kingdom, are the top five markets that accounted for about 85% of additions in Solar PV capacity[2]. Steep decline in the price of solar PV system, government incentives and rising demand for electricity are the main reasons for market expansion (REN21, 2017).

In case of Pakistan as a developing country, the energy system is juggling with the challenges of energy security, affordability and sustainability (i.e., the energy trilemma). The country's energy system is expensive and dependent on imported fossil fuel. High import dependence and ever-increasing demand keeps the cost of generation high and uncertain, leading to generation and revenue deficit a.k.a circular debt[3] along with huge subsidy burdens on the country's fiscal accounts (Kiani, 2018). Pakistan's overall national goal for 2025 is to achieve inclusive and dynamic economic growth, with energy security as a supporting pillar. The energy sector goal is to ensure uninterrupted access to affordable and clean energy for all Pakistanis, with quantitative targets for (i) increasing electricity access from 67% to over 90% by 2025, (ii) eliminating the current electricity supply–demand gap and (iii) adding 25,000 MW of generation capacity by 2025. These national targets cannot be achieve without increasing the share of renewable energy in the energy mix (ADB, 2016).

The residential household demand accounts for over 46% of the overall electricity demand in the country (NEPRA, 2018). Wide scale diffusion of residential solar can potentially address the energy challenges. However, despite of sharp decline in the Solar PV equipment prices, and government support in terms tax incentives, and enactment of net-metering[4] – the offtake of residential solar has been lackluster in the country (Aqeeq et al., 2018). This slow progress can be attributed to the lack of general awareness on the economic attractiveness of residential solar amongst the stakeholders including households and financial institutions. Specifically, given the high upfront cost of solar PV generation systems – the lack of bank financing facilities is one of the primary reasons barring wide-spread diffusion of residential solar in Pakistan (Aqeeq et al., 2018).

This research aims to propose and design an Islamic financing product for household Solar PV system for Banks operating in Pakistan and assess the economic competitiveness of the product for both the stakeholders i.e., the financier (bank) and the household (borrower). The proposed financing product will help accelerate adaption of residential solar in the country. Specifically, this research aims to:

- *To present the location solar potential by computing the LCOE of 130 districts across 6 provinces in Pakistan.*
- *Review existing domestic and international financing mechanisms and instruments employed to finance solar PV system.*

[1] The annual market increased to at least 75 GW – equivalent to more than 31,000 solar panels installed every hour.

[2] The other top ten in the additions were Germany, Korea, Australia, the Philippines and Chile.

[3] Circular debt is the debt, where all members are both a creditor and a debtor. In the circular debt every individual owes to someone and the net final creditor in the string is indebted to the first creditor. In the end all the balance of all debts between the individuals is zero.

[4] Net-metering facility enables grid-integration of residential solar enabling households to sell surplus electricity to the grid.

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- *Design an Islamic financing product for residential solar PV systems (RSPVS) for banks in Pakistan and model its economic payoffs and competitiveness from both the borrower's and bank's perspective.*

Here it is important to note that our focus on Islamic banks is driven by two major reasons. First, banks are the most prominent and accessible form of financial institution in Pakistan that accounts for over 80% of financial assets in the country. Secondly, the over 96% of the population comprises of Muslims in the Islamic Republic of Pakistan. Finally, the Shariah injunctions of asset-backed financing in the design of Islamic financing products is specifically suited for financing RSPVS, where the financing can be structured as a typically asset-backed Ijarah-Diminishing Musharaka contracts (Tabet & Nouar, 2017). Furthermore, our research can potentially inform banks to advent into the sphere of green banking tapping on to new business opportunities, and new markets enabling to diversify their risk exposures and revenue stream.

1.1 Research approach, methodology and structure

This research has been conducted in three phases (Figure 1) and in each phase, a different task has been accomplished which formed the base for the next task facilitating to realize the objective of the project.

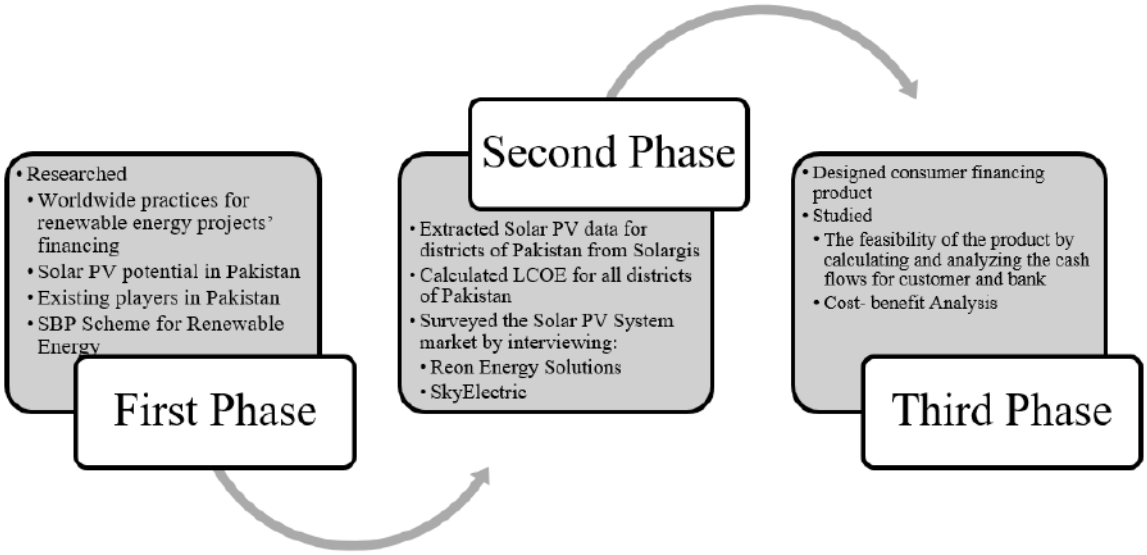

Figure 1: Research Approach

The rest of the paper has been organized in three sections. **Section 2** summarizes the major programs, products and business models practiced to finance RSPVS across countries in the world. **Section 3** provides the detailed design of consumer financing product for Household Solar PV System focusing on product structure, marketing strategies and feasibility studies.

2- Literature Review

2.1 Financing residential solar – Programs, products and business models

The challenge for any household thinking to set up a Solar PV System on their rooftops is the initial upfront costs. The Solar PV System requires low maintenance costs, and the life of the system is more than twenty years generally. The main hurdle comes before the installation, which is the upfront cost. International Financial Institutions like World Bank and Asian Development Bank (ADB) has done a lot of work related to policies and financial instruments for solar energy.

The director of sustainable Development Department, World Bank, has stated, *"The wide range of financial instruments designed to support and catalyze clean energy investment over the last decade is truly remarkable, various consumer financing instruments has been designed to lower the upfront costs of clean energy equipment"* (Wang, Stern, Limaye, Mostert, & Zhang, 2013). In the following section, we

summarize some of the major countries and financing mechanisms for residential solar from across the world.

2.1.1 Germany

In Germany, net electricity consumption from renewable energy is 39% which contains 7.2% from Solar PV only (Wirth, 2015). Large projects comprise the main portion of consumption of Solar PV electricity, whereas household consumption comprises of 19%. Germany has introduced several financial instruments for Solar PV such as leasing, crowdfunding, equity, debt financing and energy cooperatives (Financing & Deliverable). Leasing[5] and Crowd funding are the most demanding financial mechanism for the financing of Solar PV System.

Leasing is the most popular financing instrument for single family and small sized businesses. In the leasing system, responsibilities and risk of operating the system are borne by the consumer or lessee to qualify the self- consumption and avoiding the Renewable Energy Act -EEG surcharge (Appunn, 2014). Alternatively, crowd funding or crowd investing is another financing methodology that allows many small contributions for one big project. Crowdfunding is becoming more popular in recent years. In Europe, crowdfunding fund has significantly increased by 507.2% from 487 million Euro in 2012 to 2,957 million Euro in 2014.

2.1.2 India

Since then Indian Government has set the aggressive targets for producing the 100GW only from Solar energy which comprises 40% from rooftop solar PV (Rooftop & Private, 2017). To meet the ambitious target of 40,000MW by 2022, Indian Government launched a low interest based (5%) financing scheme for roof top systems throughout the country by most of the commercial banks. Banks are eligible to avail refinance facilities to refinance the rooftop solar PV systems. Financing for rooftop solar PV by Ministry of new & renewable energy (MNRE) would be a combination of 30% capital subsidy and/or 5% interest bearing loans (Vashishtha). India is capitalizing in the renewable energy industry by offering two major business model namely: CAPEX[6] and OPEX[7] Model ("Grid Connected Solar Rooftop,")

2.1.3 China

China's national government has established various regulations, tariffs and subsidies to encourage provinces and state-owned enterprises to achieve top-down solar targets set by the national government[8] (Models & Mechanisms, 2016). In China, for

[5] There are three different models implemented for lease financing.

Model I: A solar installer leases the PV system to a building owner. There can be only one user of the PV system such as single-family to qualify for self-consumption to avoid the payment of the complete EEG surcharge.

Model II: In this model, contract is signed off for solar installer leases the PV system to a tenant. Rest of the conditions remains same, as there can be only one user of the PV system such as single-family to qualify for self-consumption and avoid the payment of the complete EEG surcharge.

Model III: A building owner leases the system to a tenant. There can be only one user of the PV system such as single-family to qualify for self-consumption and avoid the payment of the complete EEG surcharge. The difference is the building owner invests in a PV system there is no need for a rooftop contract.

[6] The most common model in which consumer himself purchases the system by upfront payment or through financing.

[7] In India, two OPEX models are used. In ***OPEX Gross Metering Model***, third party finances, installs, operates and maintains the rooftop solar power plant. Third party leases the rooftop and then pays a fixed amount to the building owner for a fixed tenure and exports the solar energy to the utility at a predetermined feed-in-tariff (FiT) approved by the regulator. In ***OPEX Net Metering Model***, third party finances, installs, operates and maintains the rooftop solar power plant. Third Party generates power to the building owner in favor of a lower solar power tariff and the building owner could sell excess power to the utility through net metering system.

[8] Further, some locations offer additional feed-in-tariffs (FiT) to individuals and companies to encourage distributed solar projects. The major financial incentives in existence today include subsidies, tax-related

Distributed Solar Photovoltaic (DSPV) deployment, different business models and financing mechanisms are used (refer table 1).

Business Models	
Host-Owned Model	It is the simplest business model in China. The solar host purchases the Solar PV System, have it installed on their rooftops, uses the power that the system generates and sell the excess power to the grid.
Solar Energy Management Service Model	The EMS model is similar to the third-party ownership model in the US. It comprises of the PPA model and the lease model.
Financing Mechanisms	
Conventional Bank Loan	In China, the current conventional bank loans are in the form of mortgage based on the borrowers' credit, real estate or negotiable security and normally short term (1-5 years) for DSPV.
Loan Financing Platforms	The CDB provides credit lines to finance eligible loan borrowers. It offers credit endorsements---an ideal financing form for medium- and small-sized companies and individuals who cannot get access to bank loans due to limited credibility or financing capability.
Solar PV Industry Investment Fund	This is the fund set aside for the construction of solar PV projects. It makes equity investment in large-scale PV stations and DSPV projects and provides value-added services along the whole PV supply chain.
Lease Financing	This mechanism is emerging for DSPV projects in China lately. In this model, the lessee selects the product, and the lessor purchases it and leases it to the lessee, who then pays lease rentals for using the PV system.

Table 1: Business Models and Financing Mechanisms used in China

2.1.4 United States of America

The third-party ownership model (TPO) has largely facilitated the growth in distributed solar PV deployment in the US[9]. Until recently, home equity loans, commercial loans, and other standardized loan products has been available to homeowners and business to finance solar installations. However, from the period between October 2013 and October 2014, at least nine new solar-specific loan programs have been launched in the US market[10] (Feldman, Lowder, Feldman, & Lowder, 2014).

Financial incentives and support policies available from the US government have been the reason for high levels of year-over-year growth achieved in the US solar PV market. Currently, homeowners have been offered 10% Investment Tax Credit (ITC) that could be used directly or indirectly[11]. Homeowners in the US may also be eligible for rebates, Production Based Incentives (PBIs), and Renewable Energy Certificates (RECs)[12] (Speer, 2012).

incentives, custom duties, and pricing incentives, and the government is moving toward more comprehensive quantity- and price-based support mechanisms.

[9] In 2013, TPO represented 66% of the US residential solar market.

[10] Prior to this, solar-specific loans – i.e. products for which the underwriting, loan terms, lender security interest etc. are all designed for financing solar installations exclusively – were not widely available in the US market.

[11] Historically, in the first year of operation, homeowners 30% ITC was offered. The ITC and MACRS can provide a tax benefit that amounts to more than half of the upfront installed cost of a solar system.

[12] Rebates reduce the upfront cost of the system, while PBIs provide a cash in-flow over a certain number of years (e.g., 5 to 10) that reduces the payback period of the system

Financing Mechanism available to homeowners in US	
Traditional self-financing[13]	Cash purchases Home equity loans (HEL) Home equity lines of credit (HELOC) Cash-out mortgage refinancing (COMR)
Third-party ownership options[14]	Power purchase agreements (PPA) Solar leases
Utility and public financing[15]	Governments and utilities provide a variety of financing options, grouped into three primary categories: Public loans Utility financing Property assessed clean energy financing (PACE)

Table 2: Financing Mechanism available to homeowners in US (Source: Residential Solar Photovoltaics: Comparison of Financing Benefits, Innovations and Options, NREL (2012)

2.1.5 Grameen Shakti Solar Home System (SHS) Revolution

The objective of the Grameen Shakti Project has been to contribute to sustainable development through the provision of renewable solar electricity to households not connected to the electricity grid and thereby reduce Greenhouse Gas (GHG) emissions by displacing kerosene and diesel use for lighting and off-grid electricity generation. This carbon-offset project consists of the purchase of ERs generated from installation of up to 1,000,000 solar homes systems by Grameen Shakti, the project proponent, to rural users in Bangladesh. The costs of the Solar Home Systems (SHS) can be paid on a cash basis or can be purchased through a variety of monthly instalment plans to maximize participation by increasing affordability.

2.1.6 Barriers to Residential Rooftop Solar PV System

Renewable energy has the potential to play an important role in providing energy with sustainability to the vast populations who yet have no access to clean energy. Although it is economically viable but due to following barriers to its penetration, renewable energy has not been able to realize its potential (Painuly, 2001).

Lack of awareness and Information	Inadequate information available on product, technology, costs, benefits & potential of the energy generated by solar projects, O&M costs, financing sources etc. discourage people from considering solar panels as source of projects energy. In addition, feedback on such projects is missing or inadequate. Due to lack of knowledge/access to RET resource assessment data, implementation requirements
High transaction costs	Implementation of solar projects require time and cost investment to gather and process information, procedures and delays, technology acquisition etc.
High discount rates	Households get financing at high discount rate because risk/uncertainty for these projects is perceived high.
High cost of capital	Lack of access to cheap capital, risk perception of financial

[13] Traditional self-financing options are widely available to homeowners offered by banks and credit unions. However, to access this option, homeowners must have good credit, enough equity to finance the system and a home preferably in an area with stable property values.

[14] Solar PPAs and leases benefit homeowners by collaborating with a third-party solar provider from commercial tax incentives available for solar (the ITC and MACRS). It can be a cost-competitive option with local retail electricity rates if the tax incentives are efficiently used. These two options are widely available in markets with favorable net-metering policies and local financial incentives.

[15] Utility loans can either be an on-bill loan or meter-attached (i.e., secured to the meter) and is low-cost financing option. Customers who are customers of utilities that participate in financing programs can only access these loans.

	institution (FIs), macro-economic parameters such as inflation rate, demand for credit etc. is another important factor restricting this source to generate energy to penetrate.
High up-front capital costs for investors	Solar PV System installation to generate electricity provides positive cash flow during its overall life but initially it requires high up front capital. Unavailability of capital limits its penetration.
Lack of financial institution, instruments.	Limited financing options are available for households because financial institution has failed to realize its potential.
Unstable macroeconomic environment	High inflation rate, high price fluctuations, balance environment of payment problems, unstable currency, uncertain exchange rates, uncertain economic growth is another important reason limiting this source of energy to realize its true potential.
High risk perception	Investment in solar projects is perceived to be very risky because this project requires high upfront cost/investment, and its benefits are uncertain.
Lack of infrastructure	Households facing problems related to availability of infrastructure such as roads, connectivity to grid, communications, and other logistics while considering solar systems as a source of energy.

Table 3: Barriers for Solar PV Rooftop Projects' penetration

3 Findings and Discussion

Based on our prior cross-country analysis, the existing peer banks products analysis, interviews with bankers and self- conceived market survey, we have designed a consumer financing product for Household Solar PV Systems whose economic payoffs have been modelled in the perspective of both the stakeholders i.e., borrower and the bank. The key defining framework for the product is the SBP Prudential Regulation for Consumer Financing. In our research, we have also identified market segment, marketing communication mechanism and other prospects of value addition that can potentially complement product penetration and acceptance.

3.1 Product Structure

With the increasing demand of Solar PV System, a consumer-financing product has been developed with the perspective of secured (backed by collateral) and unsecured portfolio. Table 4 shows the product structure in both the scenarios (Secured and Unsecured).

Product Structure for Solar PV Financing		
Type	Secured (Solar panels will be kept as collateral with the bank)	Unsecured
Nature	One-time financing 75% bank financing 25% Financed by customer himself	One-time financing 100% bank financing
Tenor	Up to 7 years	Up to 5 years
Pricing	1-year KIBOR + 6%	Fixed Mark-up rate till maturity
Minimum and maximum loan size	Minimum Finance Rs.300,000 Maximum Finance Rs.5,000,000[16]	Minimum Finance Rs.300,000 Maximum Finance Rs.2,000,000[17]
Financing Availability	Financing will be provided for 3kw to 10Kw system	Financing will be provided for 3kw to 10Kw system
Structure for Shariah compliance	The lending product shall be structured as combination of Ijarah and diminishing Musharaka, as followed in Car and home financing by Islamic banks.	
Processing Fees	5000 Rupees or 1% of loan amount whichever is higher.	

[16] As per Regulation (Consumer & SBP-Policy, 2016), both on secured as well as on unsecured basis, financing facilitates availed by one person from all banks/DFIs in aggregate should not exceed Rs.5,000,000/-.

[17] As per Regulation (Consumer & SBP-Policy, 2016), the aggregate clean limit of the borrower should not exceed Rs.2,000,000.

Re-payment Frequency	The interest and principal will be paid on equal monthly instalments. The payment will commence from the date on which the solar panels will be delivered to the client, no matter whether the Customer has started using it or not.
Re-payment Modes	Re-payment account Direct Debit authority Drop box Inter Bank Funds Transfer (IBFT)

Table 4: Product Structure for Solar PV System Financing Marketing Communication

Solar PV System Financing is new to market and therefore needs to be supported by aggressive campaigning to create broad-based awareness product. This is a mass-market product so to create awareness and impact among customers, this product should be advertise using all media vehicles. The bank should launch this product by cold calling, using the conventional medium, and mobile marketing & digital mediums

3.1.1 Target Market

Country's population living in the urban areas mainly constitutes the target market for any bank's asset products, 36.4% of the total population of Pakistan resides in urban areas[18]. It is important to note that the shift from rural to urban is on increasing trend. The segment targeted will be credit card/personal loan segment. This product has huge potential to be sold to socio-economic class A & B (Subohi, 2006) due to the nature of the product. It is a progressive product so it has potential for educational class and can be cross-sold to retail segment as well. Targeted consumer will be the one married households and who has the decision making power (Table).

Market Segmentation	
Target Market/Citizenship	Adult Pakistani Presently Resident of Approved Cities Self Employed/Salaried CNIC/Passport holder
Geographic Concentration	Karachi; Islamabad; Rawalpindi; Lahore; Quetta
Age	**Salaried** Min – 25 years Max – 65 years or verified retirement age whichever is earlier at loan maturity Max. age would be 62 if retirement age could not be verified **Self Employed** Min – 25 years Max – 65 years
Limit	Minimum Rs.80,000[19]
Security/Collateral	Secured
Currency	PKR
Job Status	Permanent & Contract (Excluding third party contract)
Credit History	Any written off amount which has been cleared for at least 18 months

Table 5: Market Segmentation for bank's Solar PV System Financing Product

3.1.1.1 Marketing Strategies

3.1.1.1.1 Cross Selling and sales acquisition[20]

For greater reach and penetration among target market, multiple channels should activate for sales. Channels like corporate sales and Tele sales should incorporate and

[18] As per the Pakistan's sixth Population and Housing Census-2017, total population was 207,774,520. Urban population was 75,584,989 (Pakistan Bureau of Statistics, Statistics Division, Ministry of Statistics, 2017).

[19] As per PR for consumer financing, R-3 Total financing facilities to be commensurate with the income (Consumer & SBP-Policy, 2016).

[20] Cross selling is a sales technique used to get a customer to spend more by purchasing a product that is related to what is being bought already. Cross selling in the ecommerce environment involves identifying related products and creating appropriate offers while in-person cross selling could require training in effective approaches. In both cases, though, the goal is to make more money for the company while creating a satisfied customer

all the sales staff should train through in–house training department and should be equipped with product knowledge to market the product well to target customers. Call center staff should be train so that they can also guide and answer to initial thrust of customers' queries during advertisement campaigns.

3.1.1.1.2 Using the Conventional Medium

TV provides the highest coverage for any brand. Television is still the most dominant advertising medium attributing to 37% of global ad spend. TV advertising creates, builds, and grows brands. TV advertising builds brand fame and keeps brands alive in your mind for much longer than a sponsored post or a search result.

3.1.1.1.3 Mobile Marketing & Digital Channels

It is nearly impossible for financial institutions to reach their customers without shifting to mobile marketing. Majority of financial institutions use mobile and digital channels to spread awareness and generate leads for their products. Cost per lead acquired through digital is cost effective and gives you full control on who you want to show your ads as 95% consumption of digital social platforms is now done on mobile[21]. Brands are now developing their content with mobile first approach, to reach the right audience on the device they spend the most time on[22].

Pakistan has a digital landscape of 35 million on just Facebook, out of which our target audience comprises of more than 15 million. Making use of such platform and running awareness and lead generation[23] [24] ads is an essential way to go about it. Targeting can be done in detailed and even custom database can be used to target consumers on digital.

3.1.2 Value addition through vendor integration

By placing the (potential) customer at the center of the business, value addition takes place. The products and/or services do not represent this benefit as such, but because they are used, a Customer Value Proposition creates. The Bank with collaboration with any listed vendor of AEDB can provide the following value propositions to their customers.

3.1.2.1 Smart Energy Storage Systems

Smart Energy systems require replacements after 8-10 years. They sometimes last long and are costly to replace. 75% of the Smart Energy system cost will be paid by the bank as per the agreement contract.

3.1.2.2 Real Time Tracking

The smartphone mobile app gives you visibility and control as Smart Energy Console. You can keep eye on your energy consumption and production no matter where you are if you have internet connectivity. Internet packages can be provided at discounted rates (For only those telecommunication companies who have partnership agreement with the bank).

3.1.2.3 Extended Warranty

Smart Energy System comes with a 4-year warranty on the entire system including batteries as opposed to other conventional solar systems that have a 1-year warranty on their inverters and 6-month warranty on batteries. Warranty will extend to further 2 years if financed from the bank.

3.1.2.4 Operation and Maintenance

Two (2) years free-of-cost O&M service from vendors and Client will be provided with the basic level maintenance manual. Service Level Agreement (SLA) will be signed

[21] Facebook study showed that 95% consumption of content in Pakistan is done on Mobile.

[22] A research has found that we are spending five hours a day on mobile devices, and the time we spend on mobile apps has skyrocketed 69 percent from 2016 (Perez, 2017).

[23] Lead Generation is methodology to attract and covert the new customers and non-stakeholders who has showed some interest in one's company or its products and services (Kolowich).

[24] Lead generation forms on your mobile content are short and easy to fill. People on the go do not have the time to stop and fill out complicated forms and making it easy for them to complete a form can boost the number of prospects who engage with your content.

after completion of 2 years, which will be 2.5% of total system cost per annum. Under the banks agreement, customer will have one-year extended FOC O&M service and after completion of 3 years, which will be 2% of total system cost per annum.

3.4 Technology and Commercial Analysis

3.1.2.5 Solar PV System Specification

For the proper utilization of funds, Bank will provide the funds to vendors[25] instead of its borrower for the purchase of solar panels systems ranging from 3kW to 10kW. In local market, solar panels are available in different qualities and technologies that then affect the price level (Table below). The most traded technology is Polycrystalline cell that provides an affordable price level and long-term sustainability.

(In PKR)	3kW	5kW	10kW
Panels	283,500	472,500	945000
Inverter	75,001	115,000	220,000

Table 6: Costing of Solar Panels with Different System Sizes

3.1.2.6 Generation of Solar Energy

Pakistan is gifted with opulent solar irradiation, and the southern and southwestern parts of the country record greater irradiation levels than the north. This consideration is integrated into the upfront tariffs for Solar PV power generation, which differ in the northern and southern parts of the country[26]. For the research purpose and to analyze the solar PV potential in Pakistan, solar maps[27], made with the collaboration of AEDB and World Bank, were used to extract the data related to Solar PV electricity generation units for the 159 districts of Pakistan. With the help of generation units, LCOE has been calculated to know which districts of Pakistan could avail the most benefit from the Solar PV electricity generation units (presented in Table at the end of paper) using the equation below. The LCOE calculated on the baseline assumptions of Debt: Equity of 70%, system size of 5kW, operating cost of 4% and maintenance cost of 1%.

LCOE= (Lifecycle cost (Rs.))/(Lifetime energy production (kWh))

The mean LCOE for 130 districts is approximately PKR 9/kWh and increases with increasing cost of debt and decreasing loan tenor.

3.1.2.7 Customer's and bank's profitability

For any product or service offering's success, profitability and sensitivity analysis are the core point of interest for both the customer and company. Regarding study the profitability of consumer-financing product, cash flows have been calculated in terms of secured and unsecured nature of portfolio. For cash flows' calculations, all the rates have been used considering industry standards. Our survey suggests that an average residential household needs 5kw solar system to meet their electricity needs. 5kW system costs around Rs.587500/- that include both panel and inverter cost. Therefore, keeping margin of few thousands, average ticket size amounts Rs.600,000 for unsecured scenario because in unsecured product, 100% cost of system will be financed by bank. In secured case, average ticket size amounts Rs.450,000, as the one quarter of the cost is contributed by the borrower as equity.

Solely depending on profitability, unsecured appears a better options for bank because using the same investment of Rs.600M generates almost double profitability in unsecured scenario than secured scenario and it also involves a smaller number of loans to handle (Table 6). Bank benefits when customers demand for its product and customers only demand when they get benefits from a particular product. As far as this

[25] As per PR for Consumer Financing, R-1 Facilities to related persons & utilization of clean loans for Initial Public Offerings (IPOs) (Consumer & SBP-Policy, 2016)

[26] The highest global horizontal irradiance is in southwest Pakistan, gradually decreasing towards the north and northeast of the country; it is at its lowest in the Himalayan and Karakorum Mountain ranges. Global horizontal irradiance is a good resource measure for solar PV installations. Baluchistan in the southwest is the site of the country's maximum annual global horizontal irradiance at just over 2 300 kWh per square meter (m2).

[27] http://globalsolaratlas.info/

Solar PV System financing is concerned, customers are better off under secured scenario owing to lower cost of borrowing. The investment made by customers in Solar PV System is more profitable under secured scenario as shown by NPV, IRR and Payback period (Table 5). Moreover, LCOE calculated considering this product as secured, is less than the KE cost for electricity (Table 5) therefore it generates savings for customers on monthly basis during the overall life of Solar PV system.

	Unsecured	Secured
EMI	Rs.16,571	Rs.8,433
Payback Period (years)	10.59	8.26
NPV	Rs.452,429	Rs.620,666
IRR	19.17%	28.49%
LCOE	22.28	12.43

Table 5: Customer's Profitability related to Solar PV System Financing

	Unsecured	Secured
Interest Rate	22%	1-year KIBOR rate + 6% 14% is used to calculate the cash flows
Funds Transfer Pricing[28]	6.5%	6.5%
Average ticket size	Rs.600,000 to fully finance 5kw Solar PV System	Rs.450,000 to 75% finance 5kw Solar PV System
Average Tenor	5 years	7 years
Total loan/volume in three years	Rs.600,000,000	Rs.600,000,000
Units in 3 years	1,000	1,324
ENR[29] **at the end of third year**	Rs.592,801,877	Rs.590,880,623
Profitability	Rs.116,541,522	Rs.53,816,530
Processing Fees	5000 rupees or 1% of loan whichever is higher	
Credit loss	0.75% first year; 1.75% second year; 2% third year	

Table 6: Banks Profitability related to Solar PV System Financing

4 Conclusion

Widespread diffusion of residential solar is strictly contingent on availability of financing facilities, and mass consumer mobilization. The interest of both the bank and the borrower is driven by the economic reward that the RSPVS can potentially offer. In this research, we demystified the economics of RSPVS, and presented the economic competitiveness of RSPVS both for the financier and the household. Our research emphasize that banks should advent in the residential solar market segment by providing the customers a consumer-financing product for the financing of Solar PV System. Our findings emphasize that both the stakeholders i.e., Customer and the Bank are at an advantage after adapting themselves to this consumer-financing product in different perspectives. Cash flows in absolute terms are setting a favorable position for banks when the product offering is kept unsecured in nature but at the same time, customers are better off in secured nature of product offering. However, when Risk Adjusted Return on Capital[30] is considered, the product offering in secured terms is rationalized to be beneficial for both the stakeholders and bank. The proposed RSPVS financing product can arguably help the bank to increase its portfolio by creating new

[28] Funds transfer pricing (FTP) - A method used to individually measure how much each source of funding is contributing to overall profitability for a firm. The FTP process is mostly used in the banking industry as a means of outlining the areas of strength and weakness within the funding of the institution ("Funds Transfer Pricing,").

[29] Ending net receivables.

[30] Risk-adjusted return on capital defined as modified return on investment (ROI) that takes elements of risk into account. RAROC is also referred to as a profitability-measurement framework, based on risk that allows analysts to examine a company's financial performance and establish a steady view of profitability across business sectors and industries. The general underlying assumption of RAROC is investments or projects with higher levels of risk offer substantially higher returns. Companies that need to compare two or more different projects or investments must keep this in mind.

business opportunities and improving the risk profile of current portfolio. Customers on the other hand will benefit from the cost reduction by shifting their electricity unit's usage from conventional power to Solar PV System and can earn money by exporting the excess generated units from Solar PV System to on-grid through the net metering process. Finally, the product is based on the contract combination Ijarah and diminishing Musharaka and is well aligned with the Shariah injunctions of asset-based financing – which can make it appealing to the general religiously convicted masses in the country.

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Appendix

LCOE of Districts of Pakistan												
Assumptions: Debt 70% Equity 30% - system rate 120/watt - size 5kW - OC 4% - Maintenance 1%												
District	**3 Years**				**5 Years**				**7 Years**			
	6%	**11.53 %**	**15%**	**24%**	**6%**	**11.53%**	**15%**	**24%**	**6%**	**11.53 %**	**15%**	**24%**
PUNJAB												
Jhang	9.37	12.95	15.42	22	9.6	13.52	16.23	23.5	9.81	14.01	16.92	24.67
Chiniot	9.54	13.18	15.7	22.4	9.77	13.76	16.52	23.91	9.99	14.26	17.22	25.1
Faisalabad	9.74	13.46	16.02	22.85	9.98	14.05	16.86	24.41	10.2	14.56	17.58	25.63
Toba tek Singh	9.26	12.8	15.23	21.73	9.49	13.36	16.04	23.22	9.7	13.85	16.73	24.37
Dera Ghazi Khan	8.9	12.3	14.64	20.89	9.12	12.84	15.42	22.32	9.32	13.31	16.07	23.43
Rajanpur	8.65	11.96	14.23	20.3	8.86	12.48	14.98	21.68	9.06	12.93	15.61	22.76
Layyah	9.24	12.77	15.2	21.68	9.47	13.33	16	23.17	9.68	13.82	16.68	24.32
Muzaffargarh	8.97	12.4	14.76	21.06	9.19	12.95	15.54	22.5	9.4	13.42	16.2	23.62
Lahore	9.89	13.68	16.28	23.2	10.14	14.27	17.14	24.81	10.36	14.79	17.86	26.05
Hafizabad	9.63	13.32	15.85	22.61	9.87	13.9	16.69	24.16	10.09	14.41	17.39	25.36
Narowal	9.83	13.6	16.17	23.1	10.07	14.18	17.03	24.65	10.3	14.7	17.75	25.88
Sialkot	9.88	13.67	16.26	23.2	10.13	14.26	17.12	24.79	10.35	14.78	17.85	26.02
Vehari	8.93	12.35	14.7	20.96	9.15	12.89	15.47	22.4	9.36	13.36	16.13	23.52
Bahawalpur	8.82	12.2	14.52	20.71	9.04	12.73	15.28	22.13	9.24	13.2	15.93	23.23
Pak Pattan	9.26	12.8	15.23	21.73	9.49	13.36	16.04	23.22	9.7	13.85	16.72	24.37
Attock	9.24	12.78	15.21	21.69	9.47	13.34	16.01	23.18	9.68	13.82	16.69	24.33
Mianwali	9.14	12.64	15.04	21.45	9.37	13.19	15.84	22.92	9.58	13.67	16.51	24.07
Bhakkar	9.36	12.93	15.4	21.96	9.59	13.5	16.2	23.4	9.8	13.99	16.89	24.63

LCOE of Districts of Pakistan												
Assumptions: Debt 70% Equity 30% - system rate 120/watt - size 5kW - OC 4% - Maintenance 1%												
District	**3 Years**				**5 Years**				**7 Years**			
	6%	**11.53 %**	**15%**	**24%**	**6%**	**11.5 3%**	**15%**	**24%**	**6%**	**11.53 %**	**15%**	**24%**
							1	6				
Khushab	9.4	13	15.46	22.1	9.63	13.56	16.27	23.56	9.84	14.05	16.96	24.73
Sargodha	9.6	13.27	15.8	22.53	9.83	13.85	16.63	24.07	10.05	14.35	17.33	25.27
Chakwal	9.19	12.7	15.12	21.57	9.42	13.26	15.92	23.04	9.63	13.74	16.59	24.19
Jhelum	8.97	12.4	14.76	21.05	9.19	12.94	15.53	22.49	9.39	13.41	16.19	23.61
Sahiwal	9.36	12.94	15.4	21.97	9.59	13.51	16.21	23.47	9.81	14	16.9	24.64
Okara	9.44	13.05	15.53	22.15	9.67	13.62	16.35	23.67	9.89	14.12	17.04	24.85
Khanewal	8.99	12.43	14.8	21.11	9.22	12.98	15.58	22.55	9.42	13.45	16.24	23.68
Multan	9.12	12.61	15.01	21.41	9.35	13.16	15.8	22.88	9.56	13.64	16.47	24.02
Sheikhupura	9.67	13.37	15.92	22.7	9.91	13.96	16.76	24.26	10.13	14.47	17.46	25.46
Nankana Shaib	9.59	13.25	15.77	22.5	9.82	13.83	16.61	24.04	10.04	14.34	17.31	25.24
Kasur	9.59	13.26	15.78	22.51	9.83	13.84	16.61	24.05	10.05	14.35	17.32	25.25
Gujranwala	9.86	13.64	16.23	23.15	10.1	14.23	17.08	24.73	10.33	14.75	17.81	25.96
Mandi Bahauddin	9.57	13.23	15.75	22.46	9.8	13.81	16.58	24	10.02	14.31	17.28	25.19
Gujrat	9.68	13.38	15.92	22.71	9.91	13.96	16.76	24.26	10.14	14.47	17.47	25.47
Bahawalnagar	9.1	12.58	14.97	21.35	9.32	13.13	15.76	22.82	9.56	13.64	16.47	24.01
Rahim Yar Khan	8.54	11.81	14.05	20.05	8.75	12.32	14.8	21.42	8.95	12.77	15.42	22.48
Lodhran	8.82	12.19	14.51	20.69	9.03	12.72	15.27	22.11	9.24	13.19	15.92	23.21
Rawalpindi	9.26	12.81	15.24	21.74	9.49	13.37	16.05	23.23	9.71	13.86	16.73	24.39
KPK												
Peshawar	9.58	13.24	15.76	22.48	9.81	13.82	16.59	24.02	10.03	14.33	17.29	25.21
Mardan	9.38	12.98	15.44	22.03	9.62	13.54	16.26	23.54	9.83	14.04	16.95	24.71
Swabi	9.29	12.85	15.29	21.8	9.52	13.41	16.1	23.31	9.74	13.9	16.78	24.47
Charsadda	9.41	13.01	15.48	22.08	9.64	13.57	16.3	23.59	9.85	14.07	16.98	24.77
Nowshera	9.42	13.02	15.5	22.11	9.65	13.59	16.32	23.63	9.87	14.09	17.01	24.81
Lakki Marwat	9.43	13.03	15.51	22.12	9.66	13.61	16.33	23.64	9.88	14.1	17.02	24.81
Dera Ismail Khan	9.4	13	15.47	22.06	9.63	13.56	16.28	23.57	9.85	14.06	16.97	24.75
Hangu	8.92	12.34	14.68	20.94	9.14	12.87	15.46	22.37	9.35	13.34	16.11	23.49
Abbottabad	8.95	12.38	14.73	21.01	9.17	12.92	15.51	22.45	9.38	13.39	16.16	23.57
Haripur	9.08	12.55	14.94	21.31	9.3	13.1	15.73	22.77	9.51	13.58	16.39	23.9
Mansehra	8.68	12	14.29	20.38	8.9	12.53	15.04	21.77	9.1	12.99	15.68	22.86
Batagram	8.8	12.17	14.49	20.66	9.02	12.7	15.25	22.08	9.22	13.17	15.9	23.18

LCOE of Districts of Pakistan												
Assumptions: Debt 70% Equity 30% - system rate 120/watt - size 5kW - OC 4% - Maintenance 1%												
District	**3 Years**				**5 Years**				**7 Years**			
	6%	**11.53 %**	**15%**	**24%**	**6%**	**11.53%**	**15%**	**24%**	**6%**	**11.53 %**	**15%**	**24%**
Torghar	9.4	12.99	15.46	22.06	9.63	13.56	16.28	23.57	9.84	14.06	16.97	24.74
Bannu	9.23	12.75	15.18	21.65	9.45	13.31	15.98	23.14	9.66	13.8	16.66	24.29
Kohat	9.04	12.51	14.88	21.23	9.27	13.05	15.67	22.68	9.48	13.53	16.33	23.81
Karak	9.11	12.59	14.99	21.38	9.33	13.14	15.78	22.84	9.54	13.62	16.45	23.98
Tank	9.13	12.62	15.02	21.43	9.35	13.17	15.81	22.89	9.56	13.65	16.48	24.03
Malakand	9.19	12.71	15.13	21.58	9.42	13.27	15.93	23.06	9.63	13.75	16.6	24.21
Upper Dir	8.9	12.31	14.65	20.9	9.12	12.85	15.42	22.33	9.33	13.32	16.08	23.44
Lower Dir	8.89	12.29	14.62	20.86	9.11	12.83	15.4	22.29	9.31	13.29	16.05	23.4
Chitral	8.35	11.54	13.73	19.59	8.55	12.04	14.46	20.93	8.74	12.48	15.07	21.97
Swat	9.1	12.59	14.98	21.37	9.33	13.14	15.77	22.83	9.54	13.62	16.44	23.97
Kohistan	9.41	13.01	15.48	22.09	9.64	13.58	16.3	23.06	9.86	14.08	16.99	24.78
Bunner/ Daggar	9.09	12.5	14.96	21.34	9.32	13.12	15.75	22.81	9.53	13.6	16.42	23.94
Shangla	8.66	11.98	14.25	20.33	8.88	12.5	15.01	21.72	9.07	12.96	15.64	22.81
FATA												
Orakzai Agency	9.13	12.63	15.03	21.44	9.36	13.18	15.82	22.91	9.57	13.66	16.49	24.05
Mohmand Agency	9.3	12.86	15.3	21.83	9.53	13.42	16.11	23.32	9.74	13.91	16.79	24.48
Khyber Agency	8.77	12.13	14.43	20.59	8.99	12.66	15.2	22	9.19	13.12	15.84	23.1
Kurram Agency	7.91	10.93	13.01	18.56	8.1	11.41	13.7	19.83	8.28	11.83	14.28	20.82
Bajaur Agency	9.23	12.77	15.19	21.67	9.46	13.32	16	23.16	9.67	13.81	16.67	24.31
South Waziristan Agency	7.82	10.81	12.87	18.35	8.01	11.28	13.54	19.61	8.19	11.69	14.12	20.59
North Waziristan Agency	8.48	11.72	13.95	19.89	8.69	12.23	14.68	21.26	8.88	12.68	15.31	22.32
AJ&K												
Muzaffarabad	9.03	12.49	14.86	21.2	9.25	13.03	15.65	22.65	9.46	13.51	16.31	23.78
Bagh	9.44	13.06	15.54	22.16	9.68	13.63	16.36	23.68	9.89	14.12	17.05	24.86
Bhimber	9.59	13.26	15.78	22.5	9.83	13.84	16.61	24.05	10.05	14.34	17.31	25.24
Kotli	9.14	12.63	15.03	21.44	9.36	13.18	15.82	22.91	9.57	13.66	16.49	24
Neelum	9.71	13.43	15.98	22.8	9.95	14.02	16.83	24.36	10.18	14.53	17.54	25.57
Hattian Bala	9.46	13.07	15.5	22.2	9.69	13.65	16.38	23.72	9.91	14.15	17.08	24.9
Haveli	8.88	12.28	14.62	20.85	9.1	12.82	15.39	22.28	9.31	13.29	16.04	23.39
Poonch	8.82	12.19	14.5	20.69	9.03	12.72	15.27	22.11	9.23	13.18	15.92	23.21
Mirpur	9.46	13.08	15.57	22.21	9.69	13.65	16.39	23.73	9.91	14.15	17.08	24.91
Balochistan												

LCOE of Districts of Pakistan												
Assumptions: Debt 70% Equity 30% - system rate 120/watt - size 5kW - OC 4% - Maintenance 1%												
District	**3 Years**				**5 Years**				**7 Years**			
	6%	**11.53 %**	**15%**	**24%**	**6%**	**11.53%**	**15%**	**24%**	**6%**	**11.53 %**	**15%**	**24%**
Awaran	7.62	10.63	12.69	18.15	7.8	11.09	13.35	19.39	7.98	11.5	13.92	20.35
Quetta	7.17	10	11.93	17.07	7.34	10.43	12.56	18.24	7.51	10.81	13.09	19.15
Dera Bugti	8.1	11.26	13.44	19.23	8.27	11.75	14.15	20.54	8.45	12.18	14.75	21.56
Kohlu	7.65	10.67	12.73	18.21	7.83	11.13	13.4	19.45	8	11.53	13.96	20.42
Musa Khel	8	11.03	13.17	18.84	8.1	11.51	13.86	20.12	8.28	11.93	14.45	21.12
Washuk	7.36	10.26	12.25	17.52	7.54	10.71	12.89	18.72	7.7	11.1	13.44	19.65
Kharan	7.47	10.42	12.44	17.79	7.65	10.88	13.1	19.01	7.82	11.27	13.65	19.96
Pishin	7.1	9.89	11.8	16.88	7.26	10.32	12.42	18.04	7.42	10.69	12.95	18.93
Turbat	7.83	10.92	13.03	18.64	8.02	11.4	13.72	19.92	8.19	11.8	14.29	20.88
Loralai	7.31	10.19	12.17	17.4	7.48	10.64	12.8	18.59	7.65	11.04	13.37	19.55
Qila Saifullah	7.3	10.19	12.16	17.4	7.48	10.63	12.8	18.58	7.65	11.03	13.37	19.54
Kachhi(Bolan)	8.73	12.19	14.54	20.81	8.95	12.72	15.31	22.23	9.12	13.12	15.88	23.19
Sibi	8.03	11.2	13.37	19.12	8.22	11.69	14.07	20.43	8.39	12.09	14.64	21.39
Harnai	7.6	10.61	12.65	18.11	7.79	11.07	13.32	19.34	7.96	11.47	13.89	20.3
Barkhan	7.66	10.68	12.75	18.24	7.84	11.15	13.42	19.49	8.01	11.55	13.99	20.45
Qila Abdullah	7.13	9.94	11.86	16.97	7.3	10.37	12.49	18.13	7.47	10.77	13.06	19.09
Zhob	7.56	10.55	12.6	18.02	7.75	11.02	13.26	19.26	7.92	11.42	13.83	20.22
Ziarat	7.31	10.2	12.17	17.41	7.49	10.64	12.81	18.61	7.66	11.04	13.38	19.57
Khuszdar	7.3	10.18	12.15	17.38	7.48	10.63	12.79	18.57	7.65	11.03	13.36	19.53
Sindh												
Karachi West	8.45	11.8	14.08	20.14	8.66	12.31	14.82	21.52	8.86	12.77	15.45	22.6
Karachi South	8.45	11.8	14.08	20.14	8.66	12.31	14.82	21.52	8.86	12.77	15.45	22.6
Karachi East	8.4	11.72	13.99	20.01	8.6	12.23	14.72	21.38	8.8	12.68	15.35	22.44
Korangi	8.28	11.55	13.79	19.73	8.48	12.06	14.52	21.08	8.67	12.5	15.13	22.13
Karachi Central	8.5	11.86	14.15	20.24	8.71	12.37	14.9	21.63	8.91	12.84	15.55	22.73
Malir	8.41	11.74	14.01	20.05	8.62	12.26	14.75	21.42	8.82	12.7	15.38	22.49
Hyderabad	8.1	11.3	13.49	19.29	8.3	11.79	14.2	20.61	8.5	12.24	14.83	21.67
Ghotki	8.25	11.51	13.73	19.65	8.45	12.01	14.46	20.99	8.65	12.46	15.09	22.05
Larkana	8.45	11.79	14.07	20.13	8.66	12.31	14.82	21.51	8.86	12.76	15.45	22.57
Jacobabad	8.07	11.27	13.34	19.24	8.6	12.22	14.71	21.36	8.8	12.67	15.34	22.42
Badin	8.25	11.51	13.74	19.66	8.45	12.02	14.47	21	8.65	12.47	15.1	22.06
Dadu	8.34	11.64	13.89	19.88	8.55	12.1	14.6	21.2	8.75	12.6	15.2	22.3

LCOE of Districts of Pakistan												
Assumptions: Debt 70% Equity 30% - system rate 120/watt - size 5kW - OC 4% - Maintenance 1%												
District	**3 Years**				**5 Years**				**7 Years**			
	6%	**11.53 %**	**15%**	**24%**	**6%**	**11.53 %**	**15%**	**24%**	**6%**	**11.53 %**	**15%**	**24%**
Kashmore	8.34	11.63	13.88	19.86	8.54	12.14	14.62	21.22	8.74	12.59	15.25	22.28
Thatta	8.24	11.5	13.72	19.63	8.44	12	14.45	20.98	8.64	12.45	15.08	22.04
Sujawal	8.28	11.55	13.79	19.72	8.48	12.06	14.51	21.07	8.68	12.51	15.14	22.13
Mirpurkhas	8.17	11.4	13.61	19.46	8.37	11.9	14.32	20.8	8.57	12.35	14.95	21.86
Umerkot	8.3	11.58	13.82	19.77	8.5	12.09	14.55	21.13	8.7	12.54	15.18	22.19
Sanghar	8.5	11.85	14.15	20.24	8.71	12.37	14.9	21.63	8.91	12.82	15.53	22.69
Tharparkar	8.3	11.58	13.83	19.78	8.51	12.09	14.56	21.13	8.71	12.54	15.19	22.19
Sukkur	8.37	11.67	13.93	19.93	8.57	12.18	14.67	21.3	8.77	12.63	15.3	22.36
Jamshoro	8.1	11.31	13.5	19.31	8.3	11.8	14.21	20.63	8.5	12.25	14.84	21.69
Shikarpur	8.36	11.67	13.92	19.92	8.57	12.18	14.66	21.28	8.77	12.63	15.29	22.34
Tando Allah Yar	8.11	11.32	13.51	19.32	8.31	11.81	14.22	20.65	8.51	12.26	14.85	21.71
Tando M.Khan	8.12	11.34	13.53	19.32	8.33	11.83	14.25	20.68	8.53	12.28	14.88	21.74
Shahdadkot	8.57	11.97	14.28	20.43	8.79	12.49	15.04	21.83	8.99	12.94	15.67	22.89
Khairpur	8.32	11.61	13.85	19.82	8.52	12.11	14.58	21.17	8.72	12.56	15.21	22.23
Naushero Feroz	8.33	11.63	13.88	19.85	8.54	12.13	14.61	21.22	8.74	12.58	15.24	22.28
Matiari	8.06	11.25	13.43	19.21	8.26	11.74	14.14	20.52	8.46	12.19	14.77	21.58
Shaheed Benazirabad	8.18	11.41	13.62	19.48	8.38	11.91	14.34	20.81	8.58	12.36	14.97	21.87
Gilgit Baltistan												
Gilgit	9.5	13.26	15.82	22.63	9.73	13.83	16.66	24.18	9.95	14.34	17.36	25.39
Baltistan	9.5	13.26	15.82	22.63	9.73	13.83	16.66	24.18	9.95	14.34	17.36	25.39
Ghanche	8.56	11.95	14.26	20.4	8.77	12.47	15.01	21.8	8.97	12.93	15.65	22.88
Nagar	8.44	11.77	14.05	20.1	8.65	12.29	14.8	21.48	8.84	12.74	15.42	22.55
Ghizer	11.15	15.56	18.57	26.56	11.43	16.24	19.55	28.38	11.68	16.83	20.38	29.8
Astore	10.16	14.18	16.93	24.21	10.41	14.8	17.82	25.87	10.65	15.34	18.57	27.16
Islamabad Capital Territory												
Islamabad	9.08	12.67	15.12	21.63	9.3	13.22	15.92	23.12	9.51	13.71	16.6	24.27

Table 7: LCOE of Districts of Pakistan

	Secured					
(In Rupees)	75% Bank Financing					
Year	5%	7%	9%	12%	13%	15%
0	(150,000)	(150,000)	(150,000)	(150,000)	(150,000)	(150,000)
1	56,349	55,295	54,281	52,827	52,359	51,449
2	53,156	51,187	49,326	46,719	45,896	44,313
3	50,151	47,391	44,830	41,323	40,236	38,173
4	47,323	43,883	40,750	36,556	35,279	32,888
5	44,662	40,642	37,047	32,344	30,938	28,340
6	42,159	37,646	33,687	28,623	27,136	24,425
7	39,803	34,878	30,638	25,335	23,806	21,055
8	106,080	91,217	78,657	63,300	58,955	51,235
9	100,733	85,001	71,951	56,353	52,020	44,422
10	95,665	79,215	65,824	50,173	45,905	38,518
11	90,861	73,831	60,224	44,675	40,513	33,403
12	86,308	68,820	55,106	39,784	35,759	28,970
13	81,991	64,156	50,429	35,432	31,565	25,128
14	77,900	59,815	46,155	31,560	27,867	21,798
15	74,021	55,775	42,247	28,114	24,605	18,912
16	70,344	52,014	38,675	25,048	21,727	16,409
17	66,859	48,512	35,410	22,319	19,189	14,240
18	63,554	45,253	32,425	19,890	16,949	12,359
19	60,421	42,218	29,695	17,727	14,973	10,728
20	57,451	39,392	27,199	15,802	13,229	9,314
21	54,635	36,761	24,917	14,089	11,690	8,087
22	51,965	34,311	22,829	12,563	10,331	7,023
23	49,434	32,030	20,920	11,204	9,132	6,100
24	47,034	29,905	19,174	9,994	8,074	5,299
25	44,758	27,926	17,577	8,916	7,139	4,604
NPV	**1,463,617**	**1,127,074**	**879,973**	**620,666**	**555,271**	**447,192**
IRR	**37.06%**	**34.49%**	**32.03%**	**28.49%**	**27.35%**	**25.14%**

Table 7: NPV and IRR calculation for Consumer-financing Product in secured term

	Unsecured					
(In Rupees)	100% Bank Financing					
Year	5%	7%	9%	12%	13%	15%
0	-	-	-	-	-	-
1	(42,375)	(41,583)	(40,820)	(39,727)	(39,375)	(38,691)
2	(41,085)	(39,563)	(38,125)	(36,110)	(35,473)	(34,250)
3	(39,818)	(37,626)	(35,593)	(32,809)	(31,945)	(30,307)
4	(38,575)	(35,770)	(33,216)	(29,798)	(28,757)	(26,808)
5	(37,357)	(33,993)	(30,987)	(27,053)	(25,877)	(23,704)
6	112,225	100,213	89,674	76,194	72,236	65,019
7	106,326	93,170	81,842	67,676	63,594	56,244
8	100,736	86,622	74,694	60,111	55,985	48,654
9	95,440	80,534	68,170	53,391	49,286	42,088

10	90,422	74,874	62,216	47,423	43,389	36,407
11	85,668	69,612	56,782	42,122	38,198	31,494
12	81,164	64,719	51,823	37,413	33,628	27,243
13	76,897	60,170	47,296	33,230	29,604	23,567
14	72,854	55,941	43,165	29,515	26,062	20,386
15	69,023	52,009	39,395	26,216	22,943	17,635
16	65,394	48,353	35,954	23,285	20,198	15,255
17	61,955	44,955	32,813	20,682	17,781	13,196
18	58,698	41,795	29,947	18,370	15,654	11,415
19	55,611	38,857	27,331	16,316	13,781	9,874
20	52,687	36,125	24,944	14,492	12,132	8,541
21	49,916	33,586	22,765	12,872	10,680	7,389
22	47,291	31,225	20,776	11,433	9,402	6,391
23	44,805	29,030	18,961	10,155	8,277	5,529
24	42,448	26,989	17,305	9,019	7,287	4,783
25	40,216	25,092	15,793	8,011	6,415	4,137
NPV	1,210,569	905,335	682,905	452,429	395,103	301,485
IRR	27.11%	24.74%	22.45%	19.17%	18.11%	16.06%

Table 8: NPV and IRR calculation for Consumer-financing Product in unsecured term