Value Chain Analysis of the Solar PV Market in Pakistan

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Pakistan-German Renewable Energy Forum

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Acronyms

GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
REEE	Renewable energy and energy efficiency
BSW-Solar	Bundesverband Solarwirtschaft e.V. (German Solar Association)
MoWP	Ministry of Water and Power
AEDB	Alternative Energy Development Board
FBR	Federal Board of Revenue
PSQCA	Pakistan Standards and Quality Control Authority
NEPRA	National Electric Power Regulatory Authority
NTDC	National Transmission and Despatch Company Limited
DISCO	Distribution company
MFI	Microfinance institutions
CPPA	Central Power Purchasing Agency (Guarantee) Limited
PCRET	Pakistan Council for Renewable Energy Technologies
PSA	Pakistan Solar Association
REAP	Renewable Energy Association of Pakistan
ADB	Asian Development Bank
JICA	Japan International Cooperation Agency
UNDP	United Nations Development Programme
USAID	United States Agency for International Development
KfW	Kreditanstalt für Wiederaufbau
EU	European Commission
UET	University of Engineering and Technology
NUST	National University of Science and Technology
RE	Renewable energy
PV	Photovoltaic
PKR	Pakistani rupee

i. Executive Summary

Pakistan is a federal parliamentary republic and the sixth most populous country in the world, with a present population of over 190 million.[1] Recent economic developments in the country have been positive, with a GDP growth of 4.2 percent in FY 2015 compared to 4 percent in FY 2014 and a growth of 4.5 percent forecasted for 2016.[2] The country has been facing a significant energy deficit in the past decade with power shortfalls of approx. 5 GW[3] and load shedding across the country varying between 5 to 12 hours a day in rural areas that bear the main brunt of the load shedding.

The Government of Pakistan (GoP) has taken a considerable number of incentives in its energy strategy to overcome the energy deficit through the promotion of both large-scale grid-connected PV projects as well as smaller-scale projects. The introduction of the net metering scheme in September 2015 has been an encouraging sign. Further steps are being taken to reduce bureaucratic procedures (i.e. 'red tape') n the processing of applications for issuance of net metering licenses. The GoP has also encouraged 'large-scale' grid-connected PV projects through the introduction of a feed-in tariff (FiT), increasing the interest of investors.

Currently the PV market is dominated by Chinese products: 95.6 percent (975.3 MW) of PV panels, 71.5 percent (1328.8 MW) of inverters and 85.1 percent (24,970 tons) of deep cycle batteries have been imported from China into Pakistan between October 2015 and September 2016. The dominance of Chinese products is attributed to price competitiveness with similar products from other countries, extensive customer outreach through dealership networks and the large variation in product quality/ pricing that caters to different economic classes of customers.

However, sub-standard/low-quality PV products proliferate in Pakistan and awareness concerning the benefits of quality PV is lacking.

According to the survey conducted with the selected stakeholders from the solar value chain for the development of this analysis[4], the level of customer awareness regarding quality PV is low: The value chain players perceive the share of 'certified' PV components related to the total PV components in the market to be only 20 percent for PV panels, 14 percent for inverters and 9 percent for batteries.

Amongst the different PV customer segments in the Pakistan market, the residential sector remains the most price-sensitive, although a niche market does exist for high-quality products, particularly batteries and inverters. The industrial sector claims to prefer European products, since they are bankable and more reliable. However, currently they are mostly purchasing Chinese products (PV panels and inverters) due to the higher costs of European products and the limited offer of after-sales services in comparison to Chinese products.

Grid-tied systems, particularly 'inverters', are expected to remain the prime market segment for German PV companies targeting the Pakistani market for use in medium-scale (100 kW-1 MW) and large-scale (>1 MW) grid-connected projects which are usually set up by the industrial and commercial sectors. However, price competitiveness with comparable products from other countries will be critical. Batteries as backup systems (AGM) for the residential sector,

1 data.un.org
2 data.worldbank.org/country/Pakistan
3 NEPRA et al 2015 *"State of Industry Report"*
4 Please see the methodology in chapter 1

for off-grid systems and for the commercial sector also hold considerable potential, with price competitiveness being the main aspect to be focused on by European manufacturers. There is also potential for European PV testing and monitoring equipment such as battery testers, PV panel testers, etc.

In terms of provision of services, there is considerable potential for technical consulting services such as conducting techno-economic feasibility studies, maintenance and operation of medium and large-scale projects, monitoring of installed projects, etc. European EPC companies interested in developing commercial sector (kW scale) and large-scale (over 1 MW) grid-connected projects in the country, also have a large market potential, since there are not many EPC services available.

Payback expectations from the different customer segments vary between 3.5 to 5 years. The commercial sector expects the shortest payback period with 3.5 years, followed by the industrial sector with 4.5 years.

The GoP will soon implement 'import quality standards for PV equipment' and will curb the import of uncertified and sub-standard equipment into the country. Once these standards have been implemented, there will be greater standardization, both in terms of pricing and quality of products available in the market. This will encourage leading solar companies to increase their participation in Pakistan's emerging solar market.

In order to increase the 'access to finance' for PV, the GoP has also taken steps with the State Bank of Pakistan, announcing the 'Financing scheme for renewable energy' in June 2016, with loans being offered at 6 percent interest rate for PV projects up to 50 MW.[5]

Pakistan has a huge PV potential and all the necessary conditions for its implementation: high radiation yield, a regulatory framework and financing instruments that support its development. However, the level of awareness of quality of PV is very low and customers are still not aware of the benefits of high-quality products. The implementation and dissemination of quality standards for PV are expected to lead to a reduction of price sensitivity and increase the procurement of high-quality PV products.

5 **http://www.sbp.org.pk/smefd/circulars/2016/C3.htm**

1 Introduction

1.1 Background

The Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH's Renewable Energy & Energy Efficiency (RE-EE) project in Pakistan was initiated in 2005, with a focus on promoting renewable energy (RE) and industrial energy efficiency (EE). The main counterpart to the project on behalf of the Government of Pakistan is the Alternative Energy Development Board (AEDB), Ministry of Water and Power (MoWP).

On December 17, 2015, under the framework agreement of the Pakistan-Germany Renewable Energy Forum (PGREF), the German Solar Association (BSW-Solar) and the Pakistan Solar Association (PSA) signed a memorandum of understanding (MoU) declaring mutual support for awareness, quality assurance and business networking to promote high-quality solar photovoltaic (PV) products and services in Pakistan.

In order to create wide-ranging business opportunities for the private sector of both countries and to engage German solar companies that can offer top-quality components, this value chain analysis was agreed to be developed under the framework of the project 'Pakistan Solar Quality Potential: Measures to Increase the Market Demand for Quality', coordinated by BSW-Solar.

1.2 Objective

The objective of this report is to analyze the value chain of PV in Pakistan and to describe the existing and required supply structure and customer segmentation. This will allow the identification of the market potential for high-quality German manufacturers and the needs of local stakeholders and to develop policy recommendations to improve the quality demand of the Pakistani PV market.

1.3 Methodology of the Value Chain Analysis

The methodology of the study includes:

a) The analysis of available market data on the PV market in Pakistan. The main sources of information were the Alternative Energy Development Board (AEDB), the National Electric Power Regulatory Authority (NEPRA) and the customs authorities.

b) Carrying out a survey with selected actors in the PV value chain. This information was analyzed and backed up with previously published literature to develop a landscape of the existing PV value chain in the country. The gradual approach adopted for this activity is provided in the **Figure 1** below.

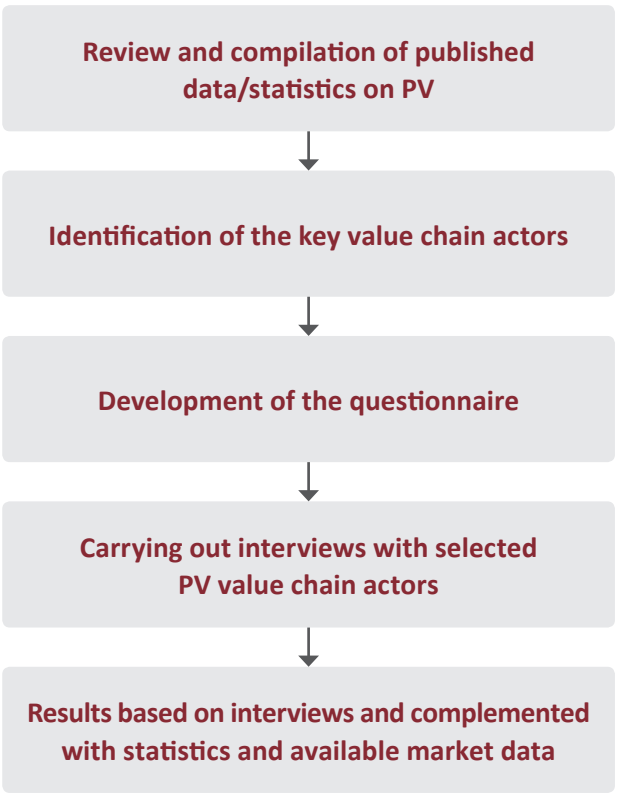


Figure 1: Methodology of the value chain analysis

The customized questionnaire is provided in **Annex B**. The interviews were conducted with different value chain actors (importers, installers, retailers, etc.) to identify Pakistan's perception of quality and their willingness to pay for quality PV products, including the assessment of customer awareness and interests based on the respective merchant's perceptions. The results were complemented with statistics and available market data, despite limited availability of the latter. The obtained results were identified and summarized for the identification of the potential for quality PV products.

1.3.1 PV Value Chain Actors

The PV value chain actors in the country are provided in **Figure 2** below. A total of twenty-six small, medium and large PV companies and businesses were interviewed in order to obtain their feedback regarding existing and future PV market dynamics. Their names and contact details are provided in **Annex C**.

It was ensured that the value chain actors interviewed included market leaders as well as medium-sized firms and start-ups, in order to get a holistic picture of the entire PV landscape.

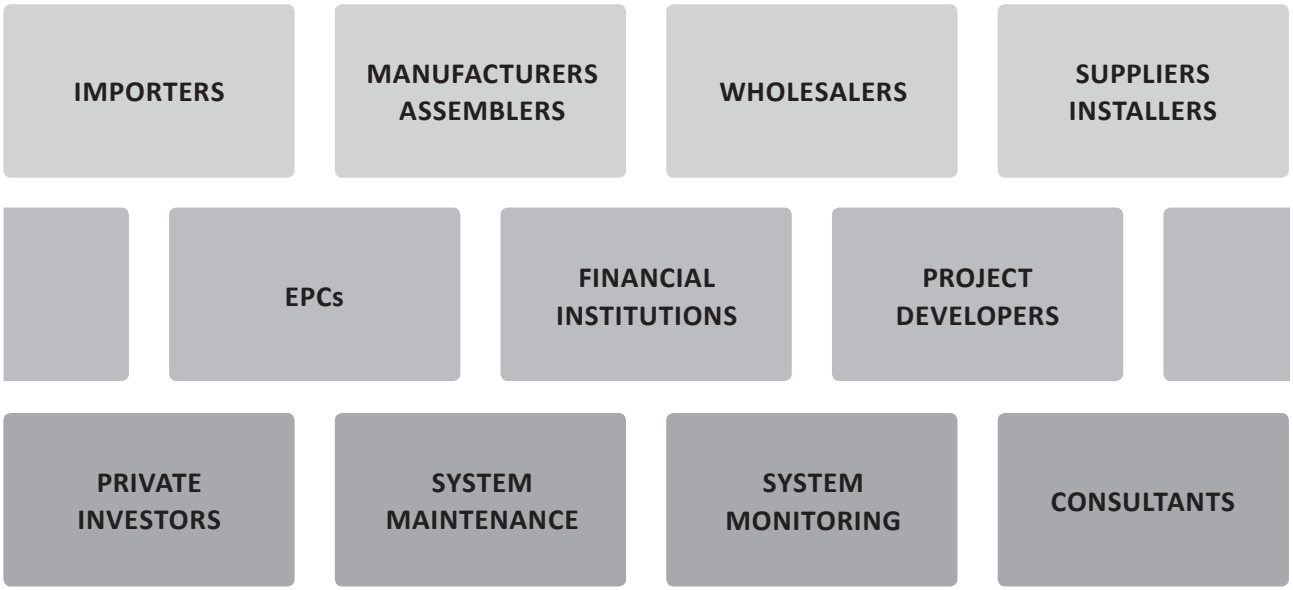


Figure 2: PV Value Chain Actors

1.3.2 Types of PV Companies/Businesses Consulted

96 percent of the PV businesses surveyed for this activity are directly importing PV equipment into the country and are increasing their profit margins in comparison to PV businesses that procure equipment locally.

Only 38 percent of the firms are acting as 'wholesalers' and selling equipment directly to other business entities in the market, while 4 percent of the firms are engaged in the monitoring of the PV systems. It needs to be mentioned that 'monitoring' of PV systems is currently in its infancy and holds considerable potential. Most of the firms are focused on obtaining business with little emphasis put on monitoring system performance, unless the client highlights an issue.

1.4 Introducing Pakistan

1.4.1 General Description

Pakistan is a federal parliamentary republic. It has four provinces (Khyber Pakhtunkhwa, Balochistan, Punjab and Sindh), one capital territory (Islamabad Capital Territory), two autonomous and disputed territories (Azad Jammu & Kashmir and Gilgit Baltistan) and the Federally Administered Tribal Areas (FATA). It is the sixth most populous country in the world, with a population of over 190 million.[6]

Recent economic developments in the country have been positive, with a GDP growth of 4.2 percent in FY15 compared to 4 percent in FY14, and growth of 4.5 percent forecasted for 2016.[7]

1.4.2 Energy Situation & Rationale for Development of Solar PV in Pakistan

The country has been facing a significant energy deficit for the past decade, with power shortfalls standing at 5 GW[8] and load shedding across the country varying between 5 to 12 hours a day, with rural areas bearing the brunt of load shedding. Solar PV could be a viable and cost-effective long-term solution to meet Pakistan's energy needs. The country has a large potential, being one of the sunbelt countries with solar irradiation of 6-7 kWh/m2/day in the areas identified for PV development, as shown in **Figure 3**.

The Punjab and Sindh provinces are considered the focal points for both kW and MW-scale PV development in the country, due to their high population density, as well as the high level of infrastructure and industry.

6 data.un.org
7 data.worldbank.org/country/Pakistan
8 NEPRA et al 2015 *"State of Industry Report"*

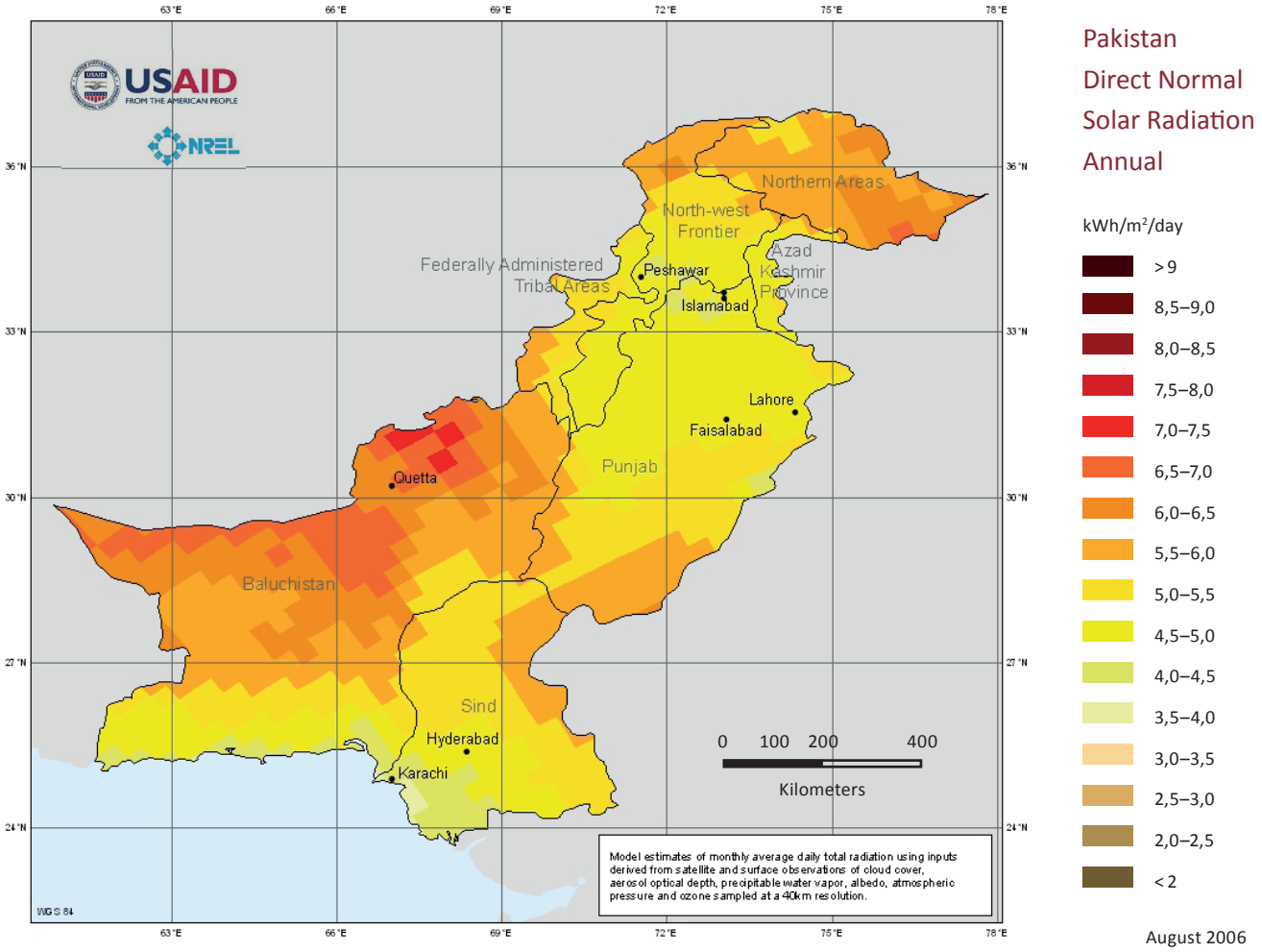


Figure 3: Map of Solar Irradiation Levels in Pakistan[9]

9 **US.Department of Energy (DOE)/NREL/ALLIANCE**

2 Key Stakeholders for Power Sector Development in Pakistan[10]

2.1 Government Institutions[11]

2.1.1 MoWP (Ministry of Water and Power)

The Federal Ministry of Water and Power is the GoP's executive arm for all issues relating to electricity generation, transmission and distribution, pricing, regulation, and consumption in the country, and it exercises this function through its various agencies as well as relevant autonomous bodies. It also serves to coordinate and plan the nation's power sector, formulate policy and specific incentives and liaise with provincial governments on all related issues.

2.1.2 AEDB (Alternative Energy Development Board)

The AEDB was established as an autonomous body with the aim of promoting and facilitating the exploitation of renewable energy projects in Pakistan. It has been designated as a 'one-window' facilitator at federal level for processing solar projects of all sizes. The AEDB can issue a letter of intent (LOI), which is the first contract that a solar developer enters into with the AEDB. The AEDB has also developed a standard power purchase agreement (known as the Energy Purchase Agreement (EPA) and a government support agreement (implementation agreement (IA).

2.1.3 NEPRA (National Electric Power Regulatory Authority)

Under the 1997 Regulation of Generation, Transmission and Distribution of Electric Power Act, NEPRA was appointed as the sole regulator in the power sector. NEPRA was established to ensure a transparent, competitive and commercially-oriented power market in Pakistan. NEPRA issues generation licenses, establishes and enforces standards, approves investment and power acquisition programs of the utility companies and determines investment tariffs for bulk generation and transmission and retail distribution of electric power.

2.1.4 CPPA (Central Power Purchasing Agency Guarantee Limited)

The CPPA is a non-profit independent company established under the 1984 Companies Ordinance and is solely responsible for implementing and administering the "Single Buyer Plus" market mechanism, i.e. awarding of exclusive rights by the government to the transmission and dispatch company, the single buyer, to purchase electricity from generators and sell it to distributors (ultimately leading to competitive market operations). Under this mechanism, since the risk is borne by a single entity, i.e. the buyer, the generators are expected to accept lower tariffs since they assume a lower risk.

2.1.5 NTDC (National Transmission and Despatch Company Limited)

The National Transmission & Despatch Company Limited (NTDC) commenced commercial operations on 24 December, 1998. It was organized to take over all the properties, rights and assets, obligations and liabilities of 220 KV and 500 KV grid stations and transmission lines/network owned by Pakistan Water and Power Development Authority (WAPDA). NTDC operates and maintains 12 500-KV and 29 220-KV Grid Stations, 5077 km of 500-KV transmission line and 7359 km of 220-KV transmission line in Pakistan.[12]

2.1.6 DISCOs (Distribution Companies)

There are a total of 11 DISCOs in the country, tasked with ensuring a smooth and uninterrupted delivery of power to residential, commercial and industrial customers.

10 **The contact information of the stakeholder is provided in Annex A.**
11 **The contact information of the stakeholder is provided in Annex A.**
12 **http://www.ntdc.com.pk**

They are the following: IESCO (Islamabad Electric Supply Company), QESCO (Quetta Electric Supply Company), PESCO (Peshawar Electric Supply Company), HESCO (Hyderabad Electric Supply Company), GEPCO (Gujranwala Electric Power Company), K-Electric, LESCO (Lahore Electric Supply Company), MEPCO (Multan Electric Power Company), TESCO (Tribal Electric Supply Company), FESCO (Faisalabad Electric Supply Company) and SEPCO (Sukkur Electric Power Company).

2.1.7 PCRET (Pakistan Council of Renewable Energy Technologies)

PCRET was, according to its mandate, developed for coordinating R&D and promotional activities in different renewable energy technologies. However, it is a largely inactive organization, with no noteworthy role relating to solar technology promotion in the country.

2.1.8 FBR (Federal Board of Revenue)

The FBR has the responsibility for formulating and administering fiscal policies, levying and collecting federal taxes and conducting quasi-judicial hearings of appeals. In the context of the solar sector of the country, FBR's role is key in ensuring that all imported solar equipment into the country complies with the recently approved quality import standards for Solar PV equipment.

2.1.9 PNAC (Pakistan National Accreditation Council)

The Pakistan National Accreditation Council (PNAC) was established under the administrative control of the Government of Pakistan's Ministry of Science and Technology as the national apex agency to accredit conformity assessment bodies such as laboratories and certification bodies. PNAC was established in 1998 after Pakistan joined the WTO in 1995. The accreditation services of PNAC were launched during the year 2001.

PNAC achieved a milestone in the form of a mutual recognition arrangement (MRA) with the International Laboratory Accreditation Cooperation (ILAC) and the Asia Pacific Laboratory Accreditation Cooperation (APLAC) in 2009, and MLA status in 2013. Now Pakistan is included in the list of countries having equivalent status for accreditation of testing and calibration laboratories and certification bodies for QMS & EMS all over the world.

2.1.10 PSQCA (Pakistan Standards and Quality Control Authority)

The PSQCA is the national standardization body. Its main function is to foster and promote standards and conformity assessment as a means of advancing the national economy, promoting industrial efficiency and development, ensuring the health and safety of the public, protecting consumers, facilitating domestic and international trade and furthering international cooperation in relation to standards and conformity assessment.

2.1.11 Provincial Energy Departments

The energy departments based in each province of the country act as the focal points for all energy-related matters for the respective province. Their key functions consist of attracting private-sector investment, providing an enabling environment and promoting energy efficiency and conservation.

The most active provincial energy department is the Punjab Energy Department (PED), with a key focus on exploiting the province's energy resources and exploiting power projects in the private and public sectors. PED has also played a key role in ensuring

that the concept of the Quaid-e-Azam solar park was realized.

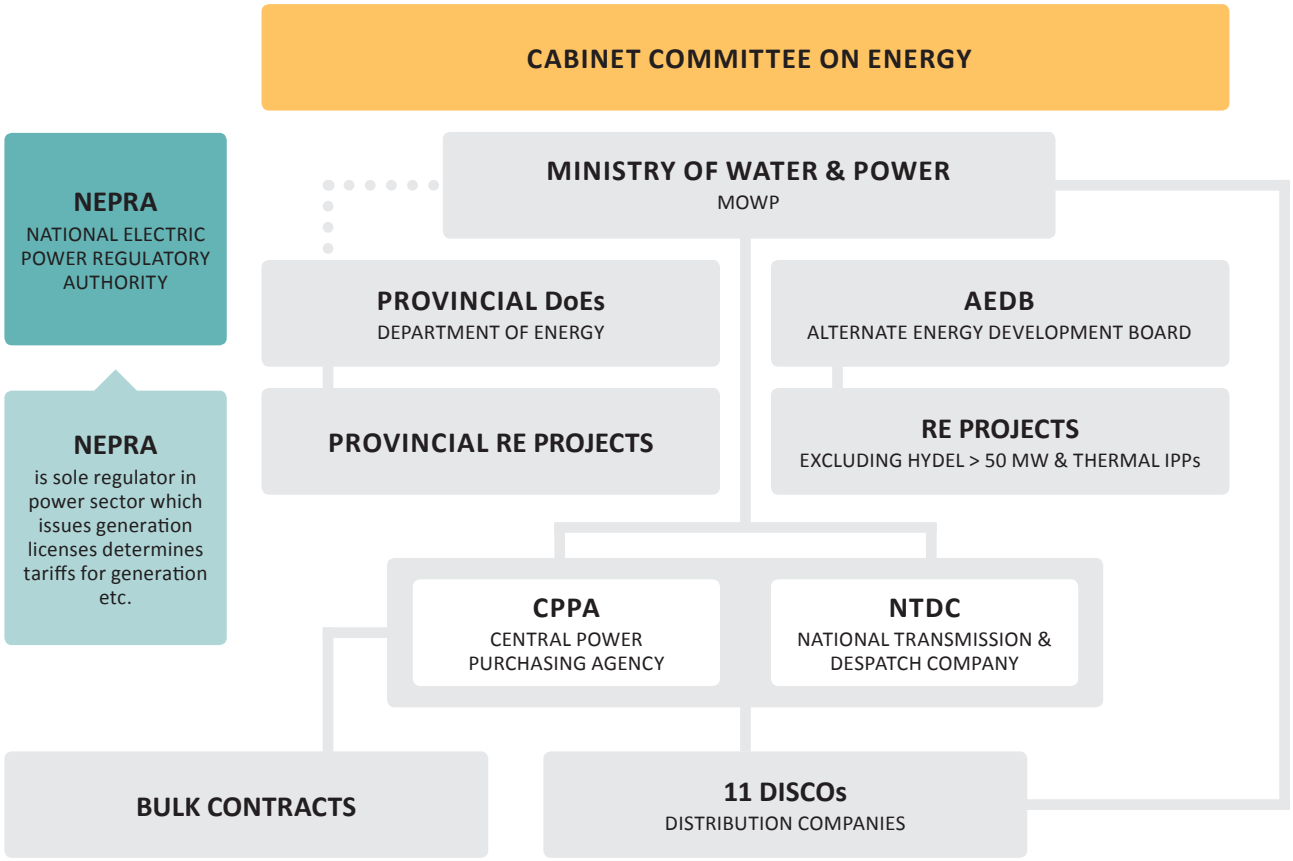
Similarly, the Pakhtunkhwa Energy Development Organization (PEDO) is also active in promoting solar as well as micro- and mini-scale hydropower projects in the province.

The energy department of Sindh has been supporting the considerable wind energy installations in the province, while the Gilgit Baltistan energy department remains focused primarily on micro- and mini-scale hydropower projects.

2.1.12 Cabinet Committee on Energy (CCE)

The Prime Minister of Pakistan chairs the CCE with the ministers of Finance, Water and Power, Petroleum and Natural Resources and Chief Minister of Punjab as its members. The CCE was developed to conduct bi-weekly meetings and take decisions on matters relating to entire power chain including generation and distribution.

A graphic summarizing the inter-relationships of the key power sector actors in the country is presented in **Figure 4**.



CCoE is chaired by PM of Pakistan and takes decisions on fortnightly basis on entire power chain.

MoWP is Federal Ministry and GoP's body for all issues relating to energy generation, transmission and distribution, policy formulation etc.

AEDB is autonomous body and 'one window' facilitator at federal level for processing solar projects of all sizes and issues LOIs and issues tax exemption certificates.

Provincial DoEs are focal points for all energy related issues in the province.

NTDC operates and maintains 500 kV and 220 kV grid stations and transmission lines.

CPPA responsible for implementing and administering 'Single Buyer Plus' market mechanism leading to competitive market operations.

Figure 4: Institutional Setup of the Power Sector in the Country

2.2 Renewable Energy Associations

2.2.1 PSA & REAP

The Pakistan Solar Association (PSA) and the Renewable Energy Association of Pakistan (REAP) are the only major associations/platforms representing the interests of private-sector firms/companies working in renewables in the country. REAP presently has over 400 members consisting of both small and large private-sector entities as well as individual business entities. On the other hand, PSA presently has over 100 members, primarily large and medium-sized entities and individual business entities.

While REAP was the first association to be established in the country, PSA was founded to focus primarily on solar energy-based ventures and to provide a forum for firms/companies working specifically on solar. Both associations are still at a very early stage of development.

2.3 International Organizations

The international organizations actively working in the country and playing a key role in the energy sector are USAID, JICA, ADB, KfW, EU, GIZ and UNDP. Amongst these institutions, the GIZ RE-EE project is the only one dedicated to the promotion of renewable energy and energy efficiency in Pakistan.

The United States Agency for International Development (USAID), together with the government-owned DISCOs, have been playing a key role through its three-year program aimed to improve the performance of DISCOs through reduction of losses as well as improvement of revenues and customer services.

2.4 Scientific/Academic Organizations

Although there is a high level of interest from all sectors, there are no focused academic institutions working solely on solar PV, since the market is still at an early stage. Certain reputed universities such as National University of Science and Technology (NUST) with campuses in both Rawalpindi/Islamabad and Karachi have developed a dedicated 'U.S. Center for Advanced Studies in Energy' (USPCAS-E)[13] in order to focus on renewable technologies such as solar and biomass. Similarly, the University of Engineering and Technology (UET) in Lahore presently has an accredited laboratory for conducting flash tests in order to assess panel efficiency.

In the recent years, USAID has extended considerable financial support to NUST for the establishment of the Center for Energy Studies.

The PCRET, mentioned in Section **2.1.7**, is a public-sector research organization focused on conducting research and development (R&D) in different renewable energy technologies, with one of the focal areas being solar PV.

13 **http://www.nust.edu.pk/INSTITUTIONS/Centers/CES/Pages/default.aspx**

3 PV Sector in Pakistan

3.1 Power Sector Status in Pakistan

3.1.1 Existing and Projected Supply and Demand Scenario

The power deficit in the country currently stands near 5 GW, with the supply and demand scenario shown in **Figure 5**. However, multiple power generation projects from various sources are currently in the pipeline and are envisaged to eliminate the power deficit by 2019, provided that expected projects are completed on time. PV projects can play a key role in the elimination of the power deficit, particularly in the industrial and residential sectors.

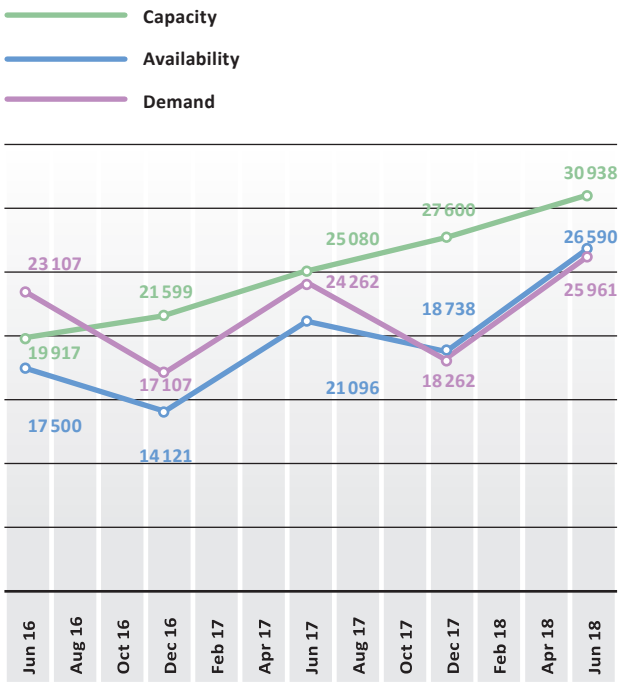
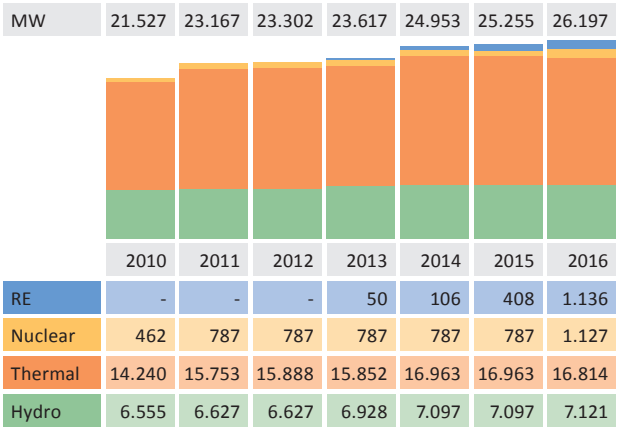


Figure 5: Power Supply and Demand Scenario in Pakistan[14]

The share of renewables in Pakistan has been steadily increasing each year, with 1136 MW of renewables having been installed by 2016 (primarily PV, biogas and wind projects). During the last year, i.e. 2015-16, there has been a promising increase in the share of renewables, with 728 MW of renewables added. The increase in renewables to the overall power sector landscape of Pakistan is provided in the **Figure 6** below.



MW	21.527	23.167	23.302	23.617	24.953	25.255	26.197
	2010	2011	2012	2013	2014	2015	2016
RE	-	-	-	50	106	408	1.136
Nuclear	462	787	787	787	787	787	1.127
Thermal	14.240	15.753	15.888	15.852	16.963	16.963	16.814
Hydro	6.555	6.627	6.627	6.928	7.097	7.097	7.121

Figure 6: Share of Renewables in Power Sector Landscape of Pakistan[15]

14 MoWP
15 CPPA, NEPRA and AEDB

The trend in electricity consumption is provided in the **Figure 7** below.

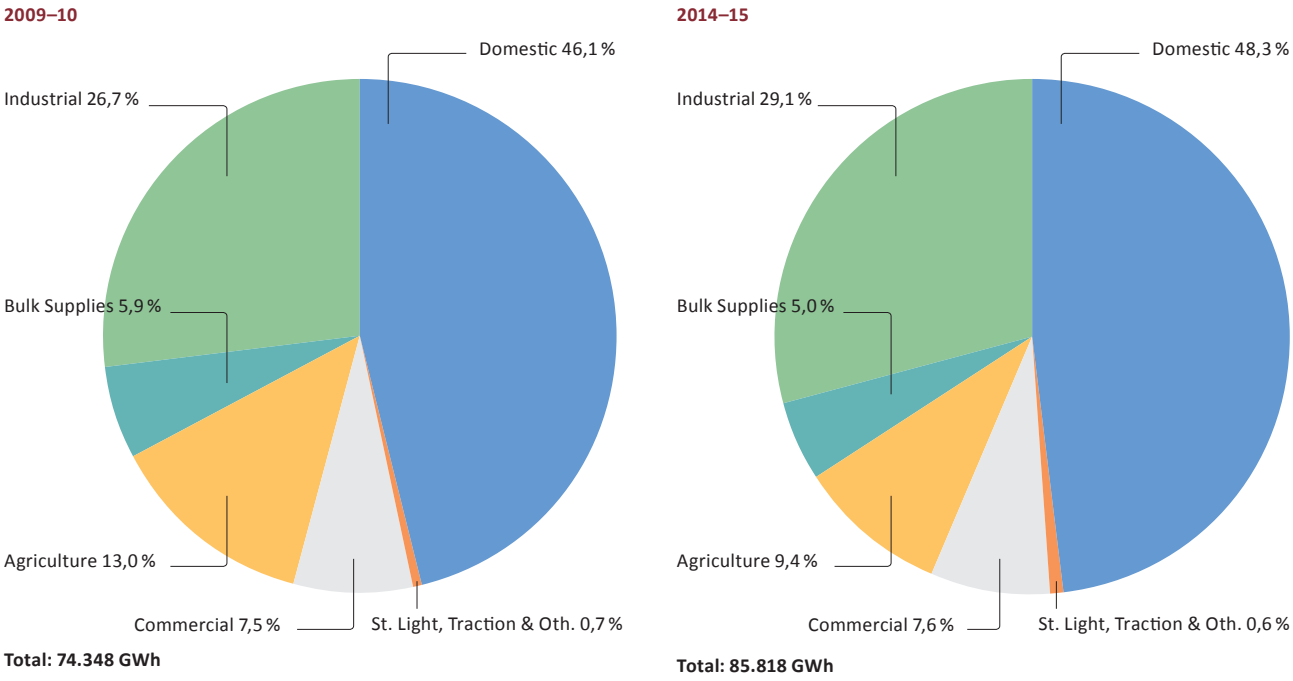


Figure 7: Electricity Consumption Trend by Sector

An overall growth in demand of 11,000 GWh in overall electricity consumption has taken place over the past five years, with both the domestic and industrial sectors displaying an increase in electricity consumption. The overall growth in demand over this period was approximately 7300 MW.

3.2 Legal Framework for PV Development[16]

The GoP has also taken a considerable number of incentives in its strategy to overcome the energy deficit through the promotion of both large-scale grid-connected PV projects as well as smaller-scale projects. The first step in this regard was its 2006 'Policy for development of renewable energy for power generation,' which intends to increase the deployment of renewable energy technologies in Pakistan to 9700 MW by the year 2030, according to the Medium Term Development Framework (MTDF).[17]

This was followed by the introduction of net metering in September 2015, with further steps being taken to reduce bureaucratic 'red tape' in the process of applications for issuance of net metering licenses.

Additionally, the 'import quality standards for PV equipment' by the GoP is expected to be adopted soon and aims to curb the import of uncertified and sub-standard equipment into the country. Once these standards are implemented, there will be greater standardization, both in terms of pricing as well as the quality of products available in the market, and the leading international solar companies will be encouraged to increase their stakes in this emerging solar market. These approved standards are detailed in **Annex D**.

16 IFC et al 2016. *Solar Developer's Guide to Pakistan*
17 GoP, et al 2006: *Policy for Development of Renewable Energy for Power Generation*

The GoP has also taken some very promising steps with its focal public-sector financial institution, the State Bank of Pakistan, announcing a 'financing scheme for renewable energy' in June 2016 with loans being offered at 6 percent for PV projects of 4 kW up to 50 MW.[18]

At the same time, the government has also taken steps to encourage 'large-scale' grid-connected PV projects through the introduction of a feed-in tariff (FiT) mechanism, which has proved a much needed catalyst to induce investor interest and considerably speed up the project development cycle.

In the off-grid sector, approximately 40,000 villages across Pakistan are presently un-electrified. This sector has a large potential, with only a small amount of companies being active. Microfinancing for small-scale solar has considerable potential if it is implemented successfully.

According to the last statistic available, the import of PV products was at 260 MW[19] in 2014. The volume of PV commercial and residential installations has been steadily increasing, with a total of 33.68 MW of PV installed by 2013 and 49.97 MW installed by 2014.[20] As a result of the commissioning of the 100-MW PV project at the Quaid-e-Azam Solar Park in May 2015, the total installed capacity of PV in 2016 stands close to 400 MW; this is only the contribution from large-scale grid-connected installations and does not include off-grid and small-scale installations (data is not available).

3.3 PV Market Potential

The Alternative Energy Development Board (AEDB) reports that 35 renewable energy projects including solar, wind and other technologies with a capacity of 1.1 GW are under development within the framework of the AEDB policies and procedures. FiTs (or upfront tariffs as they are known in Pakistan) have been approved for 10 developers, and of those, three projects of 100 MW each have signed a power purchase agreement with the public off-taker.

Apollo Solar Pakistan, Crest Energy Pakistan, and Best Green Energy Pakistan are each working on a 100-MW PV project. These projects are expected to be commissioned by the end of this year.

Six other developers have been issued letters of support for the development of projects with a cumulative capacity of 48 MW. The AEDB has also issued letters of intent for the development of 25 projects with a combined generation capacity of 660 MW. These projects are expected to be operational by 2018.

Additionally, the government of the Punjab province has issued letters of intent for projects with a total capacity of 1519 MW.

The recent introduction of net metering is expected to catalyze the local solar industry with the residential, commercial and industrial sectors being key beneficiaries, with high levels of interest being expressed for installing systems to reap the benefits of this mechanism. The process of obtaining the license for utilization of net metering has also been fine-tuned by the respective power utilities to minimize the time period for obtaining such a license.

18 **http://www.sbp.org.pk/smefd/circulars/2016/C3.htm**
19 **GIZ REEE Project et al 2014. *Updating of Renewable Energy Installations Database***
20 **GIZ REEE Project et al 2014. *Updating of Renewable Energy Installations Database***

Apart from the many residential users of solar systems who are planning to obtain a net metering license, a significant number of commercial entities such as hospitals, educational facilities (such as school, colleges and universities) as well as public and private-sector office buildings and premises are planning to install installations up to 1 MW to benefit from the cost savings expected through this support scheme. If different types of industry can be convinced, based on the potential of additional income through net metering, to switch to solar PV as an electricity source, this could lead to a significant pipeline of PV projects. It is expected that in the next three to four years, between 3000 and 4000 MW of solar PV will be installed across the country through net metering.

3.4 Updates on Net Metering

The introduction of net metering is generating high levels of interest and expectations across all segments of the PV market.

The NEPRA's 'Distributed Generation and Net Metering Regulations' were announced/approved on 1 September 2015, while the first net metering generation license of 1 MW at the parliament building was issued on 28 January 2016 after a period of 4 months and 28 days.

While NEPRA is the authority that issues the generation licenses, the DISCOs sign the 'Distributed Generation Interconnection Agreement' with the prosumers and forward the prosumers' application for electricity generation license to NEPRA.

Currently, the processing time for issuance of net metering licenses has been reduced to one month. About seventeen net metering license applications are being processed with IESCO, with nine connections in Islamabad. The installed capacity through net metering stands at 1.6 MW for IESCO, while a 135-kW system has been recently installed at an industrial unit under the distribution company LESCO. This is a most encouraging sign, since the LESCO market for net metering-based installations is much larger compared to the market size for IESCO systems. The origin (local/foreign) of electricity meters for net metering installations is not mentioned in NEPRA regulations. Currently, local companies that fulfill the specification from the authorities produce energy meters.

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4 Results of the Value Chain Analysis

4.1 Proportion of Revenue from Solar Components

The revenue generated from sale of the different solar components by the firms surveyed is provided in **Figure 8**.

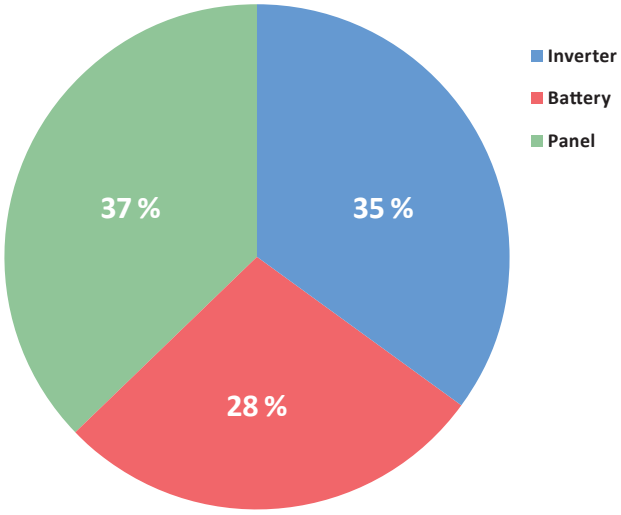


Figure 8: Revenue Generated From Different PV Components

As displayed in the figure above, 37 percent of revenue is generated from panels, 35 percent from the sale of inverters and 28 percent from the sale of batteries. Since the cost of PV panels is lower in comparison to the two other components in a solar system, a large number of businesses are generating considerable revenue from their sale. In contrast, even though inverters are a much costlier item, the sale of a smaller proportion of this component leads to greater profit margins. Batteries were generally observed to be the item contributing the least to the revenue generation of the solar businesses interviewed as a part of this activity.

4.2 Importers/Wholesalers

As mentioned above, 96 percent of the companies consulted import equipment themselves in order to maximize profit margins. At present the emphasis remains on importing equipment from China since it is the most readily accessible market with a large range of products varying in both price and quality. For the most part, companies either import an entire container of goods or share a container with another interested business entity for importing the required solar components.

The entities involved in importing solar components themselves were observed to possess a project pipeline as well as the financial strength to develop a sizeable inventory and thus bear the risk of market turbulence and diminished demand. The importers that were consulted expressed the hope that the adoption of net metering will provide greater stability to the local PV market through a stable demand of PV systems and will reduce the risk of holding a large inventory.

On the other hand, 38 percent of businesses interviewed are involved in wholesale activities, with their business models focused on importing and then selling their products to other business entities. The types of firms that are currently involved in the wholesale sector tend to be prosperous business entities, often active in other business fields, with the required financial muscle to import large quantities of inventory and hold onto it during lean periods as well as during periods of uncertainty.

4.3 Manufacturers/Assemblers

The assembly of silicon wafers is currently carried out by five different companies in the country. These are:

- Ikram Solar
- Akhtar Solar
- Saba Solar
- Tesla PV
- PV Silicon

However, the imported panels manufactured by reputed brands are currently preferred, due to the higher reliability and trust enjoyed by the foreign brands.

4.4 Suppliers/Installers

Most of the PV businesses interviewed import solar PV components in large quantities, capitalizing on the larger profit margins and at times selling the solar solutions as wholesalers to other smaller business entities. These businesses deal directly with clients, irrespective of which sector they might belong to – i.e. residential, industrial or commercial – and they also install the systems and offer customized solutions.

Additionally, there is limited expertise in the market related to system designing and installation. Most installers working in the PV field are electricians with no specific training related to solar PV, and are, as a result, 'learning by doing.'

4.5 Solar PV Product and Service Range in the Pakistani Market

4.5.1 Locally Produced Products

Apart from minor accessories such as wiring and panel mounting structures, 80 percent of PV components are currently being imported into the country.

4.5.2 PV Panels

Currently, five companies in Pakistan are conducting the local 'assembly' of panels. However, imported panels are preferred. The PV panel landscape in the country is provided in **Figure 9** below.

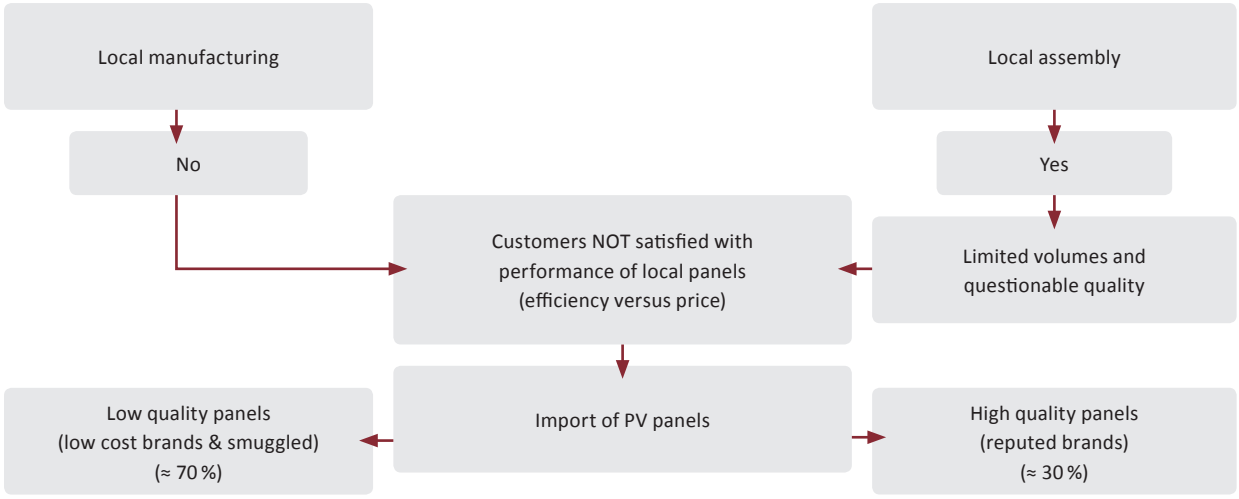


Figure 9: Landscape of PV Panels in Pakistan[21]

21 **The figures provided with regards to proportion of PV panel market shares are rough estimates based on feedback collected during surveys and market research. Detailed surveys are necessary to determine more accurate statistics regarding the PV panel landscape in Pakistan.**

4.5.3 Batteries

Locally manufactured and low-quality flooded lead acid batteries are being widely used wherever battery backup is necessary, particularly in hybrid solar systems in the residential and commercial sectors as well as in the off-grid systems in rural parts of the country.

These batteries are used both in cars and also in homes for utilization with the UPS hybrid inverters as well as with solar PV systems. Needless to say, these batteries are not developed for use with solar systems and thus do not provide a long life; there have also been frequent cases of malfunctioning.

Considering the significant opportunity with regards to the demand for these batteries, there is a high proportion of instances where the batteries are refurbished and sold as new.

The manufacturing of AGM batteries is expected to commence soon in the country, with the following industrial groups setting up factories in the southern Pakistani city of Karachi:

- Daewoo (Korea)
- Treet (Korea)
- Eco star (DWP Group, GREE Group) – China
- Homage (China)

The landscape and dynamics of battery usage for solar PV systems in Pakistan is illustrated in **Figure 10** below.

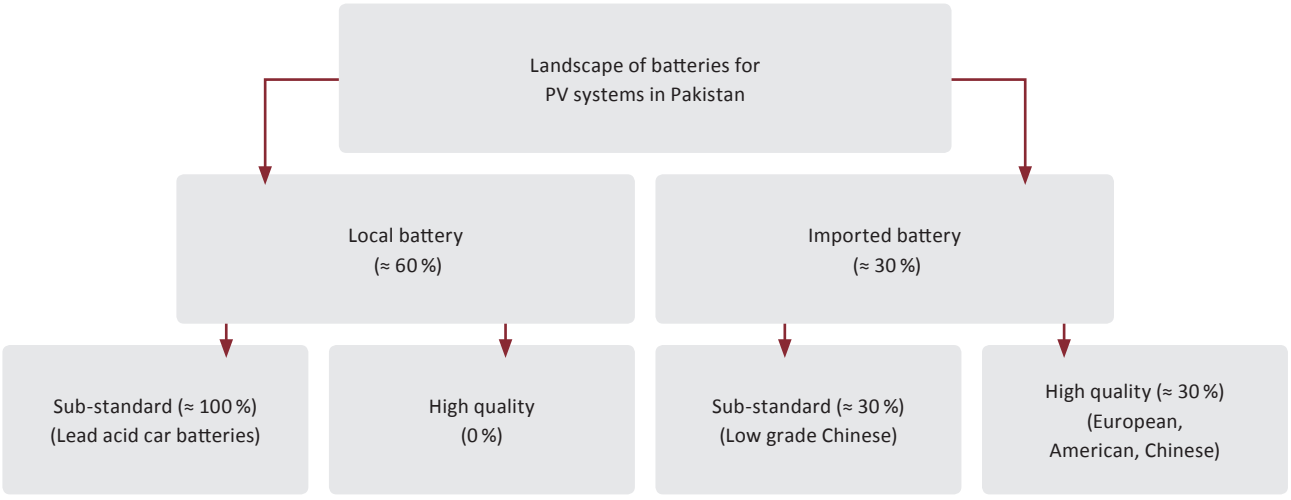


Figure 10: Landscape of Batteries for Use with PV Systems in Pakistan[22]

22 **The figures provided with regards to proportion of battery market shares are rough estimates based on feedback collected during interviews and market research. Detailed surveys are necessary to determine more accurate statistics regarding the battery landscape in Pakistan.**

4.6 Imported Products

Chinese products have a considerable market share of the PV market in the country, with over 90 percent of PV panels and over 80 percent of 'deep cycle' batteries imported. This is attributed to price competitiveness with similar products from other countries, extensive dealership networks and a large variation in product quality/pricing, which caters to different economic classes of customers.

There is a niche in every market sector (industrial, commercial and residential) that requires high-quality and reliable PV products, particularly inverters and batteries. These elements of the market constitute the target customer group for high-quality European products.

Pakistan currently purchases Chinese products (PV panels and inverters) due to the high cost of European products, the lack of awareness about the benefits of quality PV and the limited offer of after-sales services in comparison to the Chinese products.

4.6.1 Import Trend for 'PV Panels' from Different Countries

As can be seen in **Figure 11** below, Chinese PV panels have the highest share of imports in Pakistan, which has increased between 2014 and 2016. This is attributed to price competitiveness with similar products from other countries, extensive customer outreach through dealership networks and a large variation in product quality/pricing, which caters to different economic classes of customers.

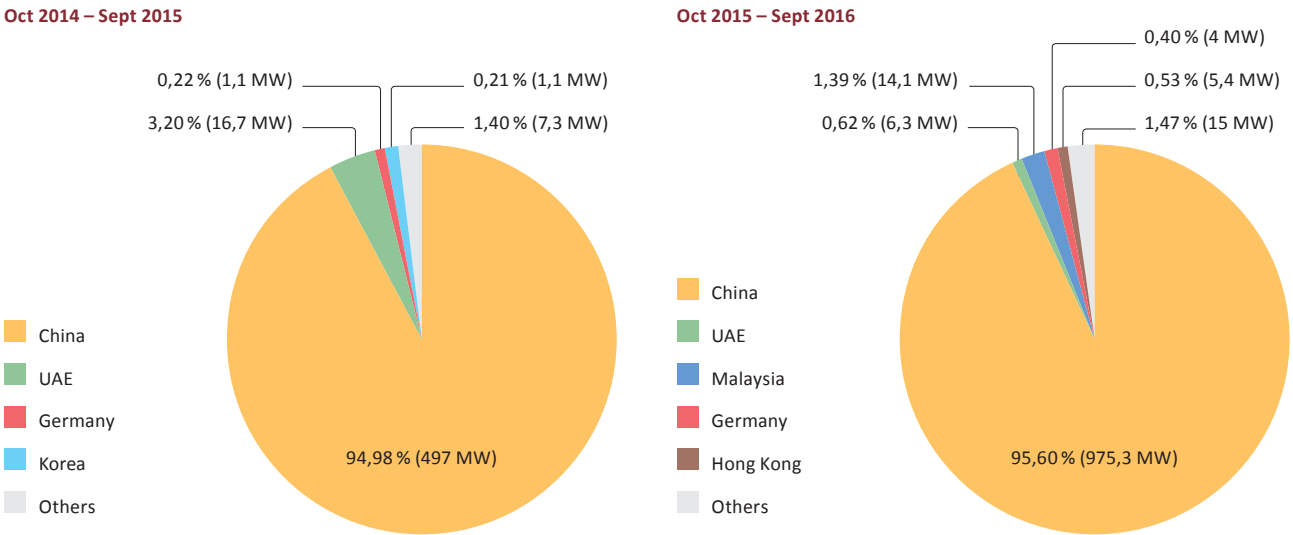


Figure 11: Import Trend for PV Panels in Pakistan

4.6.2 Import Trend for Deep Cycle Batteries from Different Countries

A high proportion of Chinese 'deep cycle' batteries are being imported into the country, with the same reasons behind this dynamic as those already cited above for PV panels. The overall volume of batteries imported from Germany has increased over the last year (October 2015 to September 2016), although there has been a minor decrease in the market share as can be seen in **Figure 12** below.

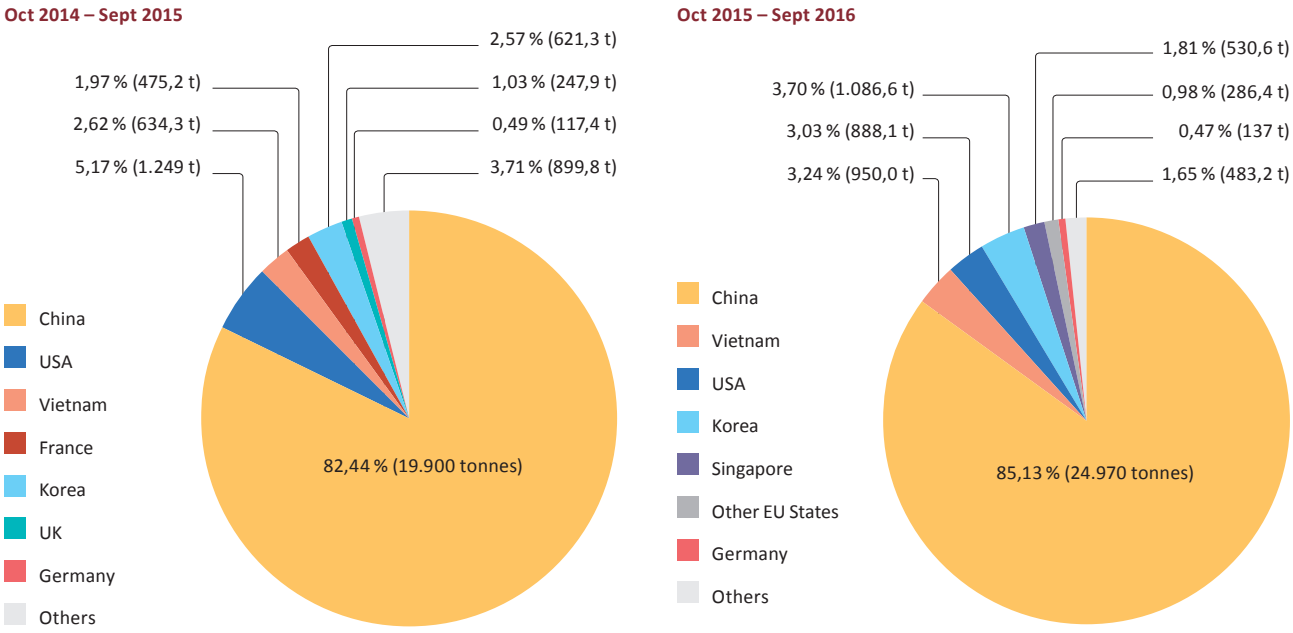


Figure 12: Import Trend For Deep Cycle Batteries in Pakistan

4.6.3 Import Trend for Inverters from Different Countries

Chinese inverters have the highest share of imports in Pakistan, which has increased between 2014 and 2016, as can be seen in **Figure 13** below. The reasons behind this dynamic are the same as in the case of import of the other PV components, i.e. price competitiveness with similar products from other countries, extensive dealership networks and a large variation in product quality/pricing, which caters to different economic classes of customers.

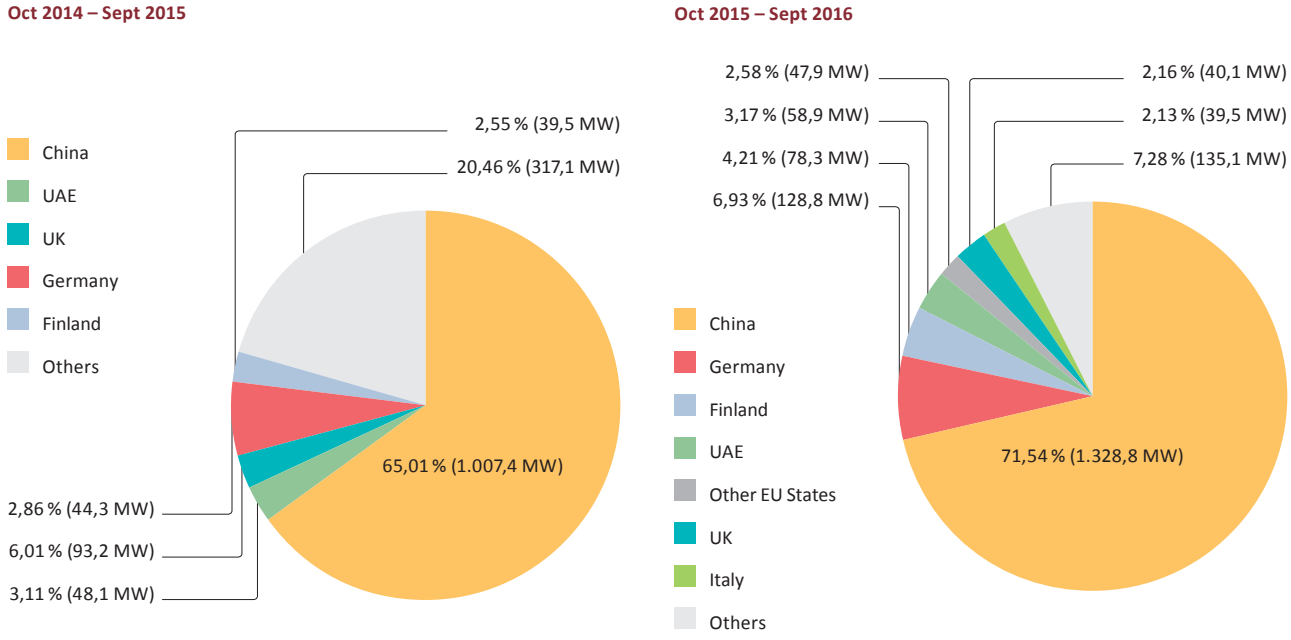


Figure 13: Import Trend for Inverters in Pakistan

4.6.4 Import Trend for Charge Controllers from Different Countries

A high proportion of Chinese charge controllers are being imported into the country, with the same reasons behind this dynamic as those already cited above for the other PV components. The overall volume of charge controllers imported from Germany has increased by 0.92% over the last year (October 2015-September 2016), although there has been a minor decrease in the market share as can be seen in **Figure 14** below.

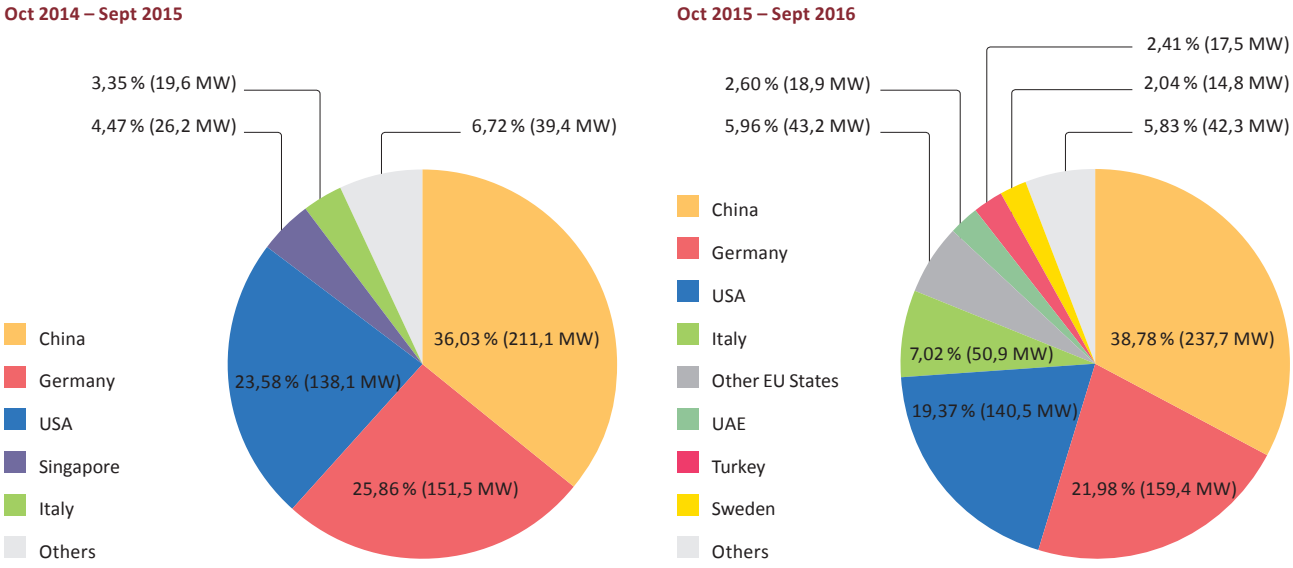


Figure 14: Import Trend for Charge Controllers in Pakistan

4.7 Analysis of Products Fulfilling Norm and Quality Standards

Based on the feedback obtained from the different value chain actors, the proportion of certified products in the local market is provided in **Figure 15**. As can be observed, only 14 percent of inverters in the local market are perceived as quality products, which fulfill local and international norms and quality standards. This seems a reasonable perception, since a large proportion of 'copies' of high-quality Chinese inverters are available in the market, which are similar in price and are very difficult to differentiate from the original product.

Similarly, only 9 percent of batteries in the local market are perceived to be quality or certified products; this is due to the predominant use of sub-standard flooded lead acid car batteries for use with PV systems. This trend can be largely attributed to the smuggling or importing of used and sub-standard flooded and maintenance-free batteries, which often malfunction after only a few months of use.

In comparison to inverters and batteries, 20 percent of PV panels in the local market are perceived as quality products. This is primarily due to sub-standard Chinese panels flooding the market.

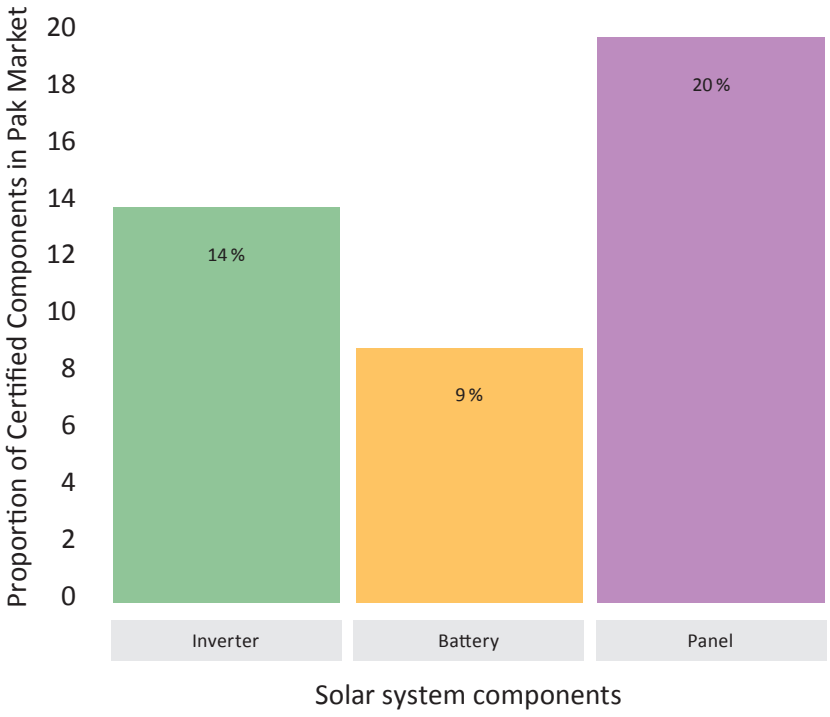


Figure 15: Proportion of Certified Products in the Local Market[23]

23 **Results based on interviews with PV key value chain actors (wholesalers, importers, installers, retailers etc.)**

The different imported brands observed in the market are listed in **Figure 16** below.

PV Panels		Inverters		Batteries	
Yingli	(China)	**Voltronic**	(Taiwan)	**Long**	(Vietnam)
Kyocera	(Japan)	**Schneider Electric**	(France)	**Hoppeke**	(Germany)
Rene Sola	(Korea)	**Sacred Sun**	(China)	**Powersonic**	(China)
JA Solar	(China)	**SMA**	(Germany)	**Trojan**	(USA)
Canadian Solar	(China)	**ABB**	(Sweden-Switz.)	**Narada**	(China)
Alfa Solar	(Germany)	**Outback**	(USA)	**Baykee**	(China)
Hitek	(UK)	**Nedap**	(Holland)	**JTE**	(China)
Jinko Solar	(China)	**Sungrow**	(China)	**CSB**	(Taiwan)
GH	(Belgium)	**Baykee**	(China)	**Huawei**	(China)
Trina Solar	(China)	**Studer**	(Switzerland)	**Sunny Power**	(China)
Solar World	Germany)	**TBB Power**	(China)	**Inti Power**	(China)
Phono	(China)	**Fronius**	(Austria)		
Beyond PV	(Taiwan)	**Victron**	(Holland)		
Eurener	(Spain)	**I-Energy**	(Taiwan)		
Hanergy	(China)	**Kaco New Energy**	(Germany)		
Shanghai Solar	(China)				

Figure 16: Imported PV Brands in Pakistan[24]

The harm to both customer confidence and the difficulties in choosing certified products is evident considering that 'certified' solar PV panels are sold for up to 1 USD per Watt and last for 20 years, while an 'uncertified' panel costs 0.5 USD per Watt and lasts for 2 years.

The adoption of the "import quality standards for PV products" that is to be implemented in the near future is expected to pave the way for a reduction in the quantity of sub-standard and uncertified equipment present in the market. Based on the feedback received from the value chain actors, it is generally felt that a short to medium-term improvement of 35 percent in the volume of certified equipment available in the local market can be expected, with stricter implementation of these standards expected to increase the proportion of high-quality products.

24 **Results based on interviews with PV key value chain actors (wholesalers, importers, installers, retailers etc.) and on market research. The list is not exhaustive and may not include all available brands. The component brands are listed in no particular order. Considering the scope of this study, it was not possible to assess the specific market share of each respective brand mentioned here. Classification of equipment into 'tiers' is currently not possible due to the lack of quality standards in Pakistan.**

4.8 Availability Analysis of High-Quality Products and Services

The availability of high-quality products and services is limited to a handful of companies working in the country's PV market. There are certain local PV companies with dealerships of reputed brands that use this advantage as the sole selling point for that particular product in the country. Also, in many cases, the local seller's product knowledge is limited and the inventory maintained by the dealer is restricted to a few high-selling products in order to minimize the risks of maintaining large inventories and thus to ensure a high cash flow.

Reputed quality brands from Europe, USA and Asia are available in limited quantities, with the specific component directly imported in case of large-scale project interventions. In periods of high demand, equipment shortages are common due to insufficient inventories maintained by the local dealers. The only solution in such instances is a waiting period of at least one month until the required shipment is ordered and reaches the port of Karachi in the south of the country.

It should be mentioned that high-quality spare parts are rarely available, as is the expertise for repairing these products; in most cases, a defective component is sent back to the manufacturer, who is often based in Europe, resulting in a considerable time lag until the client receives the repaired equipment.

4.9 Potential Areas for Solar PV Products

There is considerable potential for marketing and deploying solar products throughout the country. In the case of residential installations, significant demand exists in the urban hubs, e.g. the cities of Karachi, Lahore, Rawalpindi/Islamabad and Multan, with the onset of net metering posing a massive opportunity for the development of the solar PV landscape in the country. The commercial sector in these urban hubs also holds high potential, since hospitals, hotels, educational institutions (universities, colleges, schools etc.) are planning to install solar PV and utilize net metering.

In areas where industry is concentrated, such as the textile industry in and around Faisalabad and Lahore, as well as the sports industry in Sialkot, there is a high potential for the deployment of solar PV products.

Also, there is enormous potential for solar pumping in the agricultural sector, with the Punjab and Sindh provinces being the two largest agricultural regions with the greatest potential demand.

In addition, the off-grid areas in the country also possess high potential, with over 40,000 villages across the country that are presently un-electrified.

4.10 Market Segments Using Different Product Qualities

The different market segments and their preferences in terms of cost versus quality while choosing PV products are provided in **Figure 17** below.

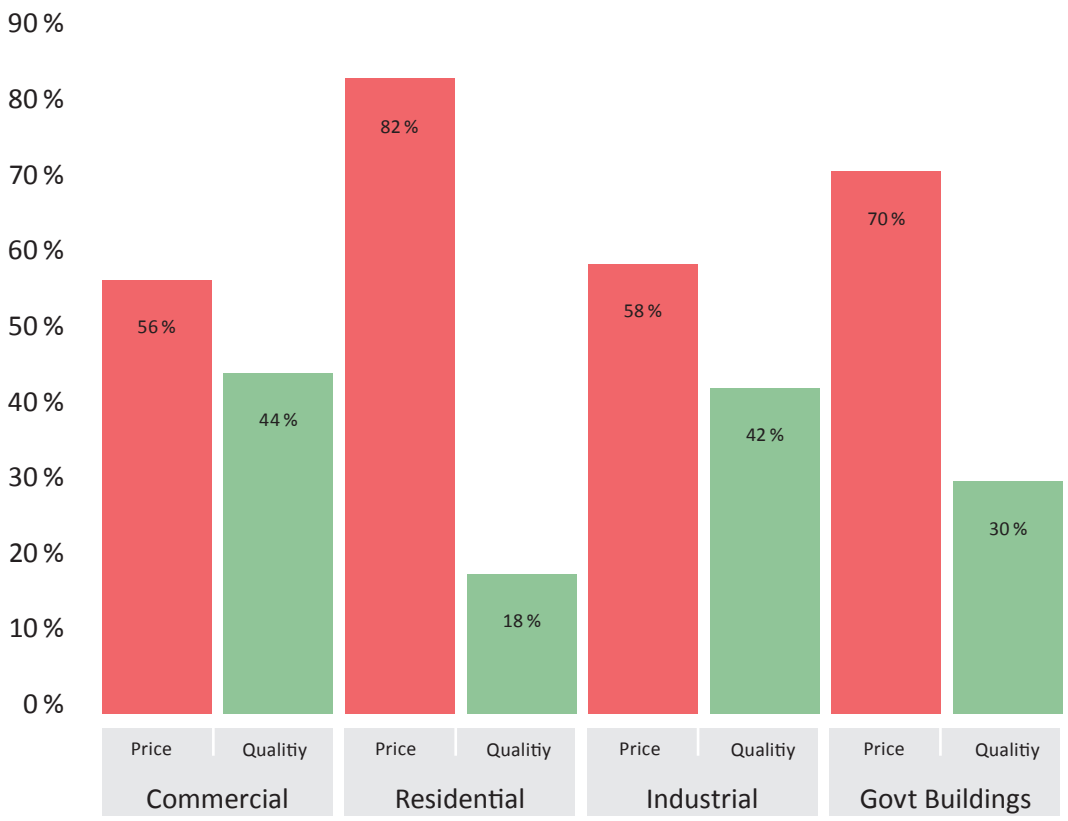


Figure 17: Price Versus Quality Preferences[25]

4.10.1 Commercial

In the commercial sector, price is weighted 56 percent compared to quality with 44 percent. Due to the high electricity demand diesel generators are needed. Hence, if PV projects are implemented the payback period would be short (around 3-4 years). While the focus from this sector might be more on price, commercial entities always prefer to procure products of reasonable quality to avoid possible malfunctions and problems during equipment operation.

4.10.2 Residential

In the residential sector, the mindset is heavily skewed towards price (82%) in comparison to quality (18%), with the residential customers being highly price-sensitive and for the most part preferring cheaper and lower-quality products due to a lack of awareness of the long-term impacts of procuring cheap and sub-standard equipment.

25 **Results based on interviews with PV key value chain actors (wholesalers, importers, installers, retailers etc.)**

4.10.3 Industrial

The industry sector is the most promising market segment for high-quality PV products. While economic aspects can never be neglected and do weigh in at a higher level compared to quality, to ensure profitability of the project and obtain financing for a project, a majority of industries prefer to pay an extra amount to procure high-quality products. European inverters, for example, are popular across the different industrial set-ups across the country due to their reliability and high level of efficiency.

4.10.4 Public Sector (government schools, district administration officers etc.)

This particular segment focuses heavily on cost in comparison to quality, with a 70 percent of weighting placed on cost and the remaining 30 percent on quality. Keeping in view the tendering procedures commonly used in the public sector, the lowest bid is mostly awarded the bid, while quality checks of the proposed equipment hardly factor into the decision-making process; in the long term, this can pose serious issues.

4.11 Customer Segmentation Product Preferences

The preferences of the different PV market segments in Pakistan are outlined in **Figure 18** below.

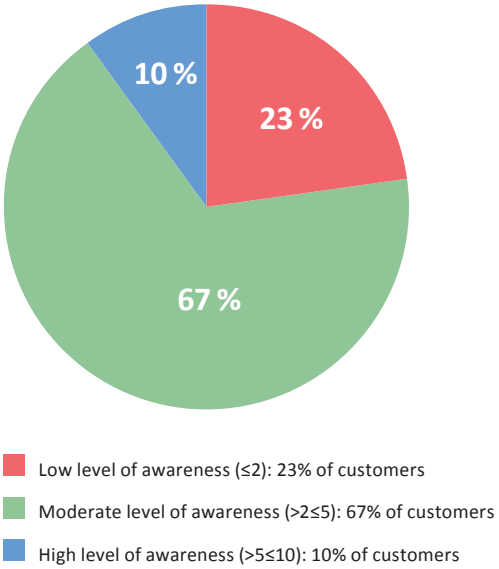


Figure 18: Customer Awareness Landscape of PV Quality Products

The interviews with value chain actors show that the emphasis of residential and public-sector (government) customers remains on obtaining the cheapest product of good quality, which is a rare combination, and for the most part focuses on Chinese products. However, batteries procured by these two customer segments are generally locally-manufactured lead acid car batteries (Volta, Exide and Phoenix are popular brands) in order to minimize costs.

In comparison, the industrial segment prefers European or American products. To a slightly lesser extent, the commercial segment also prefers to procure quality products, even though whenever there is a considerable price difference, the preference is moved to procuring Chinese products of good quality, as far as possible.

4.12 Quality Perceptions of Key PV Target Groups

The lack of import regulations in the country pertaining to solar products has led to a considerable influx of cheap and sub-standard Chinese products, dealing a considerable blow to consumer confidence across all target groups. The frequent malfunctioning and limited lifespan of inverters and batteries, combined with low-efficiency panels, has not helped to foster strong confidence amongst consumers.

In the last decade, a large number of businessmen and vendors, with no specific knowledge or expertise relating to PV, have felt there is a significant opportunity in this sector, with large profits to be made. Unfortunately, with the primary focus on profit-making, sub-standard equipment has been imported from a few Asian countries, primarily China.

Once the consumers have purchased sub-standard systems due to lack of product and technology knowledge, the perception is eventually established that PV technology itself is unreliable.

In terms of awareness of the different product ranges and associated qualities and certifications, the general awareness scenario on a scale of 1 to 10 is presented in **Figure 19** below.

Industrial

Typical installation size
1 MW – 10 MW

High-potential industries & locations
(i) **Textile** (spread across Punjab province)
(ii) **Sports** (focused in Sialkot city)
(iii) **Food industry** (across the country)
(iv) **Pharmaceutical industry** (Karachi)

Possible project financing models
(i) Financing through recently announced scheme for RE project financing by State Bank of Pakistan. Loans offered at **6 percent** for solar PV projects up to 50 MW.

(ii) Conventional financing through lending from bank along with equity from project developer

Product preferences
Based on past trends, industry prefers to install reliable and high-quality components to ensure project bankability.

SMA, Schneider and ABB quite popular in terms of reliability compared to Chinese products

Commercial

Typical installation size
100 kW – 1 MW

High-potential industries & locations
(i) **Hospitals** (across the country)
(ii) **Private educational institutions**
(iii) **Hotels & restaurants** (across the country)
(iv) **General provision stores** (across the country)

Possible project financing models
(i) Financing through recently-announced scheme for RE project financing by State Bank of Pakistan. Loans offered at 6 percent for solar PV projects up to 50 MW.

(ii) Conventional financing through lending from bank along with equity from project developer

(iii) Equity

Product preferences
In the past, tendency was to install cheaper and less reliable quality Chinese brands.However, slowly trend moving towards increasing awareness leading to installation of SMA, Schneider and ABB due to high level of reliability

Residential

Typical installation size
1 kW – 20 kW

High-potential locations
(i) **Urban centers** (Karachi, Lahore, Islamabad, Rawalpindi, Faisalabad, Multan, Hyderabad)
(ii) **40,000** un-electrified off-grid villages across the country
(iii) **Agricultural areas** across Punjab, Sindh and KPK provinces owned by farmers with land holdings of different sizes

Possible project financing models
(i) Financing through recently-announced scheme for RE project financing by State Bank of Pakistan. Loans offered at **6 percent** for solar PV projects up to 50 MW.

(ii) Equity

(iii) Funding through donor projects in off-grid areas

Product preferences
High price sensitivity exists with niche market for high quality and certified products. Large proportion of clients in this sector opting for Chinese products, although increasing interest in certified high-quality products as result of 'lessons learnt'

Public sector (government-funded)

Typical installation size
50 kW – 200 kW

High-potential segments & locations
(i) **Public hospitals & health facilities**
(ii) **Government educational institutions** (across the country)
(iii) **Public parks and recreation facilities** (across the country)
(iv) **Public offices** (across the country)

Possible project financing models
(i) Public financing from national approved budget as per PC-1 document
(ii) Grant aid from international donor agencies

Product preferences
Tendency remains to maximize project size within allocated budget. Also, open tenders bidding mechanism based on awarding project to lowest bidder results in high-quality and durable products losing out to competitors offering lower-quality products.

Figure 19: Preferences of the PV Market Segments in Pakistan

4.13 Payback Time Expectations of Each Customer Segment

The payback expectations from the different customer segments are shown in Figure 20 below. As can be observed, for residential and public-sector (government) buildings, there are expectations of a payback period of five years. In comparison, the industrial sector has an expectation of payback of the investment in 4.5 years, while the commercial sector has the highest payback expectation of 3.5 years.

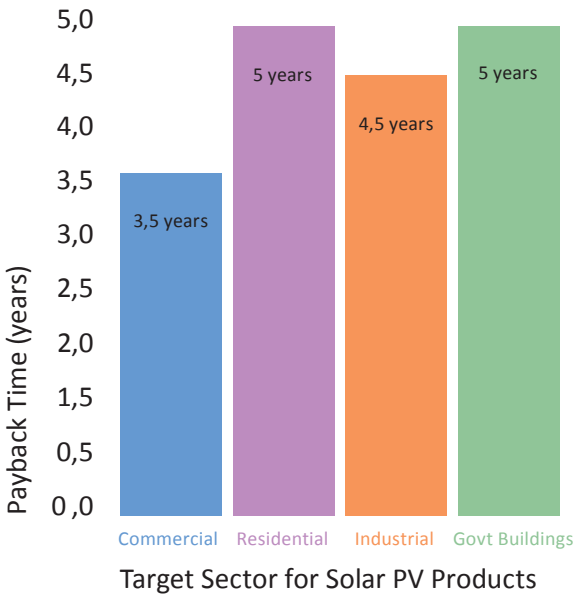


Figure 20: Payback Expectations of Each Customer Segment

5 Business Environment for German PV Businesses

5.1 Challenges and Opportunities for German PV Businesses

Challenges

Customer awareness needs to be increased to reduce price sensitivity amongst the different customer segments and disseminate the long-term benefits of investing in high quality certified equipment.

High price sensitivity for European products. In the residential sector, customers are willing to pay approximately 20% higher cost for European products compared to products from non-European brands. Industrial sector customers are willing to pay 30 to 40% higher cost while the Commercial sector is willing to pay 10-15% higher cost for European products compared to non-European products. On the other hand, the public sector always opts for the most cost-competitive product.

Lack of after-sales support network / in-country repair facilities weakens the sales strategy for such high-quality and expensive products and does not reassure the customer regarding after-sales support.

Limited technical expertise and product knowledge on complex yet highly efficient solar PV components leads to issues during commissioning for system configuration and also during operation.

Offering solar system components for Pakistan that are **not 'over-engineered'** but cater to the needs of the customers while remaining user friendly and are also cost competitive

Opportunities

Net metering regime introduced by NEPRA in **Sept 2015.** This regime will incentivize commercial units, industry and household consumers to install PV and generate revenue by feeding back into the grid. Issuance of licenses for net metering has commenced.

Financing through recently announced Scheme for RE project financing by State Bank of Pakistan. Loans being offered at **6 percent** for solar PV projects up to 50 MW (http://www.sbp.org.pk/smefd/circulars/2016/C3.htm)

Implementation of **Import Quality Standards** is expected to commence very soon. As a result, it will ensure reduction in uncertified solar PV components in the market and help promote quality certified products

German-made products enjoy high level of trust and reliability in all customer segments of the Pakistani solar PV market. **Grid-tied** systems are prime targets for German products.

The focus should be on **large industry** (textile, sports, pharmaceutical etc.) due to high interest in installing bankable certified high-quality reliable equipment with the textile and sports industries being the mainstays of the Pakistani economy generating a high annual profit.

Solar pumping applications also possess considerable potential for projects in the pipeline from the public sector in Sindh and Baluchistan provinces.

Figure 21: Challenges and Opportunities

5.2 Target Segments for German Products in Pakistan

The high-potential target segments for German products and services are provided in **Figure 22** below.

Products

Grid-tied inverters

For use in medium-scale (100 kW-1 MW) and large-scale (>1 MW) grid-connected projects set up by industrial and commercial sectors.

Price competitiveness with comparable products from other countries will be critical.

Batteries (flooded or AGM)

For residential sector and off-grid systems as well as commercial sector installations requiring battery backup. Installed system sizes are expected to scale up to utilize the economic benefits of net metering and will require larger battery banks.

Potential for high-quality batteries exists but price competitiveness with other comparable products will be critical.

PV testing & monitoring equipment

(battery testers, PV panel testers, PV analysts, PV panel flash test equipment etc.)

Services

Technical consulting services

(techno-economic feasibility studies, grid connection studies, support in project tendering process, monitoring of commissioned projects, maintenance and operation of large scale grid-connected & medium-scale PV projects)

EPC Companies

For developing both commercial sector (kW scale) and large scale (>1 MW) grid-connected projects

High-quality EPC contracting companies with a strong profile of developing large-scale projects are in high demand.

Figure 22: Target Segments for German PV Products and Services

The different value chain actors were consulted regarding the most effective strategy to be adopted by German companies for engaging the solar PV market in Pakistan.

5.3 Proposed Modality for Engagement of German Products in Pakistan

Based on the discussions conducted with the stakeholders of the PV value chain, some of the key aspects to be focused on by the German PV companies for engaging the Pakistan market are as follows:

- Large Inventory/storehouse of high-quality PV products components must be available in the country to instantly replace any malfunctioning items that require replacement or repair.
- After-sales services of high-quality manufacturers should be available in Pakistan.
- Join forces with existing sales channels of other high-quality products from Germany such as the automotive industry (for residential) or equipment manufacturers (for industrial customers).
- High-quality manufacturing firms should to provide product information to the consumers to inform them about the added value of their product.
- Place advertising in very specialized magazines for specific industrial target groups.

5.4 Business Conditions for PV Companies

Based on the SRO 263(I)/2011 issued by the Federal Board of Revenue, Government of Pakistan (GoP) on 19 March, 2011, the import of PV equipment (panels, inverters, batteries, charge controllers) into the country is exempt from all duties.

However, the local battery industry is very powerful and influential and has managed to convince the GoP through the relevant departments (Engineering Development Board and Federal Board of Revenue) to add a duty on the import of all types of battery into the country. Nevertheless, the payment of the duty on import batteries depends on the custom officials, since they cannot judge whether a battery that arrives at the port for evaluation of duties has been manufactured in Pakistan or not.

Generally, the import of PV panels, solar inverters and charge controllers can be imported with the least amount of hassle in terms of obtaining the tax exemption. However, the import of batteries, even when imported as part of a PV system design, can be quite challenging, and the securing of the tax exemption can never be guaranteed.

Annexes

Annex A

Information on Key Energy Stakeholders in Pakistan

S/NO	NAME OF STAKEHOLDER	CONTACT INFORMATION
1	Ministry of Water & Power (MoWP)	http://www.mowp.gov.pk
2	Alternative Energy Development Board (AEDB)	http://www.aedb.org
3	National Electric Power Regulatory Authority (NEPRA)	http://www.nepra.org.pk
4	Central Power Purchasing Authority (CPPA)	http://www.cppa.pk
5	National Transmission and Despatch Company (NTDC)	http://www.ntdc.com.pk
6	Lahore Electric Supply Company (LESCO)	http://lesco.gov.pk
7	Karachi Electric Supply Company (KESC)	http://www.kesc.com.pk
8	Faisalabad Electric Supply Company (FESCO)	http://www.fesco.com.pk
9	Multan Electric Power Company (MEPCO)	http://www.mepco.com.pk
10	Islamabad Electric Supply Company (IESCO)	http://www.iesco.com.pk
11	Gujranwala Electric Power Company (GEPCO)	http://www.gepco.com.pk
12	Hyderabad Electric Supply Company (HESCO)	http://www.hesco.gov.pk
13	Quetta Electric Supply Company (QESCO)	http://www.qesco.com.pk
14	Peshawar Electric Supply Company (PESCO)	http://pesco.gov.pk
15	Tribal Electric Supply Company (TESCO) Sukkur Electric Power Company (SEPCO)	http://tesco.gov.pk
16	Sukkur Electric Power Company (SEPCO)	http://www.sepco.com.pk
17	Pakistan Council for Renewable Energy Technologies (PCRET) Federal Board of Revenue (FBR)	http://www.pcret.gov.pk
18	Federal Board of Revenue (FBR)	http://www.fbr.gov.pk
19	Pakistan National Accreditation Council (PNAC)	http://www.pnac.org.pk
20	Pakistan Standards & Quality Control Authority (PSQCA)	http://www.psqca.com.pk
21	Punjab Energy Department	http://www.energy.punjab.gov.pk
22	Sindh Energy Department	http://www.sindhenergy.gov.pk
23	Pakhtunkhwa Energy Department	http://www.kpkep.gov.pk
24	Gilgit Baltistan Energy Department	http://www.gilgitbaltistan.gov.pk
25	PSA	http://www.pakistansolarassociation.org
26	REAP	http://www.reap.org.pk
27	USAID	http://www.usaid.gov/pakistan
28	JICA	http://www.jica.go.jp
29	ADB	http://www.adb.org/countries/pakistan
30	KfW	http://www.kfw-entwicklungsbank.de
31	EU	http://www.ec/europa/eu
32	GIZ	http://www.giz.de
33	UNDP	http://www.pk.undp.org/
34	NUST (USPCAS-E)	http://www.nust.edu.pk/CES

Annex B

Interview Questionnaire

Interview Questions for Consultations with Actors of Solar PV Value Chain in Pakistan

Name of Interviewer Date of Interview

Name of Respondent

Firm/Company Name

Firm/Company Formed Since Location of Interview

No. of Employees No. of Regional Offices/Service Centers

Address Phone No. Email

Type of Value Chain Actor

(i) Importer (ii) Assembler (iii) Wholesaler (iv) Retailer (v) Installer (vi) Exporter

(vii) Manufacturer (please list products)

(viii) Operation (ix) Maintenance (x) Monitoring (xi) Other

Market Access, Trends and Governance

(i) What do you see as your main need in accessing markets for solar products?

(ii) What do you see as your main opportunity?

(iii) To whom do you sell your solar products or services (please add the percentage that each has)?

- Large firms:
- Small firms:
- Wholesalers:
- Exporters:
- Retailers:
- Direct to consumers:

(iv) Describe the relationships you have with these buyers. Who determines what to produce, product specifications, prices, and amount purchased? How much input do you have?

(v) How do you promote and market your solar PV products/services?

(vi) How strong is the market for your solar products/services right now? How much MW of product have you sold this year? How much estimated revenue have you generated this year (USD)? Next year? What trends do you see?

(vii) Are some customer groups better than others in terms of sales and revenue growth? If so, which ones?

(viii) How would you rank the quality awareness level of your customers on a scale of 1 to 10? (1 being totally unaware and 10 being highly aware)

(ix) Are there any specific system components for which the customers demand quality? If so, which components are they?

(x) Who are your major competitors?

Quality Awareness of Target Groups

(i) Which high-quality solar products do you see being popular and being sold in high volumes in Pakistan?

(ii) How much more, in percent, do you think the Pakistani population would be being willing to pay for high-quality products compared to existing products available in the market?

(iii) What do you see as the crucial components for durable solar systems in Pakistan?

(iv) What proportion of the present solar components in the local market would you say are high-quality? Which higher-quality components are generally locally available at present?

(v) What is your perspective regarding cost versus quality of local versus imported? What is the general opinion of the consumers in this regard?

Standards and Certifications

(i) What standards or certification requirements do your solar products fulfill voluntarily?

(ii) Do your customers ever request you to provide details of certifications?

(iii) Are you in favor of complying with the soon-to-be-introduced quality import standards?

(iv) Once the standards are implemented, what proportion of the solar products available in the local market do you expect to comply with these standards?

Technology / Product Development

(i) What are your major needs in product design and manufacturing (or service delivery)?

(ii) What are your major opportunities in product design and manufacturing (or service delivery)?

(iii) What percentage does each solar product represent in terms of your gross revenue?

(iv) What have you done recently to improve your solar products or services?

(v) Is your current equipment or machinery an impediment to growth? Explain. If so, what kind of equipment or machinery could improve your business?

(vi) Is the current level of your workers' training holding back growth? If so, what additional training do they need?

Management/Organization

(i) In the area of organization and management, what are your major needs/opportunities?

(ii) Who has the operational responsibility for the following?
Please specify if this is a) the owner; b) employees or c) external:

a. General management/supervision:
b. Product design:
d. Production:
g. Marketing:
h. After-sales services:
i. Repairs

(iii) Do you presently or would you consider collaborating with other firms to produce and deliver customer orders? If so, what possible types of synergies do you envision?

(iv) Which aspects of your business do you intend to change in the next 2 years (machinery, equipment, computers, new products, marketing strategy, quality control, management system, worker skills, etc.)?

(v) What management skills would you like to strengthen in order to grow your business?

Input Supply

(i) What are your major needs in the areas of input cost, quality, and availability?

(ii) What are your major opportunities in the areas of input cost, quality, and availability?

(iii) Who are your most important suppliers and what do you buy from each?

(iv) Are there problems in obtaining some important inputs? Explain.

(v) Have you ever purchased inputs jointly with other business? Explain.

Imported Items

(i) Please specify the country from where the following products are imported?

PV panels:

Inverters:

Batteries:

Charge controllers:

Wiring:

Others (mention here):

(ii) Why are you importing products?

a. Products are not locally produced:

b. Products have better quality:

c. Other:

(iii) What specific criteria are being used to select the products to be imported? (price, quality, proximity etc.?)

(iv) What are the key obstacles/barriers faced by your business relating to the import of solar PV equipment into the country?

(v) What possible suggestions do you see to remove these obstacles/barriers?

Finance

(i) Where do you go when you need money for your business?

(ii) Do you get credit from input suppliers? What are the terms?

(iii) Do you get production financing from your buyers? What are the terms?

(iv) Do you have a need for additional financing at the moment? If so, what would it be used for?

(v) What sources (formal or informal) have you approached for loans, and what have been the key problems, if any?

(vi) Other (repayment rates in the sector, risk management insurance, etc.)

Policy/Regulation

(i) What government policies/regulations benefit your business (registrations, inspections, subsidies, incentives, etc.)?

(ii) What government policies/regulations are obstacles to growing your business?

Infrastructure

(i) What are the most important infrastructure constraints affecting your business' growth and profitability (road/transport conditions, telephone service, electric supply, crime/corruption, storage, etc.)?

(ii) What is your industry doing about these problems?

Business Membership Organizations

(i) Is your solar PV sector represented by national or local business associations?

If so, please name them.

(ii) Are you a member? If not, why?

(iii) What are the primary functions and benefits of these associations?

(iv) What additional services should they provide?

Open-ended Questions

(i) Which are the high-potential areas for solar PV products in Pakistan?

(ii) What are the preferences of the different customer segments regarding product qualities?

Commercial

Residential

Industrial

Govt. buildings (schools, district administration offices etc.)

(iii) Payback time expectations of each customer segment

Commercial

Residential

Industrial

Govt. buildings (schools, district administration offices etc.)

(iv) How do you see the business environment in the country for solar businesses?

(v) What are the major incentives you have for investing in / promoting change in the solar PV value chain?

(vi) What risks or constraints do you face in making these investments?

(vii) What do you think are the strengths of the solar PV industry, locally and/or internationally?

(viii) What are the main weaknesses of the solar PV industry in Pakistan?

(ix) What do you think is the greatest challenge facing the solar PV industry today in Pakistan?

(x) Can you name some business owners in the solar PV industry who are leaders – in terms of technology, product design, quality, or marketing, for example?

Annex C

Details of Interviewed Value Chain Actors

S/NO	NAME OF PERSON CONSULTED	NAME OF COMPANY	CONTACT DETAILS
1	**Mr. Khurram Jan Chaudhry**	JKS (Private) Limited	khurram@jks-int.com / 0321-8489828
2	Mr. Usman Ahmed	Nizam Energy (Private) Limited	usman@nizamenergy.com / 0300-8250564
3	Mr. Waleed Elahi	Green Gen Solutions (Pvt) Ltd	waleed@greengen-solutions.com / 0300-8565319
4	Engr. Muhammad Ishaq Bhatti	Read Solar (Pvt) Ltd	ishaqbhatti@hotmail.com / 0321-4441400
5	Lt. Col Ahmed Fawad Farooq	Sun & Seams (Fawad Enterprises)	Fawadenterprises9@gmail.com / 0321-7869900
6	Mr. Muhammad Rizwan	Hisel Power	Muhammad.rizwan@hiselpower.com / 0344-4473993
7	Mr. Mian Sultan Mehmood	Creative Electronic (Pvt) Ltd	Sultan1256@hotmail.com / 0320-8800172
8	Mr. Haseeb Saadat(FESCO)	Allied Vitalite (Pvt) Ltd	Haseeb.saadat@gmail.com / 0345-4445666
9	Mr. Gul Sher Khan	Alpha Renewables (SMC-Pvt) Ltd	gulsher@alphasolar.com.pk / 0321-6149491
10	Mr. Rizwan Kausar	Linktech	riz@linktech.com.pk / 0333-5191865
11	Mr. Nisar	Solar Sigma	0301-5356635
12	Mr. Khalid Zaheer	Shama Solar	Khalid.zaheer@shamasolar.com.pk
13	Mr. Yasir Khan	Khan Brothers	Yasir@khanbro.com.pk
14	Mr. Ahsan	TESLA Solar	0321-8375278
15	Mr. Jeremy Hicks	Eco Energy	0322-2673973
16	Mr. Shaaf Mehboob	Adaptive Technologies	0300-8280123
17	Mr. Shafqat Iqbal	Baykee Pakistan	0321-9812222
18	Mr. Farhan	Power Highway	42 36370380
19	Mr. Hamza	Global Power	Hamza@globalpower.com.pk
20	Mr. Naseer	Atlas Power	3469740415
21	Mr. Khalid	Yaseen Sons	Khalid@yaseensons.com.pk
22	Mr. Hassan Waqas	Kinetix Power	Waqas.hassan@kinetixpower.com
23	Mr. Zamir Ahmed	Go-Solar	0300-5001244
24	Mr. Nadeem Siddique	Nadeem Solar	0333-7811227
25	Mr. Nauman Khan	Grace Solar	321 4083040
26	Mr. Rasheed Ramay	RH Solar	0345-9740413

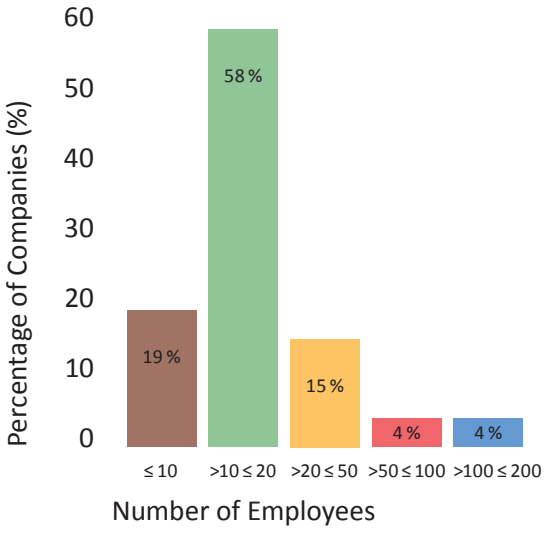
Key Public-Sector Stakeholders Consulted

S/NO	NAME OF OFFICIAL	INSTITUTION NAME
1	Irfan Yousaf	Alternative Energy Development Board (AEDB)
2	Asad Saleem	Alternative Energy Development Board (AEDB)
3	Shahzad Mehmood	Chief WEBOC Operations
4	Rana Adnan	Senior Customs Officer – Karachi Port
5	Akhter Khan	Customs Clearing Agent (Private)

C.1 Employee Workforce

As can be observed in the next figure, 19 percent of the firms have ten or fewer employees, while 58 percent of the firms have more than ten but less than or equal to twenty employees. Furthermore, 15 percent of the firms have a workforce between 20 and 50 people, while the larger market leaders that were consulted have workforces ranging between 100 to 200 people.

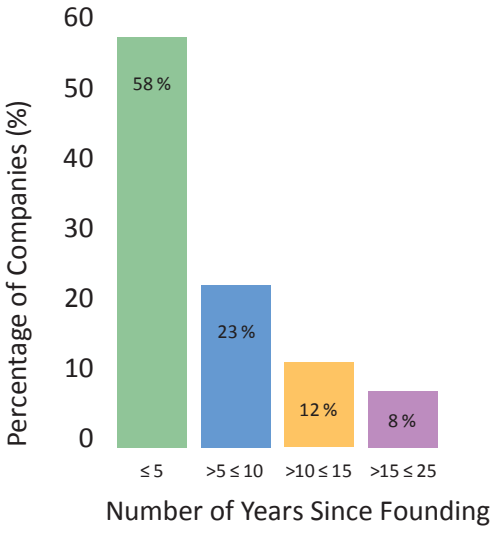
It is worth mentioning that most PV companies in the local market prefer to maintain a small employee workforce to limit their overhead costs. A large number of PV companies choose to develop joint ventures with other companies to bid for projects and increase their chances of winning a tender by displaying a larger employee workforce.



Employee Workforce of Interviewed Solar Firms

C.2 Age of PV Companies Consulted

As can be seen in the figure below, the age of firms consulted varied, with 58 percent of firms founded five or less years ago and 23 percent of firms founded between 5 and 10 years ago and 12 percent of firms founded between 10 and 15 years ago. A small proportion (8 percent) of the firms consulted were founded between 15 and 25 years ago and are basically the market leaders at present, with a considerable market share due to early entry into the PV market.

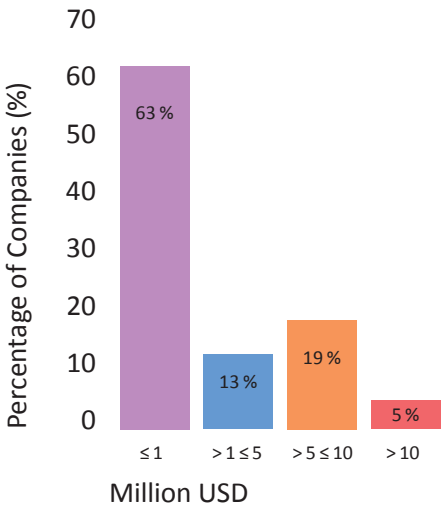


Age of Interviewed Firms

C.3 Annual Turnover of Companies Consulted

The distribution of annual turnover of the PV businesses consulted is depicted in the figure below. Considering the market turbulence in the local market due to the reduction in oil prices and the general slowing of business in the past year, 63 percent of the businesses reported turnovers of less than 1 million USD. By comparison, 13 percent of the businesses reported turnovers between 1 and 5 million USD with 19 percent of the solar businesses having a turnover of between 5 and 10 million USD.

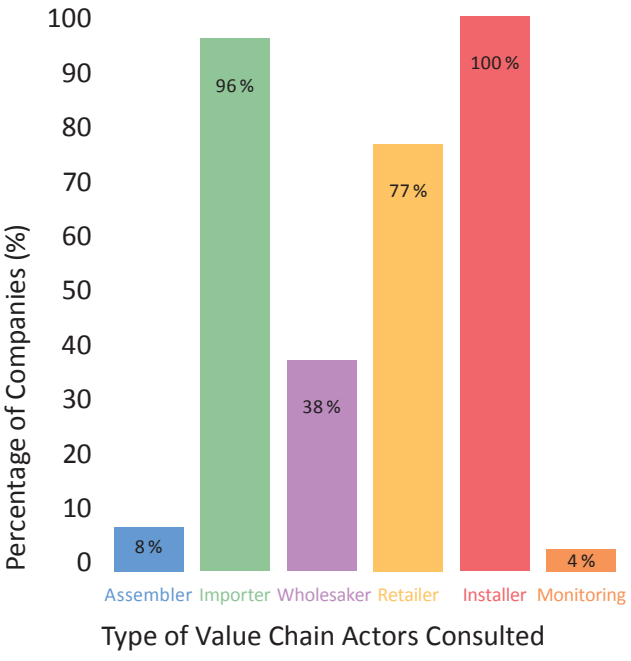
Only 5 percent of businesses mentioned turnovers of over 10 million USD.



Annual Turnover of Companies Consulted

C.4 Types of PV Businesses/Companies Consulted

The breakdown of the type of PV businesses and companies consulted is shown in the next figure:



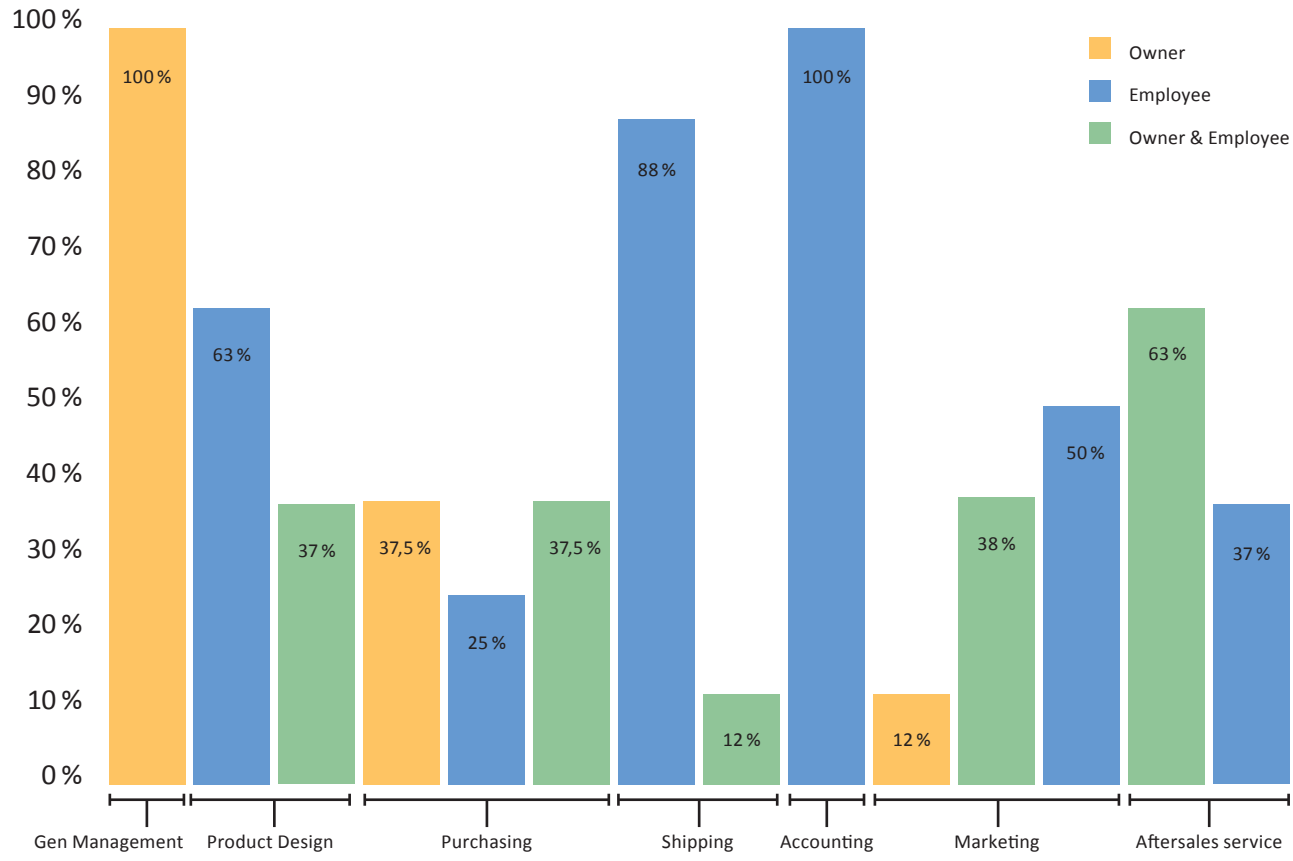
Types of PV Businesses Consulted

C.5 Allocation of Management Tasks

The allocation of different management tasks based on the solar businesses consulted is provided in the figure below. As can be observed, the general trends observed consist of the general management conducted by the owners of the businesses themselves.

The responses obtained showed that 'product design' is conducted either solely by the owner (37.5 percent) or the employee (63 percent) and also jointly by both the owner and employee (36 percent).

Similarly, with regards to 'purchasing', 25 percent of the firms mentioned use their employees for this part of their business, while the 37.5 percent of the firms interviewed stated that 'owner and employee' jointly conduct this particular task. It was observed that 'Shipping' is taken care of by the employee in the majority of the responses received, while routine tasks such as 'accounting' are also conducted completely by the employees. 'Marketing' is managed jointly by the 'owner and employee,' while 'after-sales service' is also conducted jointly.



Allocation of Management Tasks

Annex D

Import Quality Standards for Solar PV in Pakistan[26]

IEC Quality Standards

S/NO	IEC STANDARDS	TITLE
1	IEC 61646:2008	Thin-film terrestrial photovoltaic (PV) modules design qualification and type approval
2	IEC 61439-1:2011	Low-voltage switchgear and control gear assemblies – Part 1: General rules
3	IEC 60947-3:2008+A1:2012	Low voltage switchgear and control gear – Part 3: switches, disconnections, switch disconnections and fuse combination units
4	IEC: 62103:2003	Electronic equipment for use in power installations (e.g. EN 50178:1998)
5	IEC: 62930	Electric cables for photovoltaic systems (BT(DE/NOT)258) (e.g. EN 50618)
6	IEC 62103 (2003-07) Ed.1.0	Electronic equipment for use in power installations
7	IEC 61701:2011	Salt mist corrosion testing of photovoltaic (PV) modules
8	IEC 62116:2014	Protection against islanding of grid (utility-interconnected photo-voltaic inverters – test procedure of islanding prevention measures)
9	IEC 61683: 1999	Photovoltaic systems – Power conditioners – Procedure for measuring efficiency
10	IEC 62509:2010	Battery charge controllers for photovoltaic systems – Performance and functioning
11	IEC 62093:2005	Balance-of-system components for photovoltaic systems – natural environments
12	IEC 62124: 2004	Photovoltaic (PV) stand-alone systems – Design verification
13	IEC 62253: 2011	Photovoltaic pumping systems – Design qualification and performance measurements
14	IEC 62257 (2013)	Recommendations for small renewable energy and hybrid systems for rural electrification – Part 1: General introduction to IEC 62257 series and rural electrification
15	IEC/TS 62257-9-5: 2013 (E)	Recommendations for small renewable energy and hybrid systems for rural electrification – Part 9-5: Integrated system – Selection of stand-alone lighting kits for rural electrification

26 **To be implemented soon.**

IEC Safety Standards

S/NO	IEC STANDARDS	TITLE
1	IEC 62109-1:2010	Safety of power converters for use in photovoltaic power systems – Part 1: General requirements
2	IEC 62109-2:2011	Safety of power converters for use in photovoltaic power systems – Part 2: Particular requirements for inverters
3	IEC 61730-1:2004	Photovoltaic (PV) module safety qualification – Part 1: Requirements for construction
4	IEC 61730-2:2004	Photovoltaic (PV) module safety qualification – Part 2: Requirements for testing
5	IEC 61439-1: 2011	Low-voltage switchgear and Control gear assemblies – Part 1: General rules

IEC Environmental Standards

S/NO	IEC STANDARDS	TITLE
1	IEC 62109-1:2010	Safety of power converters for use in photovoltaic power systems – Part 1: General requirements
2	IEC 62109-2:2011	Safety of power converters for use in photovoltaic power systems – Part 2: Particular requirements for inverters
3	IEC 61730-1:2004	Photovoltaic (PV) module safety qualification – Part 1: Requirements for construction
4	IEC 61730-2:2004	Photovoltaic (PV) module safety qualification – Part 2: Requirements for testing
5	IEC 61439-1: 2011	Low-voltage switchgear and Control gear assemblies – Part 1: General rules

The following standards have already been adopted:

- IEC: 61215 for crystalline silicon terrestrial photovoltaic (PV) modules - design qualification and type approval.
- IEC: 60529 for degrees of protection provided by enclosures (IP Code).

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