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The Future of Net-Metered Solar Power in Pakistan

Proposed policy shifts may increase payback periods but would encourage self-consumption and steady growth.

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Key Findings

Pakistan's current Distributed Generation and Net Metering Regulations offer incentives such as high buyback rates, fixed long-term generation licenses, and generous allowances for installed capacity. These have resulted in ideal payback periods, leading to a surge in net-metered rooftop solar photovoltaic (PV) capacity across the country.

The current policy offers 2-4 year payback periods for 5-25 kilowatt (kW) net-metered solar PV systems. Power utilities are concerned that higher penetration of distributed solar could place the distribution infrastructure at risk of failure and increase capacity payments on non-net-metered consumers.

The government is considering reducing buyback rates and a shift to net billing from net metering, which could increase payback periods for consumers with a higher self-consumption ratio but may incentivize oversized systems. A net billing scheme would therefore need to limit system size. Despite all policy shifts, the payback periods remain under 5 years.

For the government, while maintaining or improving buyback rates can encourage more renewable energy adoption, this must be combined with grid optimization and digitization. For consumers, choosing the right system size for their consumption profile can significantly impact their return on investment.

Executive Summary

Pakistan's current Distributed Generation and Net Metering Regulations offer lucrative incentives such as high buyback rates, fixed long-term generation licenses, and generous allowances for installed capacity. With solar photovoltaic (PV) prices rapidly declining globally, these provisions have resulted in ideal payback periods, leading to a recent surge in net-metered rooftop solar PV capacity across the country.

Rapid solarization offers multiple benefits such as the supply of cost-competitive clean energy to the grid, and a reduction in the daytime peak for the national grid. However, the power transmission and distribution utilities are concerned that higher penetration of distributed solar in the system could place the distribution infrastructure at risk of failure and increase capacity payments on non-net-metered consumers. Therefore, the government is considering scaling back the current incentives, including a reduction in buyback rates, and a shift to a net billing mechanism.

The payback period is the most common metric defining the investment potential of rooftop solar PV in Pakistan. This report quantifies the impact of several policy amendments under consideration for the current net metering regulations on the payback period for rooftop solar PV in the country:

1. The current government offers attractive payback periods between 2-4 years for 5-25 kilowatt (kW) net-metered solar PV installations in Pakistan. Larger systems generally have lower payback periods due to lower per kW costs.

2. Reducing the buyback rate from the National Average Power Purchase Price (NAPPP), PKR27 per kilowatt hour (kWh), to the National Average Energy Purchase Price (NAEPP), PKR9.69/kWh, results in longer payback periods. However, for systems with a higher self-consumption ratio, the payback values remain within the 2-4 year range. The 5-year mark is crossed only for 5kW systems with a higher share of grid exports.

3. A more moderate buyback rate, such as PKR15/kWh, would offer reasonably low payback periods to consumers. This would encourage the addition of further net-metered capacity while stabilizing the rapid rate of solarization that concerns the government.

4. Switching to a net billing mechanism would extend the payback period for consumers with a higher self-consumption ratio, but it could also incentivize the installation of oversized systems to generate more credits, thereby significantly reducing payback periods. For larger systems, such as 25kW, the payback period could drop to just over a year as the proportion of grid exports increase. Therefore, if the government's

goal is to extend the break-even point for these systems, a net billing regime would need to be paired with restrictions on the size of systems that consumers can install.

5. Reducing the capacity of distributed generators to 80% of the sanctioned load leads to a longer payback period compared to a standard net metering mechanism. This extension of the payback period is most pronounced under a net billing scheme when the generator capacity is capped at 80% of the sanctioned load.

6. Net metering generally remains more beneficial for average sized systems, such as a typical 10kW installation, especially for consumers who utilize a higher share of generated output.

Policymakers, regulators, and consumers must recognize that selecting the right incentives requires a careful balance. For the government, maintaining or improving buyback rates can encourage greater adoption of renewable energy, but this must be paired with grid optimization and digitization efforts. For consumers, selecting the right system size and understanding their consumption profile are crucial factors that can significantly affect their return on investment.

Background and Challenges

Pakistan's Distributed Generation and Net Metering Regulations, commonly referred to as "net metering regulations" for residential rooftop PV systems, have recently become a topic of debate. The government is considering eliminating some of the incentives currently offered to net-metered consumers.

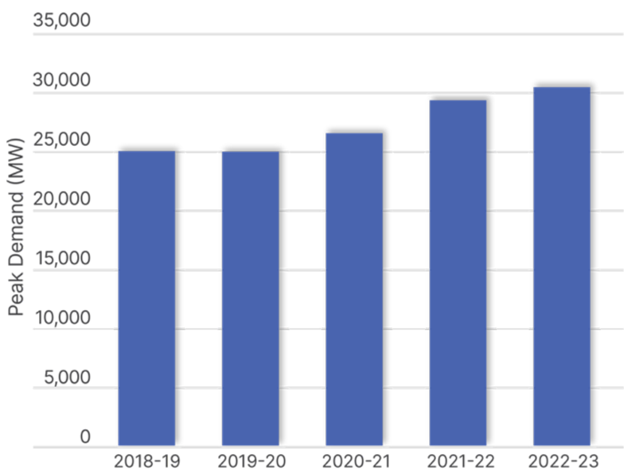
Under the current net metering regulations, residential, industrial, agricultural, and commercial consumers can install on-site distributed generation systems to reduce their dependence on the grid for electricity supply and achieve monetary savings amid rising power tariffs.[1] Consumers are also allowed to sell any excess energy generated by their systems to the national grid, thereby resulting in additional savings.

The regulations are consumer friendly, providing a lucrative buyback rate and favorable payback periods, ranging between 2-4 years, which has led to a surge in the adoption of solar PV at the residential level. However, power distribution companies (DISCOs) claim that the widespread adoption of rooftop by affluent consumers is impacting their recoveries and revenue generation, prompting the government to reconsider these incentives.[2] The DISCOs and the Power Division (Ministry of Energy) argue that, despite the benefits of peak shaving from residential solar during the day, the grid still needs to maintain idle capacity for the evening peak, which is gradually increasing. This rise is due to net-metered consumers shifting back to the grid at

[1] NEPRA. National Electric Power Regulatory Authority (Alternative & Renewable Energy) Distributed Generation and Net Metering Regulations. 01 September 2015.
[2] Aaj News. Solar panels: NEPRA, Power Division directed to change net metering rules. 16 May 2024.

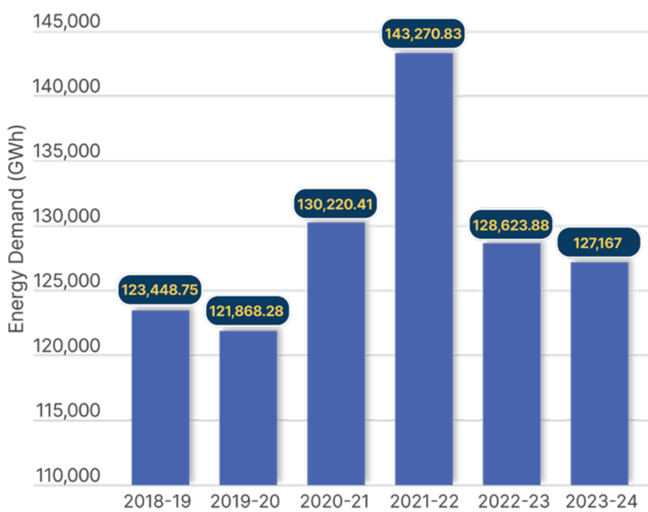
night.[3] The Ministry of Energy believes that this situation increases capacity charges per unit of electricity supplied by the grid, leading to higher electricity tariffs for other consumers.[4, 5]

Figure 1: Increase in Peak Demand Over the Years



Source: NEPRA, State of the Industry Report 2023.

Figure 2: Total Electricity Generation: All Pakistan - Excluding K-Electric (GWh per annum)



Source: NEPRA, State of the Industry Report 2023.

The recent decrease in the cost of Chinese solar panels, which constitute about 40% of the total cost for a rooftop solar PV system, has also led to attractive payback periods since the

[3] Profit. Govt to shift from net to gross metering for solar panels amid IMF talks. 19 May 2024.
[4] Business Recorder. Buyback rate of net metering likely at average energy cost. 19 July 2024.
[5] Business Recorder. Revision of buyback rates: PM directs Nepra, PD to amend net metering rules. 16 May 2024.

government's offer of buying back excess power from these systems has remained consistent at the NAPPP, which is PKR27/kWh[6, 7] or US$9.7 cents per kilowatt hour (¢/kWh).

The government is considering adjusting the incentives provided to net-metered systems. This would include the conversion of the existing net metering scheme to a gross/net billing mechanism, where separate rates would be charged for electricity imported from and exported to the grid. Additional adjustments include the revision of buyback rates to a lower value and the creation of a separate tariff category for net-metered consumers.[8, 9]

In 2022, the National Electric Power Regulatory Authority (NEPRA) proposed replacing the term 'National Average Power Purchase Price (NAPPP)' with 'National Average Energy Purchase Price (NAEPP)'[10], which would have brought the buyback rate at the time down to PKR9.69/kWh. The NAEPP only considers the marginal cost of electric supply (variable charges) and is significantly lower than the NAPPP, which comprises of fixed capacity charges, fuels costs (variable charges), Use of System Charges (UoSC), market operator fee, and transmission losses.

> **Gradually phasing out incentives is standard for new technologies after achieving maturation and main objectives.**

Gradually phasing out incentives is standard for new technologies after achieving maturation and main objectives. For example, Vietnam had a generous feed-in tariff (FiT) of US$9.35¢/kWh for small-scale and utility-scale solar in 2017 leading to the addition of almost 5 gigawatts (GW) of solar power by 2019. The FiT was then scaled down to US$8.38¢/kWh for rooftop solar power projects, US$7.09¢/kWh for ground-mounted solar projects, and US$7.69¢/kWh for floating solar power projects. Regardless, it led to 11.6GW being added to the grid by 2020.[11, 12] After the FiT scheme expired in 2020, it was extended in January 2023 for projects that had achieved commercial operations after the FiT expiry, but at a much lower tariff of around US$5.1¢/kWh.[13] In the same month, Vietnam's Ministry of Industry and Trade (MOIT) introduced further revisions, for solar and wind projects which included abolishing the FiT scheme and the fixed 20-year power purchase contract. The new arrangement also saw an annulment of the Vietnamese Dong (VND)/US$ exchange rate, with all future electricity prices being determined in the local currency only.[14]

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[6] The current NAPPP has increased to PKR 27/kWh from 01 July 2024 due to a change in base tariff.
[7] NEPRA. Decision of the Authority in the matter of request filed by CPPA-G for Power Purchase Price Forecast for the FY 2024-25. 14 June 2024.
[8] Business Recorder. Net metering policy likely to be revisited: Leghari. 20 May 2024.
[9] Business Recorder. Revision of buyback rates: PM directs Nepra, PD to amend net metering rules. 16 May 2024.
[10] NEPRA. Net Metering License Notice. 27 September 2022.
[11] CMS Law. CMS's expert guide to renewable energy development in Vietnam.
[12] Mordor Intelligence. Industry Reports – Vietnam Solar Energy Market.
[13] Vietnam Briefing. Explained: Vietnam's FiT Rates for Solar and Wind Power Projects. 16 January 2023.
[14] Ibid.

The MOIT recently announced a net metering proposal for rooftop solar in Vietnam. Under the new scheme, the government would offer a VND671 (US$0.026)/kWh tariff for surplus solar power. The government also indicated that any excess PV energy sold to the grid may not exceed 10% of the total power generated by a rooftop PV installation. This limits any motivation for setting up oversized installations and encourages a higher share of self-consumption.[15]

Similarly, in 2009, the Premium Feed-in Tariff (PFiT) was officially launched in Victoria, Australia, offering households and small businesses a high rate of AUD60¢/kWh for excess electricity exported to the grid. This rate was significantly higher than the retail electricity price, making solar installations attractive. Due to the program's success and the rapid uptake of solar PV systems, the PFiT was closed to new applicants in 2011. By then, thousands of households had already benefited from the program. Subsequently, the Transitional Feed-in Tariff (TFiT) was introduced to replace the PFIT, offering a lower but still attractive rate of AUD25¢/kWh. This program also experienced high uptake and was eventually closed to new applicants in 2012. In 2013, the Standard Feed-in Tariff (SFiT) was introduced, offering a flat rate of AUD8¢/kWh for excess electricity exported to the grid. This program shifted towards more sustainable and economically balanced support for solar PV systems.

In 2017, Victoria's Essential Services Commission (ESC) again introduced significant changes to the FiT structure. A minimum FiT rate was set annually, reflecting wholesale electricity prices and the environmental and social value of distributed generation. In 2018, a time-varying FiT option was also introduced, allowing solar system owners to receive different rates depending on the time of day when they exported electricity to the grid. This change aimed to better align solar generation with electricity demand.

Since 2020, the minimum single-rate FiT and time-varying FiTs have been designed to reflect the changing dynamics of the electricity market and encourage efficient use of solar energy. Currently, the single-rate FiT is AUD3.3¢/kWh and the time-varying rate is AUD2.1-8.4¢/kWh.[16] Recently, there has been increasing emphasis on integrating battery storage with solar PV systems to maximize self-consumption and reduce reliance on the grid. Government programs and incentives have been introduced in Victoria to support the adoption of battery storage solutions.

In Pakistan, the government's attempt to adjust incentives for net metering has been met with resistance from consumers and representative bodies like the Pakistan Solar Association. These amendments may result in much higher payback periods for consumers and dis-incentivize further investment in rooftop solar in the country.[17]

While a lack of favorable financing options from the state has meant that most consumers have been installing these systems at their own expense, with returns on their investments calculated

[15] PV Magazine. Vietnam sets $0.026/kWh tariff for net-metered solar power. 16 July 2024.
[16] Essential Services Commission. Minimum feed-in tariff review 2024–25.
[17] AAJ TV. Solar Association hits out at govt for attempting to revise net metering. 06 September 2023.

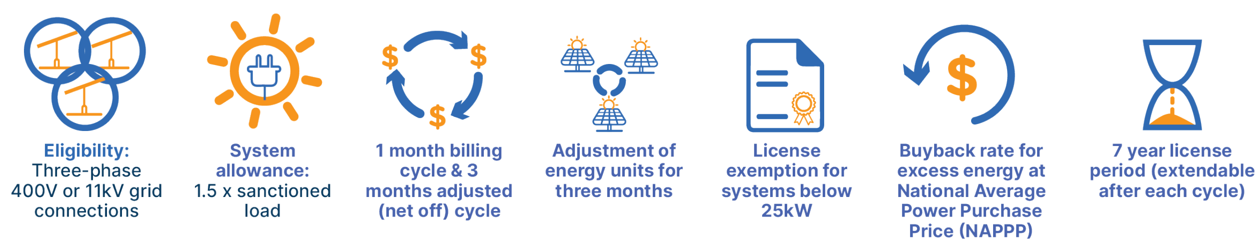
at prevailing buyback rates, the idea that a reduction in current buyback rates will have an oversized impact on payback periods and profitability may not be wholly correct.

This report identifies the impact of reduced incentives on energy/monetary savings for different configurations of solar PV installations. It argues that a gradual phasing out of incentives will have minimal impact on the profitability of rooftop PV systems, provided the system is adequately sized and the reduction in the buyback rate is not significant.

Net Metering Regulations in Pakistan

Pakistan first introduced net metering in 2015 through its Distributed Generation and Net Metering Regulations, with the dual aims of addressing the country's acute generation shortages—nearly 4000 megawatts (MW) —and promoting renewable energy under the first renewable energy policy of 2006.[18] These regulations allowed three-phase consumers on the grid to set up small-scale renewable energy installations on their premises, with capacities ranging from 1kW to 1MW, depending on the sanctioned load[19] permitted by the relevant power distribution utility. Since its inception, the net metering regulation has undergone several amendments in 2017, 2018, 2020, and 2022. These changes saw the buyback rate altered from the off-peak rate[20] to the NAPPP, the distribution generation license granted to the installer being extended from three to seven years, and an exemption from generation licenses from the regulator for net-metered systems below 25kW.[21] Figure 3 below further elaborates the features of the current Net Metering Regulations.

Figure 3: Features of the Current Distributed Generation and Net Metering Regulations



Source: Distributed Generation and Net Metering Regulations 2015; NEPRA.

*Note: **1 month billing cycle & 3 months adjusted (net off) cycle**: The DISCOs adjust (net off) energy supplied by the net-metered facility at the end of each monthly billing cycle. The energy supplied during peak hours is net off against the energy consumed from the grid during peak hours, and the energy supplied during off-peak hours is net off against energy consumed from the grid during off-peak hours. Since solar power generation normally happens during daylight, all power supplied to the grid is during off-peak hours.*
*Note: **Adjustment of energy units for three months:** If the energy supplied to the grid exceeds the amount consumed by the generator, the net energy fed back to the grid is credited against the distributed generator's next billing cycle for future consumption or is paid by the distribution company to the distributed generator every quarter, after adjustments from the energy bill if left over. However, in practice, the distribution companies show a credit on the bill which can be adjusted for a future month's electricity bill.*

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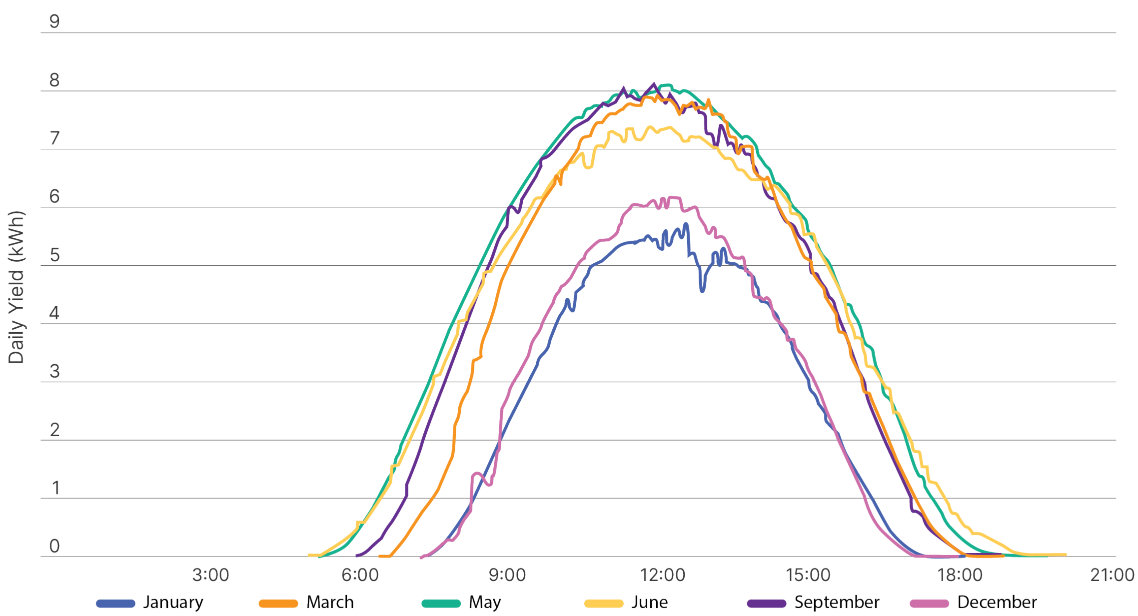
[18] PPIB. Net Metering Reference Guide for Electricity Consumers.
[19] Sanctioned load refers to the load in kilowatts (kW) applied for by the consumer and allowed / authorized by the distribution company for use by the consumer.
[20] In Pakistan, Time of Use (TOU) rates are applicable to three-phase connections, with a sanctioned load of 5kW or above. TOU rates price electricity according to the time of the day, with peak hours depicting the 4–5-hour evening peak, when grid consumption is the highest. Off-peak hours include the rest of the day. Peak-hour rates are designed to lessen the load on the grid and hence are usually higher than the off-peak rate.
[21] The National Average Power Purchase Price (NAPPP) is determined by the National Electric Power Regulatory Authority (NEPRA) and notified by the Federal Government annually. The NAPPP is the average per unit price of power borne by the DISCOs on a unit purchased basis, excluding transmission & distribution (T&D) losses and distribution margins allowed to the DISCOs.

Net-metered Solar PV in Pakistan

Pakistan's on-grid net-metered solar PV capacity was approximately 2200MW in June 2024. Historically, the onset of growth in distributed rooftop solar PV systems has been slow, given the lack of favorable financing from the government and commercial banks, and the initial high cost of installation and solar panels. As shown in Figure 6, only 50MW of net-metered solar capacity was added between 2016 and 2019. However, the last three years have seen a boom in the rooftop solar PV market, as prices of solar panels decreased 42% globally in 2023.[22] Rising electricity tariffs have also contributed to the increasing solar PV adoption trend, with high-consumption residential consumers paying up to US$ 22 cents for a unit of electricity.[23] Since 2022, the amount of net-metered solar PV installations have almost doubled, with 764MW installed in 2023. This upward trend is expected to continue, as seen during the first half of 2024, when 450MW of rooftop solar capacity was added to the grid.

Pakistan's abundant solar potential offers specific yields in the range of 3.8 kilowatt-hours per kilowatt peak (kWh/kWp) to 6kWh/kWp across the country, with a typical sunny day receiving almost 12 hours of sunshine even during winters.[24]

Figure 4: Average Yield of a Typical Sunny Day for a 10kW System in Central Pakistan

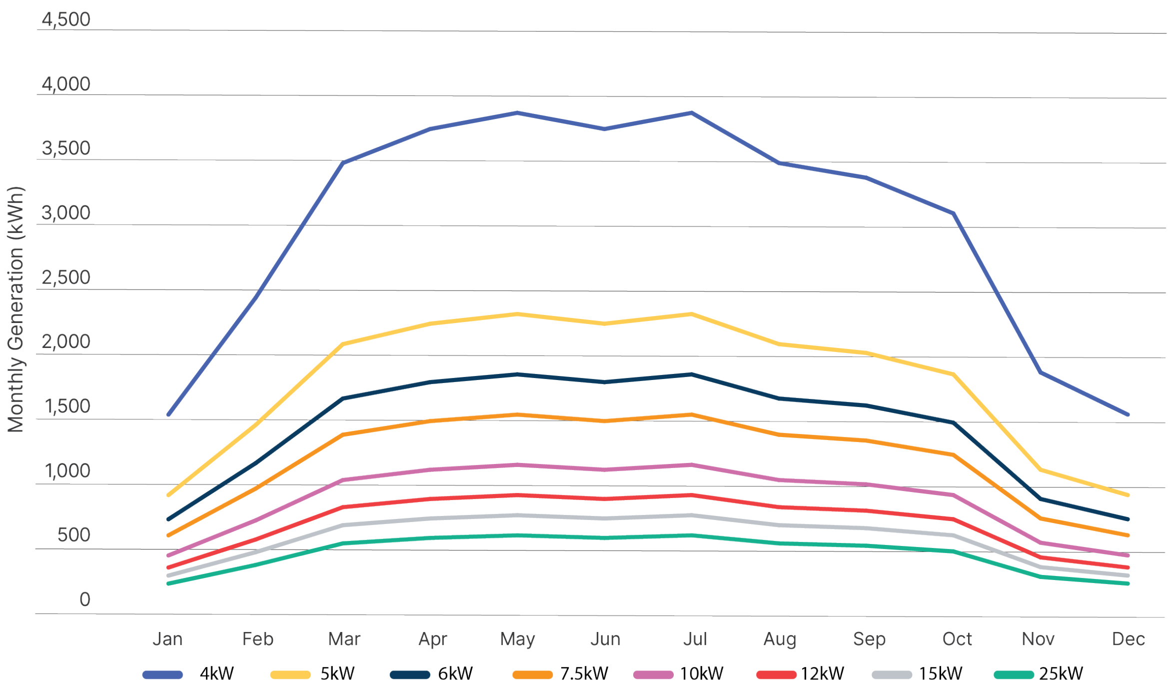


Source: SolisCloud; Author Analysis.

[22] Asia Financial. China Solar Panel Costs Plunge in 2023, 60% Cheaper Than US. 14 December 14 2023.
[23] According to NEPRA's latest uniform applicable variable tariff for the DISCOs, high consumption residential consumers (700 units or above) have a notified tariff of PKR 49/kWh. This is supplemented by taxation up to 25%, which raises the actual tariff billed to the consumer to PKR 61/kWh or US$22c/kWh.
[24] SolarGIS Map Photovoltaic Electricity Potential of Pakistan.

On average, a rooftop solar PV system is expected to have a specific production yield of 4kWh/kWp of installed capacity, but generation patterns change with the season. Spring and summer usually produce the highest system output, which gradually tapers down to half its value during winter.

Figure 5: Monthly Generation Profiles for Various System Configurations in Central Pakistan[25]

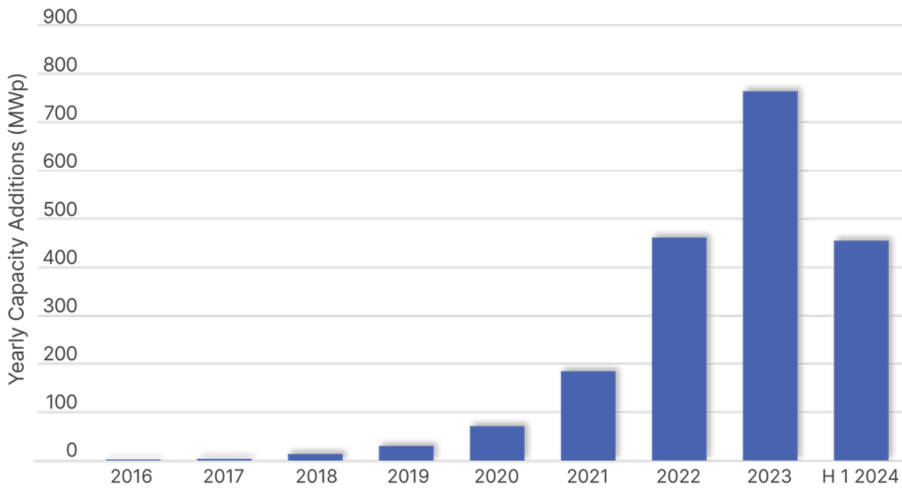


Source: PV Syst; Author Analysis.

Since net-metered connections are mainly intended for self-consumption, only a minimal portion of this supply goes to the grid. According to NEPRA's State of the Industry Report 2023 and the Private Power Infrastructure Board (PPIB)[26], the cumulative net-metered capacity of all the DISCOs was 1055.03MW in June 2023, including domestic, agricultural, commercial, and industrial installations. This 1GW of installed capacity supplied 809 gigawatt hours (GWh) to their respective DISCOs, which amounts to only 0.56% of the total energy provided by the grid in 2023.[27] Consequently, net-metered consumers may not be the actual cause of the problem. The DISCOs are aware of larger industrial and commercial consumers setting up self-generating solar PV plants and exiting the grid, but these cases remain unquantified due to their grid independence.[28]

[25] Solar PV Generation Profiles have been obtained through PV Syst, a simulation software that predicts generation output.
[26] Private Power and Infrastructure Board. Brief on Net Metering. June 2023.
[27] Author Analysis based on NEPRA's State of the Industry Report 2023.
[28] Business Recorder. Buyback rate of net metering likely at average energy cost. 19 July 2024.

Figure 6: Yearly Net-metered Solar PV Capacity Added to the National Grid (2016-2024)



Source: Author Analysis; NEPRA.

Cost of Generation from Distributed Solar Power Generation

For distributed rooftop solar PV installations in Pakistan, the largest contributor to the overall cost of generation is the price of solar panels, followed by the costs of inverters and wiring.

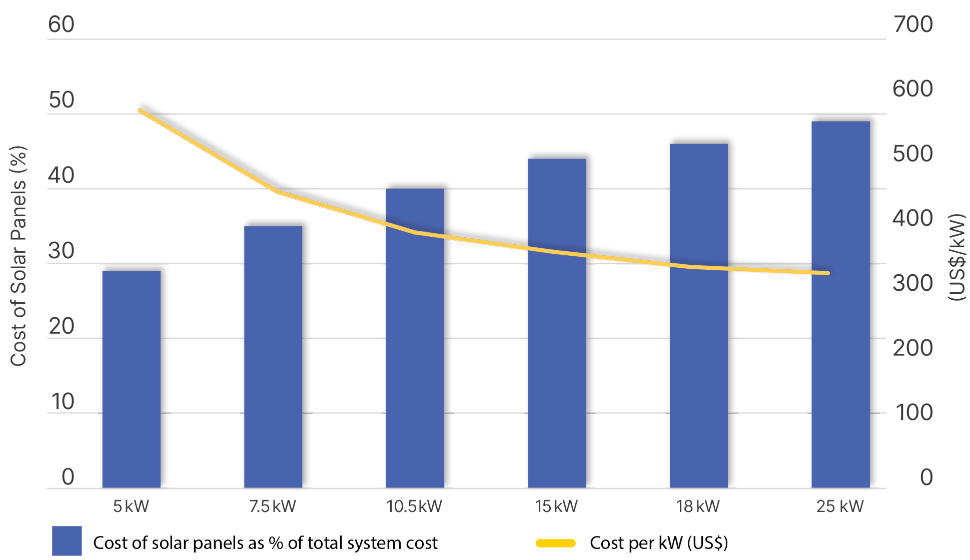
Table 1: Cost Comparison of Various Configurations of Solar PV Installations in Pakistan

Cost Input (PKR)	5 kW	7.5 kW	10.5 kW	15 kW	18 kW	25 kW
Solar Panels- monofacial	236,925	344,500	473,850	684,450	816,075	1,157,130
On-Grid Inverter	290,000	290,000	290,000	360,000	360,000	470,000
Mounting Structure- GI Stand	40,000	60,000	72,000	104,000	128,000	176,000
DC Wire	31,590	35,000	63,180	91,260	108,810	150,930
Breakers and DB Box	45,000	50,000	50,000	70,000	80,000	90,000
Earthing and Arrestor	55,000	55,000	80,000	80,000	80,000	120,000
Net Metering	100,000	100,000	100,000	100,000	100,000	100,000
Installation and Commissioning	20,000	30,000	42,000	60,000	72,000	100,000
Transportation and Handling	10,000	15,000	15,000	20,000	20,000	20,000
Total	828,515	979,500	1,186,030	1,569,710	1,764,885	2,384,060

Source: Author research based on quotations from solar PV vendors in Pakistan.

For smaller system sizes, like 5kW or 7.5kW, the cost per kW is higher and ranges between US$592/kW to US$466/kW since the inverter, wiring, and other installation costs remain the same as a 10kW system, while the energy output is less. As the system size increases, economies of scale apply, and the cost per kW decreases to approximately US$340/kW for a 25kW system.

Figure 7: Variation in Capital Cost with System Size for Solar PV Installations



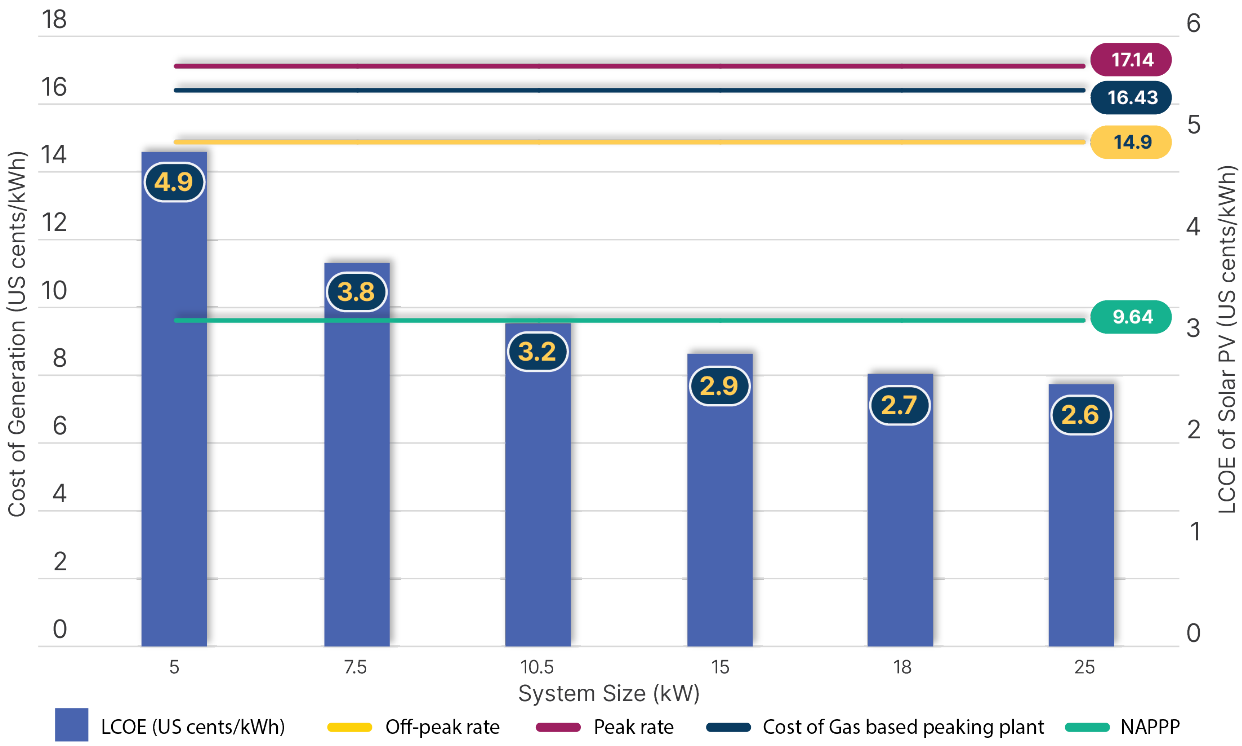
Source: IEEFA calculations.

This has a direct impact on the levelized cost of electricity (LCOE) generation as well. IEEFA's calculations reveal that the LCOE for net-metered distributed solar PV generation in Pakistan may range from US$2.6¢/kWh to US$4.9¢/kWh, depending on system size and configuration. Even at the higher end of this range, rooftop solar PV generation remains advantageous for both consumers and the off-taking utility.

For consumers, a net-metered solar PV connection not only allows low-cost self-consumption of power during the daytime, thus reducing reliance on grid imports, which may cost between US$15¢/kWh to US$17¢/kWh, but also allows for the additional units produced to be adjusted (netted off) during off-peak hours at night. Any excess leftover units may also be exported to the grid at the NAPPP.

For DISCOs, receiving supply from net-metered systems during the day is beneficial as it reduces the daytime peak load at a low cost of US$9.6¢/kWh, compared to the US$16¢/kWh cost of meeting that demand with a gas or LNG-based plant. However, the downside is that these net-metered consumers switch back to the utility grid after sunset, contributing to the system's rising peak demand, especially during summer.

Figure 8: Levelized Cost of Generation for Residential Net-metered Solar PV



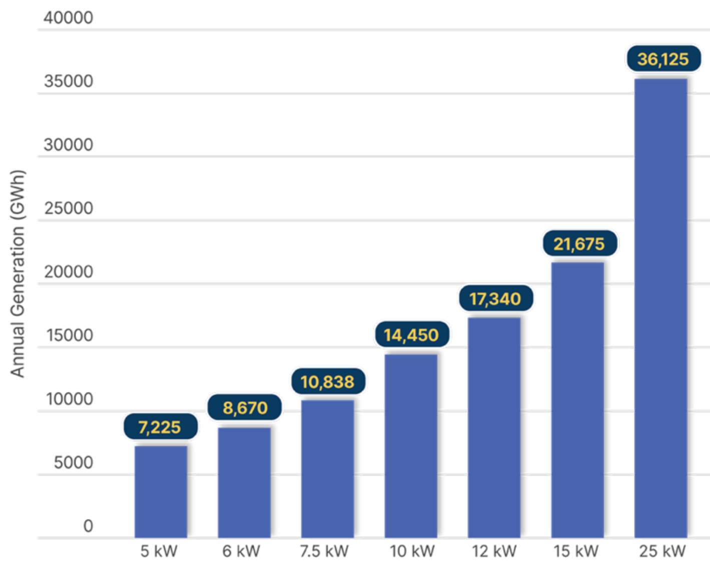
Source: IEEFA calculations; National Transmission and Dispatch Company (NTDC); NEPRA.
Note: LCOE analysis considers replacement of the inverter and 50% of the PV panels after 15 years of system operations.

Payback Period for Rooftop Solar PV Installations

Based on the cost data from the previous section, the payback period was calculated for 5kW, 7.5kW, 10kW, 15kW, and 25kW net-metered/grid-tied solar PV systems at the current buyback rate of PKR27/kWh. In addition, three scenarios were analyzed, each considering different consumption profiles:

- A high-consumption consumer profile utilizing 100% of the system's energy generation output
- A medium-consumption consumer profile utilizing 70% of the system's energy generation output
- A low-consumption consumer profile utilizing only 50% of the system's energy generation output

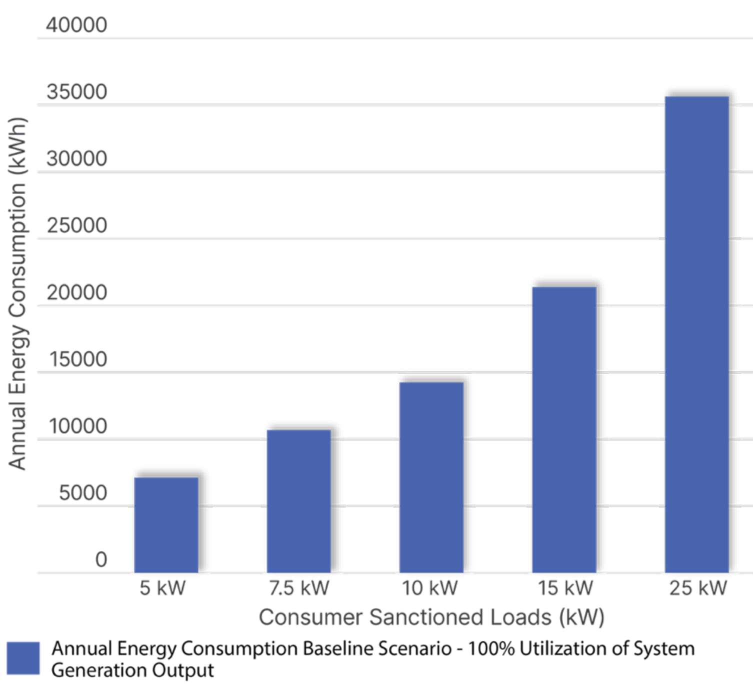
Figure 9: Annual Generation Profiles for Various System Sizes



Source: Author analysis.

Figure 10 shows the annual consumption profiles used for this report's baseline analysis - a 100% utilization of the generation output.

Figure 10: Annual Energy Consumption Profiles

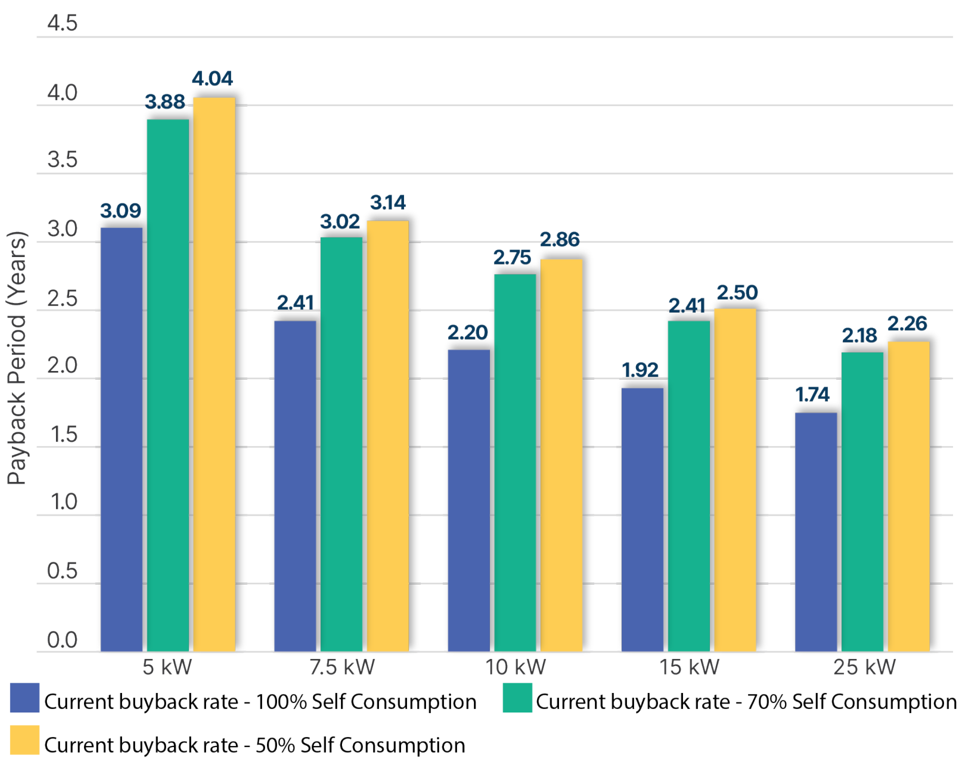


Source: Author analysis.

The relatively higher per kW cost of smaller 5kW and 7.5kW systems result in extended payback periods between 2.41 and 4.04 years. As the system size increases, the payback period decreases, with a 25kW system recording the lowest payback period of 1.74 years.

The higher the installed system's power capacity, the shorter the payback period when 100% of the energy generation consumed. However, installing a higher system while having a lower consumption profile slightly extends the payback period under the current net metering regulations. This occurs because in a 100% consumption scenario, the units utilized for self-consumption are adjusted at the off-peak rate. In contrast, for 70% and 50% consumption profiles, the excess units supplied back to the grid are adjusted at the NAPPP rate, which is always lower than the off-peak rate. This results in lower monetary savings and a longer payback period (see Appendix I for calculations).

Figure 11: Payback Period for Solar PV Installations (5-25 kW) in Pakistan Under Net Metering[29]



Source: Author analysis.

[29] Pakistan's recently notified uniform applicable peak and off-peak rates of PKR48/kWh and PKR41.68/kWh have been used for this analysis. The impact of taxation has not been included in these calculations to arrive at conservative estimates. Accounting for taxation would raise the electricity tariffs, leading to even lower payback periods for consumers utilizing a higher ratio of their generation output.

Policy Changes Under Consideration for the Distribution Generation and Net Metering Regulations

Consumers with net-metered solar PV installations effectively use the grid as a backup or battery source. During the daytime, these net-metered systems generate excess energy, which is exported to the grid. This exported energy is then adjusted on a unit-to-unit basis against the energy imported from the grid during the night or off-peak hours. In this way, net-metered consumers rely on the grid to balance their energy needs, using it as energy storage to offset periods when their solar systems are not producing electricity.

The national grid operates under a central procurement model where the Central Power Purchasing Authority (CPPA-G) procures electricity from various Independent Power Producers (IPPs) and state-owned Generation Companies (GENCOs) and then sells it to the DISCOs. The DISCOs, in turn, supply electricity to grid-connected consumers. As more consumers shift to net metering, the government is concerned that the amount of idle capacity needed on standby may increase, leading to higher electricity costs for other non-net-metered on-grid consumers.[30]

The government believes that the NAPPP offers an overly generous buyback rate, allowing consumers to recover costs in less than two years. A more reasonable cost-recovery period would be 4-5 years.[31] The NAPPP averages the generation costs across different technologies in the grid and includes Market Operator Fees (MOF), UoSC, and transmission losses. However, since net-metered systems eliminate the need for these additional charges, experts from the Power Division argue that these components should be excluded from the buyback rate. They propose that instead of using the average power price of various technologies, the buyback rate should be based on the existing LCOE rates of solar PV. The current buyback rates result in shorter payback periods than the global average of 5 years, prompting DISCOs to advocate for revising the buyback rate to reflect the average marginal cost of energy production from the grid or the NAEPP.[32]

Higher buyback rates, combined with decreasing prices of solar PV panels, could encourage consumers to increase the capacity of their existing solar systems. Many consumers are motivated by the potential to earn monetary credits from the surplus energy exported to the grid at the end of each quarterly adjustment period, which results in the installation of disproportionately sized solar PV systems.

The government is considering moving to a gross billing/net billing mechanism to increase the share of grid consumption in energy bills, bolstering revenue generation for DISCOS, and boosting usage of the national grid.[33] The net billing scheme charges separate tariffs for energy

[30] Profit. Govt to shift from net to gross metering for solar panels amid IMF talks. 19 May 2024.
[31] Profit. Govt considers cutting buyback rates from Rs 21 to Rs 11/unit for net metering. 25 April 2024.
[32] Ibid.
[33] Profit. Govt to shift from net to gross metering for solar panels amid IMF talks. 19 May 2024.

imported from and exported to the grid. It is worth mentioning that net billing is in practice at Karachi Electric (KE), the vertically integrated electric utility that supplies electricity to Karachi and its surrounding districts.[34] Therefore, the monetary benefit to consumers is reduced as off-peak units imported from the grid do not get adjusted against solar PV installation generation during the day. Instead, consumers are compensated for the total units supplied to the grid at a lower rate than the applicable peak/off-peak consumption tariff.

A significant addition of distributed rooftop solar may further constrain the conventional distribution network in Pakistan. DISCOs claim that a reverse power flow[35] problem exists at the medium voltage (MV) feeders, overloading the Distribution Transformers (DT) because of the high penetration of rooftop solar power in the distribution system.

The net metering regulations allow consumers to install distributed generator facilities with power capacity up to 1.5 times the sanctioned load (the load authorized by the distribution company for customer usage). DISCOs consider this ratio to be high because if all consumers were to connect at 1.5 times their sanctioned load, the total rooftop solar PV load could exceed the capacity of the DT by 1.5 times. This could breach the transformer's technical power limits, significantly increasing the risk of failure. During certain times of the day, the production from the distributed energy sources might exceed the local load, causing power backflow to the feeding transformer, and eventually to the substation's power transformer.

The validity of this concern remains undetermined. However, reducing the allowed installation limit could help prevent these issues and decrease the incentive to install oversized systems. The 1.5 times sanctioned load limit was initially established to encourage the installation of solar PV systems until the technology matured. Now that the uptake of rooftop solar has risen, the limit could be reduced.

As the government considers policy changes, any attempts to amend net metering regulations have faced strong opposition from existing consumers. Proponents of the current scheme argue that net metering provides economic benefits, such as displacing more expensive electricity generation sources and saving foreign exchange, all without requiring additional investment in transmission and distribution infrastructure. They say these benefits outweigh any potential impacts on capacity payments.

The government acknowledges that net metering regulations have significantly facilitated the adoption of solar PV technology. However, they also acknowledge that while these regulations have reduced overall energy demand, they have increased peak demand. As a result, the government believes that substantial changes may be necessary. However, the specific impacts of different policy adjustments —whether implemented separately or together —have not been thoroughly evaluated by the public or government entities. This report aims to clarify several

[34] Karachi Electric is a vertically integrated utility in Pakistan responsible for supplying power to the city of Karachi.
[35] When variable renewable energy sources are added to the distribution grid in large quantities, the amount of locally generated power can exceed the local load at certain times of the day, resulting in a flow of power back towards the substation.

misconceptions associated with these potential changes, particularly from a consumer perspective.

Evaluating the impact of each of these policy changes on payback periods can help the government and consumers reach a mutually beneficial arrangement. As shown in Figure 11, oversized systems tend to increase the payback period for consumers. Therefore, it is more advantageous to design installations that are optimally sized and aligned with consumer demand.

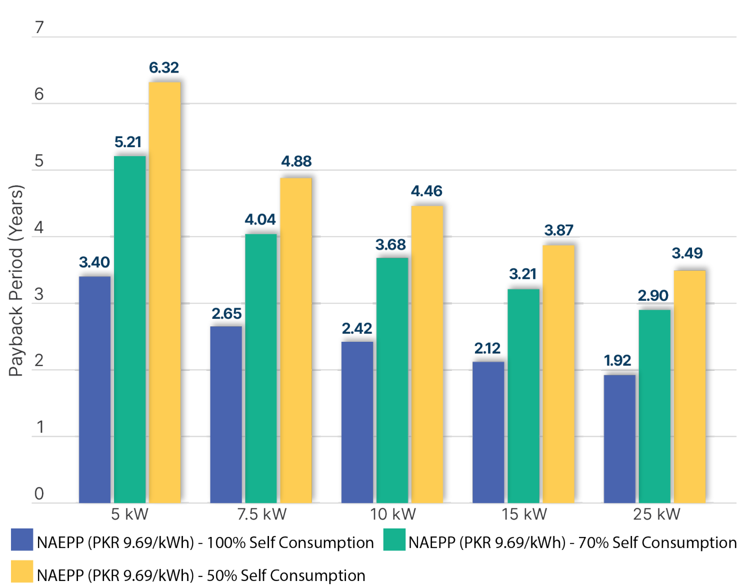
Reduction in Buyback Rates

The report evaluates two scenarios to assess the impact of reduced buyback rates on the payback period of net-metered solar installations.

Reducing the buyback rate to the NAEPP at PKR 9.69/kWh could increase payback periods for high-load consumers who utilize 100% of their generation output by 10%.

In comparison, decreasing consumer demand for the same system size leads to much higher payback periods at a reduced buyback rate. For consumers utilizing 70% of their energy output, the payback period increases up to 34%, while facility owners consuming only 50% of their generation may experience a 56% increase in payback periods. This further proves that a higher ratio of self-consumption benefits the consumer more than establishing an oversized system in the hope of achieving higher returns.

Figure 12: Payback Period for Solar PV Net-metered Connections at a Buyback Rate of PKR 9.69/kWh

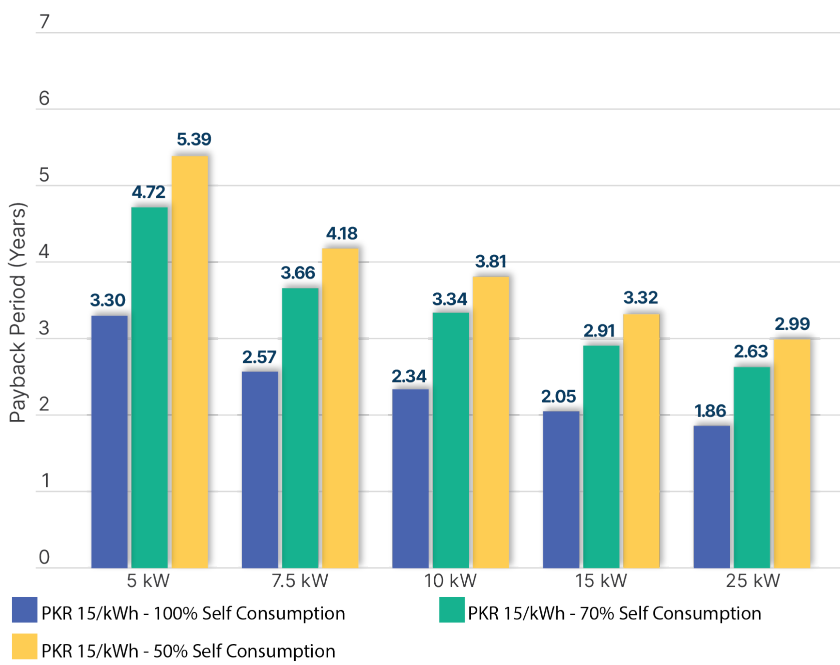


Source: Author analysis.

While a sudden decrease in the buyback rate to one-third of its current value may be difficult for consumers to accept, it would be worth exploring an intermediate rate that does not overly discourage consumers yet provides relief to the government.

For instance, lowering the buyback rate to PKR15/kWh would only increase the payback period for consumers with a 100% self-consumption rate by 6%. In comparison, the payback period for lower consumption profiles may increase by 25%.

Figure 13: Payback Period for Solar PV Net-metered Connections at a Buyback Rate of PKR 15/kWh



Source: Author analysis.

Notably, in most cases under both scenarios, the payback periods were less than five years, suggesting that customers can recover their investments within a reasonably short timeframe, even with a lower buyback rate.

While the payback periods for 100% consumption loads may not significantly increase, lower buyback rates could incentivize consumers to adopt hybrid energy systems.[36] This would ensure that any excess generated energy is compensated at the peak hour energy tariff (due to battery discharge during peak hours) instead of at a reduced buyback rate.

[36] A hybrid energy system is a system which has a hybrid inverter. The inverter is fed through the utility and solar PV, and also has a battery energy storage system.

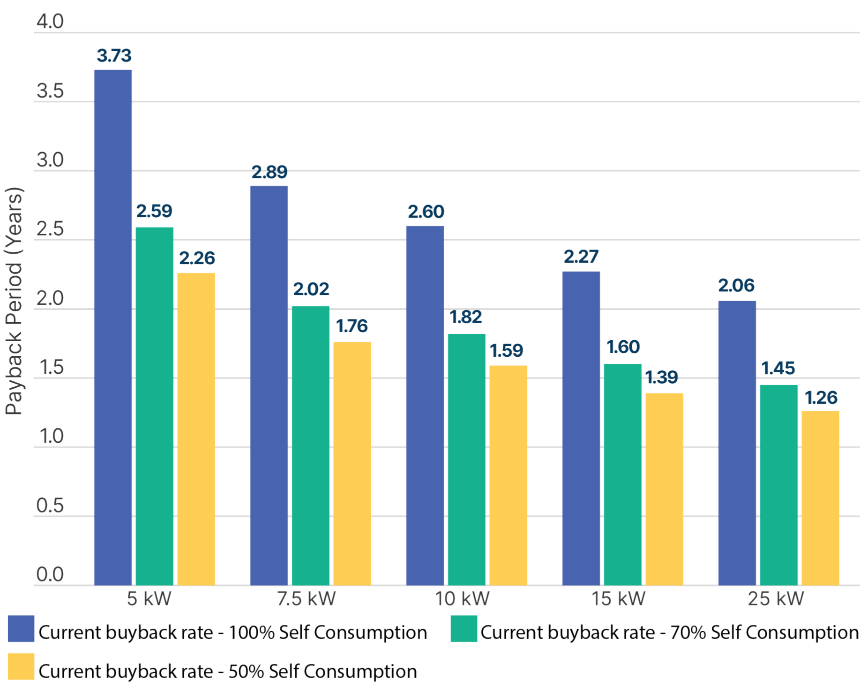
Shifting to a Net Billing System

Switching to a net billing mechanism initially leads to longer payback periods. Under a net billing scheme, consumers would benefit from self-generated energy during the daytime. However, they would still be importing from the grid during the rest of the day at the current peak and off-peak rates of PKR48/kWh and PKR41.86/kWh respectively.[37] The leftover excess units generated during the day would be exported to the grid and compensated at the current buyback rate of PKR27/kWh.

For smaller systems, such as 5-7.5kW, the payback period ranges between 3-4 years. As the system size increases, the payback period decreases to 2.06-2.60 years for high-consumption (100% self-consumption) load profiles.

For lower consumption load profiles and a higher ratio of grid exports, the payback period decreases under net billing compared to a net-metered system. Net billing creates an incentive for higher monetary savings through increased grid exports. Consumers are charged at a fixed rate regardless of their consumption, but they can generate more earnings by feeding more energy to the grid. This results in a higher share of net savings and a lower payback period.

Figure 14: Payback Periods Under a Net Billing Mechanism at Current Buyback Rates



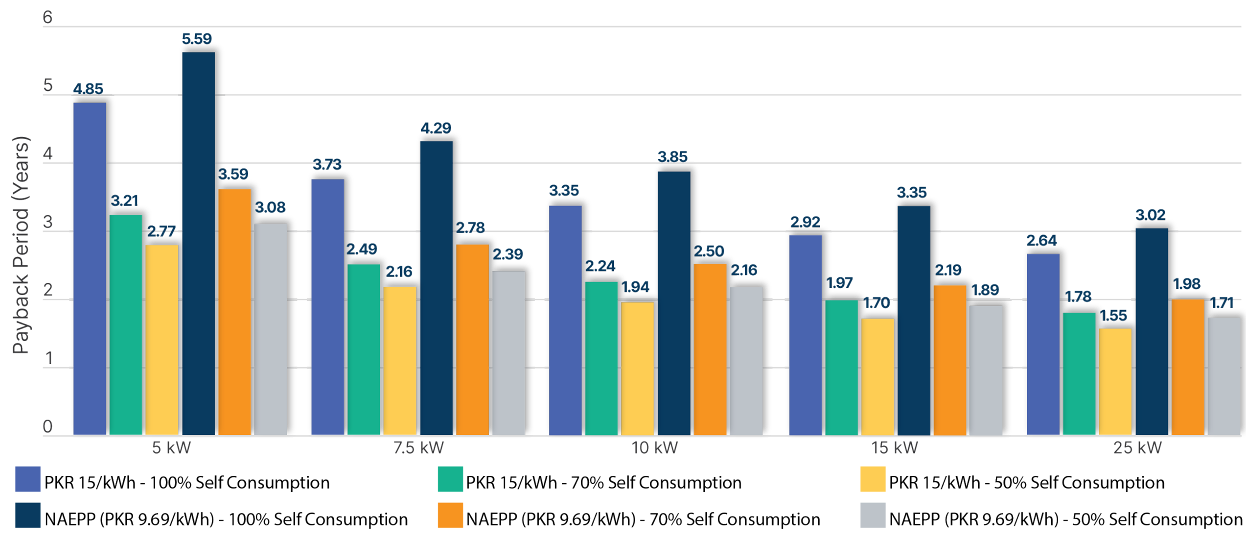
Source: Author analysis.

[37] Current peak and off-peak rates have been used, without considering the impact of taxation to arrive at conservative estimates.

In comparison, combining a net billing regime with a lower buyback rate leads to much higher payback rates for consumers with a higher share of self-consumption, especially for 5-7.5kW sized installations.

At a buyback rate of PKR15/kWh, 5kW systems would have a payback period of 4.85 years, while larger systems ranging between 10-25kW would break even at 2.64-3.35 years. Lowering the buyback rate to the NAEPP increases payback periods across all system sizes, with smaller systems like 5kW exceeding five years if 100% of the generated output is utilized. The general principle of oversized systems favoring lower payback periods remains, but despite an overall increase in payback periods, only a few cases cross the 5-year benchmark.

Figure 15: Payback Periods Under a Net Billing Mechanism at Lower Buyback Rates



Source: Author analysis.

Reducing the Allowed Limit for System Size

A consumer can install a Distributed Generator (DG) with a maximum power capacity of 1.5 times its sanctioned load. Typically, a three-phase connection starts from a sanctioned load of 5kW, up to 15kW in most cases. Sanctioned loads are allocated based on the consumer's residential covered area. Further details are in Table 2.

Table 2: Sanctioned Loads and Max Allowed Distributed Generator (DG) Power Capacity

House Covered Area	Consumer Sanctioned Load	Maximum Allowed DG Power Capacity As per 1.5 times limit	Maximum Allowed DG Power Capacity As per 0.8 times limit
5 marla or 1361 sq ft	5 kW	7.5 kW	4 kW
10 marla or 2723 sq ft	7-7.5 kW	10.5 kW	5.6-6 kW
1 kanal or 5445 sq ft	10 kW	15 kW	8 kW
Above 1 kanal	15 kW	22.5 kW	12 kW

Source: NEPRA, Consumer Service Manual, January 2021.

This report analyzes the impact of reducing the system size to 80% of the sanctioned load which could be beneficial for a variety of reasons:

Equitable Opportunity for DG Installation

Limiting DG capacity below the allowed sanctioned load ensures that all consumers connected to a specific distribution transformer can install a net metering connection. This approach prevents a few consumers from monopolizing the system, promoting a more equitable distribution of DG installations.

Protection of Distribution Transformer Capacity

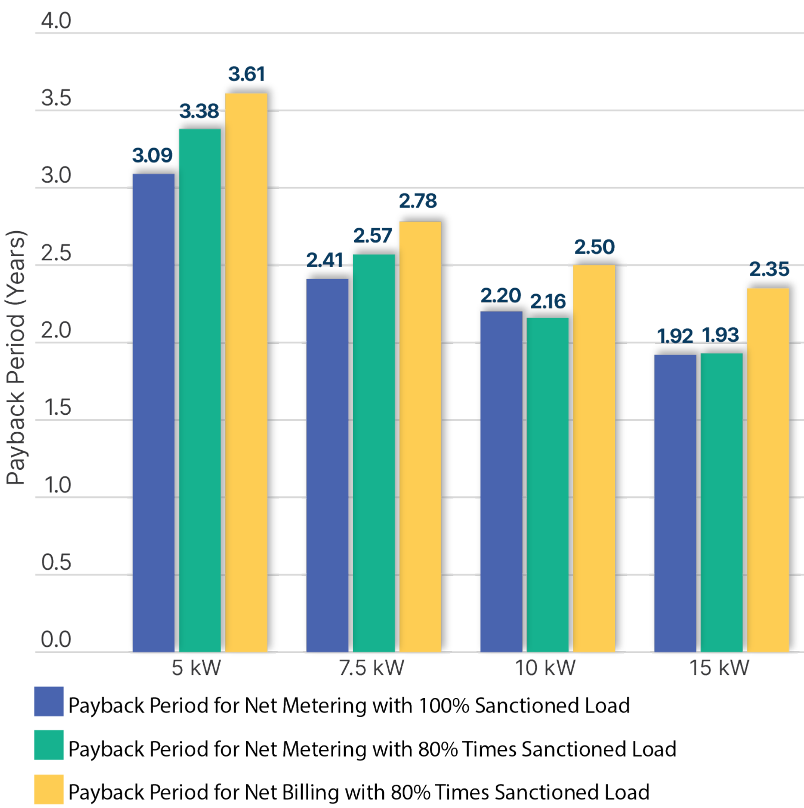
Capping the DG installation power capacity at 80% of the sanctioned load ensures that even if all connected consumers operate at their maximum allowed limit, the total DG capacity will not exceed the distribution transformer's rated power capacity. This is crucial for maintaining the transformer's safe operation, especially during periods of high solar generation and low load, thus preventing system overload and potential damage.

Payback Period Implications

Calculating the payback period for DG capacity limits set at 80% of the sanctioned load clarifies the financial implications for both consumers and policymakers. By analyzing how these constraints affect the payback period, the economic viability and attractiveness of DG installations within the current regulatory framework can be better understood.

The next part of this analysis assumes DG capacity is limited to 80% of various sanctioned loads. With a smaller system, the overall cost is reduced due to fewer panels, a smaller mounting structure, and less wiring. Consumers utilizing 100% of their system output are assumed to have installed the full sanctioned load capacity (1.0 times or 100% of the sanctioned load). Therefore, by using this consumption profile, reducing the system by 20% helps visualize the implications of limiting the system size to 80% of the sanctioned load.

Figure 16: Payback Period with Distributed Generator (DG) Limits at 100% and 80% Sanctioned Load



Source: Author analysis.

The results indicate that for smaller systems, the payback period increases due to a high per kW cost, as system size is limited under the current net metering regime. The system output falls for the same consumer demand, decreasing the potential monetary savings as no excess energy is fed back to the grid.

For larger systems with a capacity of 10kW or more, the payback period increases only slightly or remains the same. This is due to larger systems having lower per kW costs. For example, the difference between a 6kW and an 8kW solar PV system is mainly the cost of the additional 2kW panels with some minor associated material costs. By lowering the system limit, the installation costs decrease but in proportion to the reduction in savings, thus having minimal impact on the payback period.

Combining a reduced system limit with a net billing mechanism would lead to higher payback periods across the board due to reduced monetary savings as no excess energy gets exported to the grid.

Impact of Increased Solar Penetration on Capacity Payments

Distribution utilities are concerned about the impact of a growing share of rooftop solar PV on capacity payments within the power sector. Due to the 'take-or-pay' nature of power purchase agreements (PPAs) with IPPs, capacity payments —comprising fixed charges such as debt obligations, return on equity, and fixed operation and maintenance costs — must be paid to generators for 100%of their capacity, regardless of the actual power off-take.[38] These payments are indexed to the dollar because of foreign currency nominated debt. Pakistan's recent economic turmoil, marked by local currency depreciation and foreign currency shortages, has significantly increased capacity payments. Reportedly, the country has paid up to PKR 6 trillion (tn) in capacity payments over the last five years alone (FY20-24), with an additional PKR2.1tn forecasted for FY25. In contrast, amid a shrinking economy and decreasing electricity demand from industries, energy sales during the same period amounted to only PKR5tn, highlighting a net loss in the power sector.[39]

Pakistan's acute capacity payment crisis could worsen if more net-metered and non-net-metered solar PV capacity is added to the system. This would shrink electricity demand from the national grid, while capacity payments to independent power generators remain fixed. According to CPPA-G's latest Power Purchase Price (PPP) determination, which accounts for almost 90% of the consumer end tariff, the capacity charge is PKR17.31/kWh. This is nearly 65% of the PPP, while energy costs make up only 35% of the tariff.[40]

The capacity charge is calculated by dividing the total average projected capacity payments for each generation technology on the grid by the total projected sales in a fiscal year. As consumers install more distributed solar PV capacity, total sales for the same capacity payments decrease, leading to a higher per-unit capacity charge.

Conversely, the impact of an increased capacity charge can only be assessed if there is a significant decrease in energy demand from the grid as rapid solarization occurs. The current net-metered solar PV capacity is just over 2GW in June 2024, which is only 5% of the installed grid capacity. On average, this capacity could reduce a potential 3.7 terawatt hours (TWh) of energy sales from the grid[41], leading to a PKR0.5/kWh increase in the capacity charge (see Appendix II for calculations).

[38] This is based on an 85% plant availability throughout the year.
[39] Profit. Pakistan's capacity repayments hit Rs6 trillion in last five years. 29 July 2024.
[40] NEPRA. Decision of the Authority in the matter of the request filed by CPPA-G for Power Purchase Price Forecast for FY 2024-2025. 14 June 2024.
[41] Assuming an average capacity factor of 19%.

However, current trends suggest than an additional 1000-1200MW (approximately) of rooftop solar PV capacity could be added in FY25. If this materializes, the capacity charge could increase by up to PKR0.7/kWh.

It should be noted that this increase only applies to documented rooftop solar PV additions. Consumers may also rapidly adopt non-net-metered solar PV systems for self-sufficiency. For instance, industrial solarization above 1MW in capacity is non-net-metered. Such captive solarization is also contributing to energy demand reduction. Furthermore, it is believed that single-phase consumers have also reverted to solar solutions to cater to their energy needs during the daytime. This would lead to further contraction of demand from the grid, thereby increasing the burden of capacity charges for other grid-connected consumers.

The rise in capacity charges is just one factor in the overall cost-benefit analysis of net-metered rooftop solar PV additions. The DISCOs benefit from the supply of low-cost power to the grid during the daytime, saving foreign exchange-denominated fossil-fuel generation and consumption. Similarly, reducing grid demand contributes to a decrease in the afternoon peak, especially during the summer. Thus, the situation may be more balanced than initially thought.

Both net-metered and standalone solar systems can reduce grid demand, and solar-generated energy remains significantly cheaper than fossil-fuel based power. Power generated from additions on-site comes without the added expense of fixed, USD-linked capacity payments or the need for transmission upgrades. Therefore, it is in the country’s best interest, whether for utilities or consumers, to lower the cost of energy. The larger issue lies in addressing the burden of IPP-related capacity payments, which keeps energy costs high. Solutions such as retirement mechanisms or contract renegotiations are necessary to mitigate this burden.

Conclusion and Key Recommendations

The attractiveness of the current net metering regulations has catalyzed the growth of distributed solar PV in Pakistan. However, as the market matures and the government addresses various inefficiencies in the power sector, the reform agenda now includes revising the net metering regulations. As a result, some of these incentives are expected to be scaled down or removed entirely.

Figure 17: Heat Map for Comparative Analysis of Net Metering Scenarios

	Net Metering	Net Metering reduced buyback Rate	Net Metering with Reduced buyback rate and limted system size
Payback Period	2	5	6
Incentive for Self-Consumption	1	5	6
Incentive for Oversized System	4	3	1
Benefit to Government	4	3	1
Contribution to Peak Demand	4	3	1
Burden on Non-Net Metered Consumers	4	3	1

Source: Author analysis.

Figure 18: Heat Map for Comparative Analysis of Net Billing Scenarios

	Net Billing	Reduced buyback rate (reasonably low)	Reduced buyback rate (NAEPP)
Payback Period	4	5	6
Incentive for Self-Consumption	4	5	6
Incentive for Oversized System	3	2	1
Benefit to Government	3	2	1
Contribution to Peak Demand	3	2	1
Burden on Net Metered Consumers	3	2	1

Source: Author analysis.
Note: The heat maps use a numerical scale from 1 to 6 to represent the ratings for each factor under different scenarios. 1 is the lowest while 6 is the highest. For example, the payback period under the net metering scheme is lower, while the payback period under the net metering scheme (with a reduced buyback rate and sanctioned load limits) is the highest.

Currently, the net metering regulations offer lucrative buyback rates and short payback periods, which have encouraged widespread adoption of solar PV systems. However, net-metered solar PV systems can contribute to higher evening peaks, necessitating the use of power sources that can quickly ramp up to meet the increase in demand. To mitigate this issue, greater emphasis on self-consumption is needed. This could be achieved by imposing limits on the amount of surplus energy that can be exported from net-metered facilities —similar to Vietnam's 10% cap on surplus supply from such systems. Additionally, reducing the system size limit from 1.5 times the sanctioned load is another option worth exploring.

The limited availability of commercial financing for rooftop solar PV systems and programs supporting small- and medium-sized consumers has led to the adoption of distributed solar systems primarily by affluent sections of society. This concentrates the responsibility of managing surplus power on a few distribution transformers, increasing the risk of overload. Limiting system sizes can help ensure a more equitable spread of solarization and protect the distribution infrastructure.

Moreover, increased real-time monitoring of the distribution infrastructure is essential, requiring investment in DT performance monitoring systems. Advanced Metering Infrastructure (AMI) is also necessary at the consumer level to facilitate two-way communication, enabling DISCOs to be alerted of any breaches in supply terms by end-users.

Contrary to popular belief, the current net metering mechanism encourages a higher share of self-consumption and increased exports to the grid, which can lead to longer payback periods. However, some consumers may install oversized generation systems to maximize returns. Reducing the buyback rate could help discourage this practice.

The findings of this report suggest that lowering the buyback rate to PKR15/kWh would still offer reasonable payback periods of under five years in most cases. On the other hand, a buyback rate set at the NAEPP level could result in longer payback periods for system owners with 5kW or lower capacity systems under net metering. A five-year payback period is reasonable from a global viewpoint, where average recovery times range from 6-10 years.[42] Therefore, It may be practical for the government to bring current payback periods closer to the five-year mark. However, to maintain consumer interest, the government could set a higher buyback rate than the NAEPP.

Switching to a net billing system would also lead to longer payback periods but combining this with a lower buyback rate might not be acceptable to most consumers. Additionally, a shift to net billing could encourage consumers to install oversized systems to achieve higher returns and shorter payback periods. Therefore, any move to net billing should be accompanied by restrictions on the size of solar PV systems.

[42] Forbes. A Complete Guide To Payback Periods For Solar Panels. 09 February 2024.

The timing of such policy changes is crucial to avoid consumer backlash. While a revised policy with reduced incentives could be implemented immediately for new installers, a phased approach —gradually discontinuing the current policy regime every quarter — could provide a transitional period for both new and existing beneficiaries of the net metering scheme.

Another approach could involve gradually reducing and eventually phasing out the buyback rate with each renewal of a generation license or agreement. This would encourage consumers to transition to battery energy storage systems (BESS) as their solar PV systems mature.

The wide margin between the government-offered buyback rate (US$9¢/kWh) and the peak electricity rate (US$17¢/kWh) that consumers pay during the evening could incentivize a shift towards BESS. The government should introduce policies that facilitate the wider adoption of BESS, as this would also help reduce the reliance on utility services post-sunset.

For consumers, the main objectives are increased self-reliance and energy savings. This analysis shows that these objectives are met in most cases under both net metering and net billing schemes. With rapidly decreasing solar panel costs and rising consumer electricity tariffs, distributed solar generation in Pakistan is becoming increasingly cost-effective, which is likely to lead to further adoption of rooftop solar systems. However, it is essential that this growth is equitable and does not disproportionately benefit only a few segments of society.

Given the traditional grid infrastructure and its limitations, the challenges faced by distribution utilities in absorbing higher levels of distributed rooftop solar PV generation must be acknowledged. It is important to strike a balance between the initial incentives provided for new technologies and the overall sustainability of the power sector.

Appendix I

Payback Period Calculations

General Assumptions

An on-grid system is a system without battery storage	
On-grid system cost (PKR/kW)	120,000
Off-peak rate (PKR/kWh)	41.68
Peak rate (PKR/kWh)	48
Current buyback rate (PKR/kWh)	27
Reduced buyback rate (PKR/kWh)	15
National Average Energy Purchase Price (PKR/kWh)	9.69

	kW	Cost of on-grid system	Average specific yield (kWh/kW)	Daily yield (kWh)	Annual yield (kWh)
System size (kW)	5.00	828,515.00	4.00	20.00	7,300.00
	7.50	979,500.00	4.00	32.00	11,680.00
	10.00	1,186,030.00	4.00	40.00	14,600.00
	15.00	1,569,710.00	4.00	60.00	21,900.00
	18.00	1,764,885.00	4.00	72.00	26,280.00
	25.00	2,384,060.00	4.00	100.00	36,500.00

1. Payback Period Under Net Metering for a 10 kW System

Methodology

1. Average Daily Generation Output is obtained for each system configuration using simulations from PV Syst Software. It must be noted that these yields are based on geographical/weather conditions that are typical of central Pakistan.

2. A 40:60 ratio is used to distribute the daily generation output into daytime and night-time consumption.

3. Night-time consumption can be divided into peak hour and off-peak consumption.

4. It is assumed that consumption during peak hours is 20% of the total daily energy. Subtracting that from the units attributed to night-time usage from the daily generation output, provides off-peak consumption for the consumer. This will also be equal to the number of units generated during the daytime which will be offset by off-peak consumption during night-time.

5. Based on these daily estimates, monthly values for the same consumption/generation categories can be worked out by multiplying by a factor of 30/31, depending upon the month in question.

6. Excess units leftover for export to the grid are calculated by subtracting the sum of off-peak consumption at night-time and consumption during the day-time from the total Monthly Generation Output of the solar PV system.

7. Actual Bill for that month is calculated by multiplying the applicable peak rate with the number of peak units consumed and subtracting this value from the product of the excess units sold to the grid and the government approved buyback rate (NAPPP). Actual Bill (PKR) = (Excess Units Sold to the Grid x Buyback rate) – (Peak hour consumption x Peak rate)

8. Total Savings are defined by comparing the Actual Bill that the consumer is charged with what the consumer's bill would have been had there been no solar PV installation. Bill without net-metered Solar PV = (Units consumed during daytime + Off-peak units consumed during night) x Off-peak tariff + (Peak units consumed during night x Peak-hour rate)

9. Total Annual Savings = Annual Bill without solar PV – Actual Bill

10. Payback period is a function of the total annual savings resulting from the installation of the solar PV system. It is calculated using the formula below:

    Payback Period in Years = Total Capital Cost/Total Annual Savings

Case A: All Energy Generated is Consumed

Consumption during day time %	40.00	0.4													
Consumption during night time %	60.00	0.6													
Peak hour consumption factor	20%														
		Daily					Monthly								
		A	B	C	D		E =A*30	F=B*30	G=C*30	H = D*30					
System size (kW)	Daily generation (kWh/day)	Consumption during day time(kWh)	Consumption during night time (kWh)	Peak hour consumption (kWh)	Off peak Consumption (kWh)	Monthly generation (kWh)	Consumption during day time(kWh)	Consumption during night time (kWh)	Peak hour consumption at night (kWh)	Off peak consumption at night (kWh)	Excess unit left over unit to unit adjustment	Actual bill monthly with Solar PV system at current buyback rate	Actual bill monthly with Solar PV system at reduced buyback rate	Actual bill monthly with Solar PV system at NEAPP	Bill if no Solar PV system
Jan	20	8.00	12	4.00	8.00	600.00	240.00	360.00	120.00	240.00	120.00	2,520.00	3,960.00	4,597.20	25,766.40
Feb	35	14.00	21	7.00	14.00	1,050.00	420.00	630.00	210.00	420.00	210.00	4,410.00	6,930.00	8,045.10	45,091.20
March	45	18.00	27	9.00	18.00	1,350.00	540.00	810.00	270.00	540.00	270.00	5,670.00	8,910.00	10,343.70	57,974.40
April	50	20.00	30	10.00	20.00	1,500.00	600.00	900.00	300.00	600.00	300.00	6,300.00	9,900.00	11,493.00	64,416.00
May	50	20.00	30	10.00	20.00	1,500.00	600.00	900.00	300.00	600.00	300.00	6,300.00	9,900.00	11,493.00	64,416.00
June	50	20.00	30	10.00	20.00	1,500.00	600.00	900.00	300.00	600.00	300.00	6,300.00	9,900.00	11,493.00	64,416.00
July	50	20.00	30	10.00	20.00	1,500.00	600.00	900.00	300.00	600.00	300.00	6,300.00	9,900.00	11,493.00	64,416.00
August	45	18.00	27	9.00	18.00	1,350.00	540.00	810.00	270.00	540.00	270.00	5,670.00	8,910.00	10,343.70	57,974.40
September	45	18.00	27	9.00	18.00	1,350.00	540.00	810.00	270.00	540.00	270.00	5,670.00	8,910.00	10,343.70	57,974.40
October	40	16.00	24	8.00	16.00	1,200.00	480.00	720.00	240.00	480.00	240.00	5,040.00	7,920.00	9,194.40	51,532.80
November	25	10.00	15	5.00	10.00	750.00	300.00	450.00	150.00	300.00	150.00	3,150.00	4,950.00	5,746.50	32,208.00
December	20	8.00	12	4.00	8.00	600.00	240.00	360.00	120.00	240.00	120.00	2,520.00	3,960.00	4,597.20	25,766.40
					Total Annual Consumption	14,250.00					Total bill (PKR/Yr)	59,850	94,050	109,184	611,952.00
											Total savings (PKR/Yr)	552,102.00	517,902.00	502,768.50	
											Annual O&M (PKR/Yr)	(12,000)	(12,000)	(12,000)	
											Annual net benefit (PKR/Yr)	540,102.00	505,902.00	490,768.50	
											Payback period (Yrs)	2.20	2.34	2.42	

Case B: 70% Energy Generated is Consumed

For this case, it is assumed that the consumption levels are 70% of Case A. Hence a 28:42 ratio is used to distribute the daily generation output into daytime and night-time consumption, while the remaining 30% of the generation output is added to grid exports. The rest of the calculations remain the same as Case A.

Consumption during day time %	40.00	0.28													
Consumption during night time %	60.00	0.42													
Peak hour consumption factor	20%														
		Daily					Monthly								
		A	B	C	D		E =A*30	F=B*30	G=C*30	H = D*30					
System size (kW)	Daily generation (kWh/day)	Consumption during day time(kWh)	Consumption during night time (kWh)	Peak hour consumption (kWh)	Off peak Consumption (kWh)	Monthly generation (kWh)	Consumption during day time(kWh)	Consumption during night time (kWh)	Peak hour consumption at night (kWh)	Off peak consumption at night (kWh)	Excess unit left over unit to unit adjustment	Actual bill monthly with Solar PV system at current buyback rate	Actual bill monthly with Solar PV system at reduced buyback rate	Actual bill monthly with Solar PV system at NEAPP	Bill if no Solar PV system
Jan	20	5.60	8.4	2.80	5.60	600.00	168.00	252.00	84.00	168.00	264.00	(3,096.00)	72.00	1,473.84	15,540.00
Feb	35	9.80	14.7	4.90	9.80	1,050.00	294.00	441.00	147.00	294.00	462.00	(5,418.00)	126.00	2,579.22	27,195.00
March	45	12.60	18.9	6.30	12.60	1,350.00	378.00	567.00	189.00	378.00	594.00	(6,966.00)	162.00	3,316.14	34,965.00
April	50	14.00	21	7.00	14.00	1,500.00	420.00	630.00	210.00	420.00	660.00	(7,740.00)	180.00	3,684.60	38,850.00
May	50	14.00	21	7.00	14.00	1,500.00	420.00	630.00	210.00	420.00	660.00	(7,740.00)	180.00	3,684.60	38,850.00
June	50	14.00	21	7.00	14.00	1,500.00	420.00	630.00	210.00	420.00	660.00	(7,740.00)	180.00	3,684.60	38,850.00
July	50	14.00	21	7.00	14.00	1,500.00	420.00	630.00	210.00	420.00	660.00	(7,740.00)	180.00	3,684.60	38,850.00
August	45	12.60	18.9	6.30	12.60	1,350.00	378.00	567.00	189.00	378.00	594.00	(6,966.00)	162.00	3,316.14	34,965.00
September	45	12.60	18.9	6.30	12.60	1,350.00	378.00	567.00	189.00	378.00	594.00	(6,966.00)	162.00	3,316.14	34,965.00
October	40	11.20	16.8	5.60	11.20	1,200.00	336.00	504.00	168.00	336.00	528.00	(6,192.00)	144.00	2,947.68	31,080.00
November	25	7.00	10.5	3.50	7.00	750.00	210.00	315.00	105.00	210.00	330.00	(3,870.00)	90.00	1,842.30	19,425.00
December	20	5.60	8.4	2.80	5.60	600.00	168.00	252.00	84.00	168.00	264.00	(3,096.00)	72.00	1,473.84	15,540.00
					Total Annual Consumption	14,250.00	Total Consumption	9,975.00			Total bill (PKR/Yr)	(73,530)	1,710	35,004	369,075.00
											Total savings (PKR/Yr)	442,605.00	367,365.00	334,071.30	
											Annual O&M (PKR/Yr)	(12,000)	(12,000)	(12,000)	
											Annual net benefit (PKR/Yr)	430,605.00	355,365.00	322,071.30	
											Payback period (Yrs)	2.75	3.34	3.68	

Case C: 50% Energy Generated is Consumed

For Case C, it is assumed that the consumption levels are 50% of Case A. Hence a 20:30 ratio is used to distribute the daily generation output into daytime and night-time consumption, while the remaining 50% of the generation output is added to grid exports. The rest of the calculations remain the same as Case A.

Consumption during day time %	40.00	0.2													
Consumption during night time %	60.00	0.3													
Peak hour consumption factor	20%														
		Daily					Monthly								
		A	B	C	D		E=A*30	F=B*30	G=C*30	H = D*30					
System size (kW)	Daily generation (kWh/day)	Consumption during day time(kWh)	Consumption during night time (kWh)	Peak hour consumption (kWh)	Off peak Consumption (kWh)	Monthly generation (kWh)	Consumption during day time(kWh)	Consumption during night time (kWh)	Peak hour consumption at night (kWh)	Off peak consumption at night (kWh)	Excess unit left over unit to unit adjustment	Actual bill monthly with Solar PV system at current buyback rate	Actual bill monthly with Solar PV system at reduced buyback rate	Actual bill monthly with Solar PV system at NEAPP	Bill if no Solar PV system
Jan	20	4.00	6	2.00	4.00	600.00	120.00	180.00	60.00	120.00	360.00	(6,840.00)	(2,520.00)	(608.40)	11,100.00
Feb	35	7.00	10.5	3.50	7.00	1,050.00	210.00	315.00	105.00	210.00	630.00	(11,970.00)	(4,410.00)	(1,064.70)	19,425.00
March	45	9.00	13.5	4.50	9.00	1,350.00	270.00	405.00	135.00	270.00	810.00	(15,390.00)	(5,670.00)	(1,368.90)	24,975.00
April	50	10.00	15	5.00	10.00	1,500.00	300.00	450.00	150.00	300.00	900.00	(17,100.00)	(6,300.00)	(1,521.00)	27,750.00
May	50	10.00	15	5.00	10.00	1,500.00	300.00	450.00	150.00	300.00	900.00	(17,100.00)	(6,300.00)	(1,521.00)	27,750.00
June	50	10.00	15	5.00	10.00	1,500.00	300.00	450.00	150.00	300.00	900.00	(17,100.00)	(6,300.00)	(1,521.00)	27,750.00
July	50	10.00	15	5.00	10.00	1,500.00	300.00	450.00	150.00	300.00	900.00	(17,100.00)	(6,300.00)	(1,521.00)	27,750.00
August	45	9.00	13.5	4.50	9.00	1,350.00	270.00	405.00	135.00	270.00	810.00	(15,390.00)	(5,670.00)	(1,368.90)	24,975.00
September	45	9.00	13.5	4.50	9.00	1,350.00	270.00	405.00	135.00	270.00	810.00	(15,390.00)	(5,670.00)	(1,368.90)	24,975.00
October	40	8.00	12	4.00	8.00	1,200.00	240.00	360.00	120.00	240.00	720.00	(13,680.00)	(5,040.00)	(1,216.80)	22,200.00
November	25	5.00	7.5	2.50	5.00	750.00	150.00	225.00	75.00	150.00	450.00	(8,550.00)	(3,150.00)	(760.50)	13,875.00
December	20	4.00	6	2.00	4.00	600.00	120.00	180.00	60.00	120.00	360.00	(6,840.00)	(2,520.00)	(608.40)	11,100.00
					Total Annual Consumption	14,250.00	Total Consumption	7,125.00			Total bill (PKR/Yr)	(162,450)	(59,850)	(14,450)	263,625.00
											Total savings (PKR/Yr)	426,075.00	323,475.00	278,074.50	
											Annual O&M (PKR/Yr)	(12,000)	(12,000)	(12,000)	
											Annual net benefit (PKR/Yr)	414,075.00	311,475.00	266,074.50	
											Payback period (Yrs)	2.86	3.81	4.46	

2. Payback Period Under Net Billing for a 10kW System

For net billing, while all assumptions remain the same, the methodology for calculating the consumer bill and the resulting total annual savings changes.

Under net metering, four consumption metrics are reflected on a consumer bill: Peak and Off-peak grid imports, and Peak and Off-peak grid exports. If a net billing scheme is introduced instead, consumers will be charged for their Peak and Off-peak consumption as usual, but all exports to the grid will be at a single buyback rate (NAPPP), without any netting off of units during off-peak hours.

1. The actual bill for the consumer would now be:
   Actual Bill (PKR) = (Peak hour consumption x Peak rate) + (Off-Peak hour consumption x Off-Peak rate) - (Excess units sold to the grid x Buyback rate)
2. Since consumers are being charged for a higher number of units from the grid at tariffs which are significantly higher than the buyback rate, the volume of annual savings shrinks, resulting in longer payback periods.

Case A: All Energy Generated is Consumed

			70%	50%
Consumption during day time%	40.00	0.4	0.28	0.2
Consumption during night time%	60.00	0.6	0.42	0.3
Peak hour consumption factor	20%			

		Daily						Monthly			
		A		B	C	D		E =A*30	F=B*30	G=C*30	H = D*30
System size (kW)	Daily generation (kWh/day)	Consumption during day time(kWh)	Excess unit fedback to grid	Consumption during night time (kWh)	Peak hour consumption (kWh)	Off peak consumption (kWh) night	Monthly generation (kWh)	Consumption during day time(kWh) (Off peak)	Consumption during night time (kWh)	Peak hour consumption at night (kWh)	Off Peak consumption at night (kWh)
Jan	20	8.00	12.00	12	4.00	8.00	600.00	240.00	360.00	120.00	240.00
Feb	35	14.00	21.00	21	7.00	14.00	1,050.00	420.00	630.00	210.00	420.00
March	45	18.00	27.00	27	9.00	18.00	1,350.00	540.00	810.00	270.00	540.00
April	50	20.00	30.00	30	10.00	20.00	1,500.00	600.00	900.00	300.00	600.00
May	50	20.00	30.00	30	10.00	20.00	1,500.00	600.00	900.00	300.00	600.00
June	50	20.00	30.00	30	10.00	20.00	1,500.00	600.00	900.00	300.00	600.00
July	50	20.00	30.00	30	10.00	20.00	1,500.00	600.00	900.00	300.00	600.00
August	45	18.00	27.00	27	9.00	18.00	1,350.00	540.00	810.00	270.00	540.00
September	45	18.00	27.00	27	9.00	18.00	1,350.00	540.00	810.00	270.00	540.00
October	40	16.00	24.00	24	8.00	16.00	1,200.00	480.00	720.00	240.00	480.00
November	25	10.00	15.00	15	5.00	10.00	750.00	300.00	450.00	150.00	300.00
December	20	8.00	12.00	12	4.00	8.00	600.00	240.00	360.00	120.00	240.00
						Total Annual Consumption	14,250.00				

System size (kW)	Total units-export to grid on monthly basis	Units adjusted at consumer source due to self consumption / generation during day time	PKR amount of Units consumed during peak hours	PKR amount of units consumed during off peak hours at night	Value of units fedback to grid at current rate	Value of units fedback to grid at reduced rate	Value of units fedback to grid at NEAPP	Actual monthly bill with Net Billing regime (monthly adjustments in monetary terms)	Actual bill monthly with Solar PV system at reduced tariff	Actual bill monthly with Solar PV system at NEAPP	Bill if no Solar PV system
Jan	360.00	240.00	5,760.00	10,003.20	9,720.00	5,400.00	3,488.40	6,043.20	10,363.20	12,274.80	25,766.40
Feb	630.00	420.00	10,080.00	17,505.60	17,010.00	9,450.00	6,104.70	10,575.60	18,135.60	21,480.90	45,091.20
March	810.00	540.00	12,960.00	22,507.20	21,870.00	12,150.00	7,848.90	13,597.20	23,317.20	27,618.30	57,974.40
April	900.00	600.00	14,400.00	25,008.00	24,300.00	13,500.00	8,721.00	15,108.00	25,908.00	30,687.00	64,416.00
May	900.00	600.00	14,400.00	25,008.00	24,300.00	13,500.00	8,721.00	15,108.00	25,908.00	30,687.00	64,416.00
June	900.00	600.00	14,400.00	25,008.00	24,300.00	13,500.00	8,721.00	15,108.00	25,908.00	30,687.00	64,416.00
July	900.00	600.00	14,400.00	25,008.00	24,300.00	13,500.00	8,721.00	15,108.00	25,908.00	30,687.00	64,416.00
August	810.00	540.00	12,960.00	22,507.20	21,870.00	12,150.00	7,848.90	13,597.20	23,317.20	27,618.30	57,974.40
September	810.00	540.00	12,960.00	22,507.20	21,870.00	12,150.00	7,848.90	13,597.20	23,317.20	27,618.30	57,974.40
October	720.00	480.00	11,520.00	20,006.40	19,440.00	10,800.00	6,976.80	12,086.40	20,726.40	24,549.60	51,532.80
November	450.00	300.00	7,200.00	12,504.00	12,150.00	6,750.00	4,360.50	7,554.00	12,954.00	15,343.50	32,208.00
December	360.00	240.00	5,760.00	10,003.20	9,720.00	5,400.00	3,488.40	6,043.20	10,363.20	12,274.80	25,766.40
		Total bill (PKR/Yr)						143,526	246,126	291,527	611,952.00
		Total savings (PKR/Yr)						468,426	365,826	320,426	
		Annual O&M (PKR/Yr)						(12,000)	(12,000)	(12,000)	
		Annual net benefit (PKR/Yr)						456,426.00	353,826.00	308,425.50	
		Payback period (Yrs)						2.60	3.35	3.85	

Case B: 70% Energy Generated is Consumed

		Daily						Monthly			
		A		B	C	D		E =A*30	F=B*30	G=C*30	H = D*30
System size (kW)	Daily generation (kWh/day)	Consumption during day time(kWh)	Excess unit fedback to grid	Consumption during night time (kWh)	Peak hour consumption (kWh)	Off peak consumption (kWh) night	Monthly generation (kWh)	Consumption during day time(kWh) (Off peak)	Consumption during night time (kWh)	Peak hour consumption at night (kWh)	Off Peak consumption at night (kWh)
Jan	20	5.60	14.40	8.4	2.80	5.60	600.00	168.00	252.00	84.00	168.00
Feb	35	9.80	25.20	14.7	4.90	9.80	1,050.00	294.00	441.00	147.00	294.00
March	45	12.60	32.40	18.9	6.30	12.60	1,350.00	378.00	567.00	189.00	378.00
April	50	14.00	36.00	21	7.00	14.00	1,500.00	420.00	630.00	210.00	420.00
May	50	14.00	36.00	21	7.00	14.00	1,500.00	420.00	630.00	210.00	420.00
June	50	14.00	36.00	21	7.00	14.00	1,500.00	420.00	630.00	210.00	420.00
July	50	14.00	36.00	21	7.00	14.00	1,500.00	420.00	630.00	210.00	420.00
August	45	12.60	32.40	18.9	6.30	12.60	1,350.00	378.00	567.00	189.00	378.00
September	45	12.60	32.40	18.9	6.30	12.60	1,350.00	378.00	567.00	189.00	378.00
October	40	11.20	28.80	16.8	5.60	11.20	1,200.00	336.00	504.00	168.00	336.00
November	25	7.00	18.00	10.5	3.50	7.00	750.00	210.00	315.00	105.00	210.00
December	20	5.60	14.40	8.4	2.80	5.60	600.00	168.00	252.00	84.00	168.00
						Total Annual Consumption	14,250.00				

System size (kW)	Total units-export to grid on monthly basis	Units adjusted at consumer source due to self consumption / generation during day time	PKR amount of Units consumed during peak hours	PKR amount of units consumed during off peak hours at night	Value of units fedback to grid at current rate	Value of units fedback to grid at reduced rate	Value of units fedback to grid at NEAPP	Actual monthly bill with Net Billing regime (monthly adjustments in monetary terms)	Actual bill monthly with Solar PV system at reduced tariff	Actual bill monthly with Solar PV system at NEAPP	Bill if no Solar PV system
Jan	432.00	168.00	3,612.00	5,880.00	11,664.00	6,480.00	4,186.08	(2,172.00)	3,012.00	5,305.92	18,036.48
Feb	756.00	294.00	6,321.00	10,290.00	20,412.00	11,340.00	7,325.64	(3,801.00)	5,271.00	9,285.36	31,563.84
March	972.00	378.00	8,127.00	13,230.00	26,244.00	14,580.00	9,418.68	(4,887.00)	6,777.00	11,938.32	40,582.08
April	1,080.00	420.00	9,030.00	14,700.00	29,160.00	16,200.00	10,465.20	(5,430.00)	7,530.00	13,264.80	45,091.20
May	1,080.00	420.00	9,030.00	14,700.00	29,160.00	16,200.00	10,465.20	(5,430.00)	7,530.00	13,264.80	45,091.20
June	1,080.00	420.00	9,030.00	14,700.00	29,160.00	16,200.00	10,465.20	(5,430.00)	7,530.00	13,264.80	45,091.20
July	1,080.00	420.00	9,030.00	14,700.00	29,160.00	16,200.00	10,465.20	(5,430.00)	7,530.00	13,264.80	45,091.20
August	972.00	378.00	8,127.00	13,230.00	26,244.00	14,580.00	9,418.68	(4,887.00)	6,777.00	11,938.32	40,582.08
September	972.00	378.00	8,127.00	13,230.00	26,244.00	14,580.00	9,418.68	(4,887.00)	6,777.00	11,938.32	40,582.08
October	864.00	336.00	7,224.00	11,760.00	23,328.00	12,960.00	8,372.16	(4,344.00)	6,024.00	10,611.84	36,072.96
November	540.00	210.00	4,515.00	7,350.00	14,580.00	8,100.00	5,232.60	(2,715.00)	3,765.00	6,632.40	22,545.60
December	432.00	168.00	3,612.00	5,880.00	11,664.00	6,480.00	4,186.08	(2,172.00)	3,012.00	5,305.92	18,036.48
		Total bill (PKR/Yr)						(51,585)	71,535	126,016	428,366.40
		Total savings (PKR/Yr)						663,537	540,417	485,936	
		Annual O&M (PKR/Yr)						(12,000)	(12,000)	(12,000)	
		Annual net benefit (PKR/Yr)						651,537.00	528,417.00	473,936.40	
		Payback period (Yrs)						1.82	2.24	2.50	

Case C: 50% Energy Generated is Consumed

		Daily						Monthly														
		A		B	C	D		E =A*30	F=B*30	G=C*30	H = D*30											
System size (kW)	Daily generation (kWh/day)	Consumption during day time(kWh)	Excess unit fedback to grid	Consumption during night time (kWh)	Peak hour consumption (kWh)	Off peak consumption (kWh) night	Monthly generation (kWh)	Consumption during day time(kWh) (Off peak)	Consumption during night time (kWh)	Peak hour consumption at night (kWh)	Off Peak consumption at night (kWh)	Total units-export to grid on monthly basis	Units adjusted at consumer source due to self consumption / generation during day time	PKR amount of Units consumed during peak hours	PKR amount of units consumed during off peak hours at night	Value of units fedback to grid at current rate	Value of units fedback to grid at reduced rate	Value of units fedback to grid at NEAPP	Actual monthly bill with Net Billing regime (monthly adjustments in monetary terms)	Actual bill monthly with Solar PV system at reduced tariff	Actual bill monthly with Solar PV system at NEAPP	Bill if no Solar PV system
Jan	20	4.00	16.00	6	2.00	4.00	600.00	120.00	180.00	60.00	120.00	480.00	120.00	2,580.00	4,200.00	12,960.00	7,200.00	4,651.20	(6,180.00)	(420.00)	2,128.80	12,883.20
Feb	35	7.00	28.00	10.5	3.50	7.00	1,050.00	210.00	315.00	105.00	210.00	840.00	210.00	4,515.00	7,350.00	22,680.00	12,600.00	8,139.60	(10,815.00)	(735.00)	3,725.40	22,545.60
March	45	9.00	36.00	13.5	4.50	9.00	1,350.00	270.00	405.00	135.00	270.00	1,080.00	270.00	5,805.00	9,450.00	29,160.00	16,200.00	10,465.20	(13,905.00)	(945.00)	4,789.80	28,987.20
April	50	10.00	40.00	15	5.00	10.00	1,500.00	300.00	450.00	150.00	300.00	1,200.00	300.00	6,450.00	10,500.00	32,400.00	18,000.00	11,628.00	(15,450.00)	(1,050.00)	5,322.00	32,208.00
May	50	10.00	40.00	15	5.00	10.00	1,500.00	300.00	450.00	150.00	300.00	1,200.00	300.00	6,450.00	10,500.00	32,400.00	18,000.00	11,628.00	(15,450.00)	(1,050.00)	5,322.00	32,208.00
June	50	10.00	40.00	15	5.00	10.00	1,500.00	300.00	450.00	150.00	300.00	1,200.00	300.00	6,450.00	10,500.00	32,400.00	18,000.00	11,628.00	(15,450.00)	(1,050.00)	5,322.00	32,208.00
July	50	10.00	40.00	15	5.00	10.00	1,500.00	300.00	450.00	150.00	300.00	1,200.00	300.00	6,450.00	10,500.00	32,400.00	18,000.00	11,628.00	(15,450.00)	(1,050.00)	5,322.00	32,208.00
August	45	9.00	36.00	13.5	4.50	9.00	1,350.00	270.00	405.00	135.00	270.00	1,080.00	270.00	5,805.00	9,450.00	29,160.00	16,200.00	10,465.20	(13,905.00)	(945.00)	4,789.80	28,987.20
September	45	9.00	36.00	13.5	4.50	9.00	1,350.00	270.00	405.00	135.00	270.00	1,080.00	270.00	5,805.00	9,450.00	29,160.00	16,200.00	10,465.20	(13,905.00)	(945.00)	4,789.80	28,987.20
October	40	8.00	32.00	12	4.00	8.00	1,200.00	240.00	360.00	120.00	240.00	960.00	240.00	5,160.00	8,400.00	25,920.00	14,400.00	9,302.40	(12,360.00)	(840.00)	4,257.60	25,766.40
November	25	5.00	20.00	7.5	2.50	5.00	750.00	150.00	225.00	75.00	150.00	600.00	150.00	3,225.00	5,250.00	16,200.00	9,000.00	5,814.00	(7,725.00)	(525.00)	2,661.00	16,104.00
December	20	4.00	16.00	6	2.00	4.00	600.00	120.00	180.00	60.00	120.00	480.00	120.00	2,580.00	4,200.00	12,960.00	7,200.00	4,651.20	(6,180.00)	(420.00)	2,128.80	12,883.20
						Total Annual Consumption	14,250.00						Total bill (PKR/Yr)						(146,775)	(9,975)	50,559	305,976.00
													Total savings (PKR/Yr)						758,727	621,927	561,393	
													Annual O&M (PKR/Yr)						(12,000)	(12,000)	(12,000)	
													Annual net benefit (PKR/Yr)						746,727.00	609,927.00	549,393.00	
													Payback period (Yrs)						1.59	1.94	2.16	

Appendix II

Impact of Net-metered Solar PV Systems on Capacity Payments in Pakistan

A) Impact calculated for the present quantity of net-metered solar PV capacity as of June 2024 (2200 MW)

Total net-metered solar PV capacity as of June 2024	**2200**	**MW**
Annual generation (kWh)	3,661,680,000	kWh
Self-consumption 70%	2,563,176,000	kWh
Feedback to the grid 30%	1,098,504,000	kWh
A) Annual Capacity Payments for all power generated as reflected in Projected Power Purchase Price FY 2024-25 by Power Division	2,265,740,000,000	PKR
B) Total energy produced as reflected in Projected Power Purchase Price FY 2024-25 by Power Division	130,876,000,000	kWh
Average Capacity Purchase Price = A/B	17.31	PKR/kWh
Impact on Capacity Payments from Induction of Renewable Energy		
A) Total energy produced by grid after feedback	127,214,320,000	
B) Annual Capacity Payments for all power generated	2,265,740,000,000	
Average Capacity Purchase Price = A/B	17.81	PKR/kWh
% of rooftop net-metered solar as % of total grid capacity	5%	

B) Impact calculated for the present quantity of net-metered solar PV capacity after accounting for a projected 1200MW increase in capacity by June 2025

Total net-metered solar PV capacity as of June 2025	**3400**	**MW**
Annual generation (kWh)	5,658,960,000	kWh
Self-consumption 70%	3,961,272,000	kWh
Feedback to the grid 30%	1,697,688,000	kWh
Annual Capacity Payments for all power generated as reflected in Projected Power Purchase Price FY 2024-25 by Power Division	226,574,000,0000	PKR
Total energy produced as reflected in Projected Power Purchase Price FY 2024-25 by Power Division	130,876,000,000	kWh
Average Capacity Purchase Price = A/B	17.31	PKR/ kWh
Impact on Capacity Payments from Induction of Renewable Energy		
Total energy produced by grid after feedback	125,217,040,000	
Annual Capacity Payments for all power generated	2,265,740,000,000	
Average Capacity Purchase Price = A/B	18.09	PKR/kWh
% of rooftop net-metered solar as % of total grid capacity	8%	

About IEEFA

The Institute for Energy Economics and Financial Analysis (IEEFA) examines issues related to energy markets, trends and policies. The Institute's mission is to accelerate the transition to a diverse, sustainable and profitable energy economy. www.ieefa.org

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