EPH–International Journal of Science & Engineering
Published by: E-Pub Solutions Private Limited
ISSN (Online): **2454-2016**
Volume 12 Issue 03 August 2026
DOI:10.67772/3jk36b14

DYNAMIC INTERACTIONS BETWEEN SOLAR POWER GENERATION AND ELECTRICITY DEMAND FOR IMPROVED ENERGY BALANCE

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Article History:
Article Type: Research
Received Date: **12/07/2026**
Revised Date: **11/08/2026**
Accepted Date: **18/08/2026**
Published Date:**28/08/2026**

Keywords: Solar PV generation, Electricity demand, Energy balance, Demand coverage, PV self-consumption

ABSTRACT

Solar photovoltaic generation and electricity demand follow distinct temporal patterns that can create substantial energy imbalance even when aggregate solar production is high. Understanding their dynamic interaction is essential for evaluating demand coverage, self-consumption, and surplus energy in prosumer systems. This research examined the temporal relationship between solar PV generation and electricity demand and quantified its influence on energy-balance performance. Approximately 30-second-resolution measurements from 24 sampled days were analyzed using descriptive, hourly, time-weighted, and day-level statistical methods. PV generation, electricity demand, direct demand coverage, self-consumption, surplus energy, unmet load, and net energy balance were evaluated, with paired testing and Spearman correlations applied at the day level. PV generation peaked at 11:00, whereas electricity demand peaked at 21:00, producing a 10-hour separation. Total PV energy exceeded total load energy, yet direct PV demand coverage was 34.96%, PV self-consumption was 21.80%, and the PV surplus share reached 78.20%. Eighteen of 24 sampled days recorded a net surplus. Higher daily PV energy was strongly associated with greater demand coverage ($\rho = 0.721$, $p < 0.001$). Effective energy balancing therefore depends strongly on temporal alignment between generation and consumption. Load shifting, demand response, and storage could improve utilization of daytime PV surplus and reduce evening deficits.

1. Introduction

Solar PV (PV) generation is becoming a more significant part of the transition to more sustainable electricity systems. Solar energy is a renewable resource for electricity generation and can be deployed across scales, from utility-scale installations to distributed prosumer systems, reducing reliance on conventional electricity generation and supporting long-term decarbonisation goals. The increasing contribution of PV is linked to technological development, reduction of deployment barriers, and a rising interest in locally produced power (Heydari et al., 2023). Solar electricity technologies have been upgraded with the introduction of better conversion systems, system configuration, and improved generation performance, which further enhances the technology's applicability in various operating environments (Ahmadi et al., 2018). Despite these benefits, solar power generation remains inherently variable across the course of the day. This variability poses an important challenge to operations since electricity delivery is needed when the consumers want it and not just when renewable generation is available. Hence, the integration of solar resources must be considered both in terms of the amount of electricity produced and when it is produced (Hayat et al., 2019). The second source of temporal variability is the electricity demand. Consumers' consumption varies over time, depending on the behavior of each consumer, economic activity, the climate and general electricity consumption. The ever-expanding global electricity demand and the installation of renewable energy resources have made it more imperative to manage electricity generation and load in today's electricity systems (Hasanuzzaman et al., 2017). Demand profiles will also change due to changes in the load curve characteristics and magnitudes brought about by electrification and socioeconomic factors (Castillo et al., 2022). Long-term electricity consumption records also suggest that electricity demand is not temporally stationary and reacts dynamically to different situations (Deryugina et al., 2020). These properties of solar generation and electricity demand are especially significant for prosumer systems where the PV electricity is either simultaneous with or in excess of the consumption needs.

Therefore, the performance of the PV system cannot be judged solely by the total electricity output. The amount of solar energy a system could produce can be significant, but not necessarily for direct consumption, as the production can take place at a different time than consumption. Technological advances in PV have enhanced the ability and performance of PV-based generation systems; however, their practical contributions are still dependent on the correspondence between generated electricity and load demand (Panagoda et al., 2023). Improvements in materials of PV cells and related technologies have also helped in the advancement of the potential for PV energy conversion and deployment (Singh et al., 2021). There are also other PV cell technologies that offer additional potential for efficient renewable electricity generation, but with the same temporal properties of solar availability (Al-Ezzi & Ansari, 2022). Generation–demand alignment is thus a key aspect of understanding the effectiveness of PV output in supplying electricity itself. Previous studies have tackled the issue of solar generation and electricity demand in several complementary ways. Reliability-based studies have shown that data-driven approaches can be beneficial for tackling uncertainty in solar generation and for generation planning (Kumar et al., 2025). Temporal information is crucial for predicting electricity demand changes; on the demand side, sophisticated computational methods have been developed to predict electricity consumption from past energy demand data (Bedi & Toshniwal, 2019). A separate study of electricity-demand modeling has also been conducted for hybrid solar PV applications, which rely on the interplay between electricity demand and renewable generation for system design and operation, as mentioned earlier (Minai et al., 2021). At a larger level, historical trends of energy consumption and future demand forecasting illustrate that the transformation of energy demands should be taken into account together with the transformation of energy supply (Ahmad & Zhang, 2020).

These developments demonstrate the importance of solar-generation and demand analysis, yet a key question in distributed PV systems remains insufficiently addressed: the extent to which real-time PV generation coincides with simultaneous electricity demand. Even if the focus is on generation potential, forecasting, technological performance or aggregate consumption, analyses can give limited information about when PV output matches load. The figures for aggregate energy may also

mask hours of significant oversupply from solar energy and deficiency in electricity during the day. This allows a more accurate picture of solar–demand compatibility when a high-resolution assessment of the hourly generation and demand profiles, direct PV demand coverage, self-consumption, surplus energy, unmet load, and day-level energy balance is done in an integrated manner. This type of analysis can be especially helpful in identifying overall availability of energy versus how much solar energy is used to meet energy needs.
For this reason, this work investigates the dynamics of PV generation and electricity demand in an active prosumer system in the presence of high temporal resolution measurements. The first goal is to describe the hourly and daily variations in PV input and electricity demand. The second is to measure direct demand coverage, PV self-consumption, surplus energy, unmet demand and net energy balance. The third goal is to look at day-level PV–demand relationships and the variability of overall energy-balance performance. Combined, these goals create an empirical basis to evaluate the impact of the solar production time on energy balance from the perspective of electricity consumption.

2. Methodology
2.1. Research Design
A quantitative, time-series analytical design was implemented to investigate the relationship between PV generation and electricity demand over time. The analysis covered temporal generation–demand patterns, direct demand coverage, energy surplus/deficit and day-level variation in energy-balance performance. The high-resolution measurements were analyzed at their original temporal scale and subsequently summarized into hourly profiles and day-level indicators. Descriptive, time-weighted, and inferential analyses were used to characterize the temporal alignment between available solar generation and electricity demand.
2.2. Data Source
The data were collected from an operational prosumer energy system in Cyprus and included an approximate 30-second resolution measurement of the PV generation and electrical load over the time interval (Hadjidemetriou et al., 2023). Records were made on 24 measurement days from October 2021 to September 2023. Time-stamped PV active-power and electrical-load measurements were used as the primary variables for the analysis.
2.3. Data Preparation and Quality Assessment
These were arranged in chronological order based on their timestamps in the individual measurement files. Prior to analysis, the validity of the data was checked for timestamps, duplicate records, missing records, sampling intervals and daily observation coverage. The integrated data set had 69,615 observations. Of the 69,615 observations, 69,486 contained valid electricity-demand values; 129 observations with negative active-load values were excluded from demand-based calculations, while the recorded solar PV active-power observations were retained. The measurement date and the hour of day were created as temporal variables which were used for aggregation.
2.4. Descriptive and Temporal Analysis
The mean, standard deviation, median, quartiles, minimum and maximum of solar PV generation and electricity demand were summarized. Hourly profiles were derived by combining valid observations by hour of the day over the days of measurements. The PV generation and electricity demand were averaged over the hour, and the hour of maximum PV generation and hour of maximum electricity demand were determined, as well as the time lag between the two. In addition, day-level summaries were computed to describe the variability of generation and demand over the 24 measurement days.
2.5. Solar–Demand Energy-Balance Analysis
Instantaneous power balance was calculated by subtracting the electricity demand from the PV generation; if the result is positive, electricity was generated more than used, and if the result is negative, electricity was consumed more than generated. Simultaneous PV generation and demand were matched, and the minimum power was termed as direct matched power. Consecutive valid observations were integrated using their actual sampling intervals for energy-based analysis, while

intervals containing invalid demand data or excessively large time gaps were excluded. There were 69,434 valid integrated intervals, corresponding to 571.65 hours of observation, after the procedure.

2.6. Energy-Balance Performance Indicators

The integrated intervals were used to determine the following: Time-weighted PV energy, load energy, matched PV-load energy, surplus energy, unmet load energy and net energy balance. The PV demand coverage was indicated as matched PV-load energy/total load energy. PV self-consumption was defined as the percentage of PV energy production that was matched with demand, while PV surplus share was defined as the percentage of PV energy production not matched with demand. These indicators were computed over the entire analytical period and over each measurement day and each hour.

2.7. Statistical Analysis

Day-level PV and load energies were paired for statistical comparison. The Shapiro–Wilk test was used to assess the normality of paired differences; because this assumption was satisfied, a paired-samples t-test was applied, with Cohen's dz calculated as the effect-size measure. Day-level correlations between PV energy, load energy, direct demand coverage and PV self-consumption were calculated using Spearman rank correlations. A p-value of < 0.05 was considered statistically significant.

3. Results

3.1. Descriptive Characteristics of Solar PV Generation and Electricity Demand

69,615 observations of solar PV were available, and 69,486 valid observations were kept for the electricity-demand analysis. Mean solar PV active power was 920.45 ± 1,333.50, with a maximum of 5,005.00. Mean electricity demand was 569.99 ± 791.08, with a median of 306.51 and a maximum of 7,214.32. Table 1 shows the descriptive statistics of solar PV generation and electricity demand.

Table 1. Descriptive Statistics of Solar PV Generation and Electricity Demand

Variable	N	Mean	SD	Median	Q1	Q3	Minimum	Maximum
Solar PV active power	69,615	920.45	1,333.50	0.00	0.00	1,756.00	0.00	5,005.00
Electricity demand	69,486	569.99	791.08	306.51	200.64	488.06	0.10	7,214.32

3.2. Hourly Solar PV Generation and Electricity Demand

Hourly profiles revealed that there were clear differences between electricity demand and PV generation. PV generation on average started to rise from 06:00 and peaked at 3,207.19 at 11:00 before easing during the afternoon. The minimum and maximum mean demand of the hour were 233.61 and 1,133.45, respectively, and these were achieved at 05:00 and 21:00, respectively. The peak of PV was 10 hours away from the peak of demand. The hourly profiles of mean solar PV generation and electricity demand are shown in Figure 1.

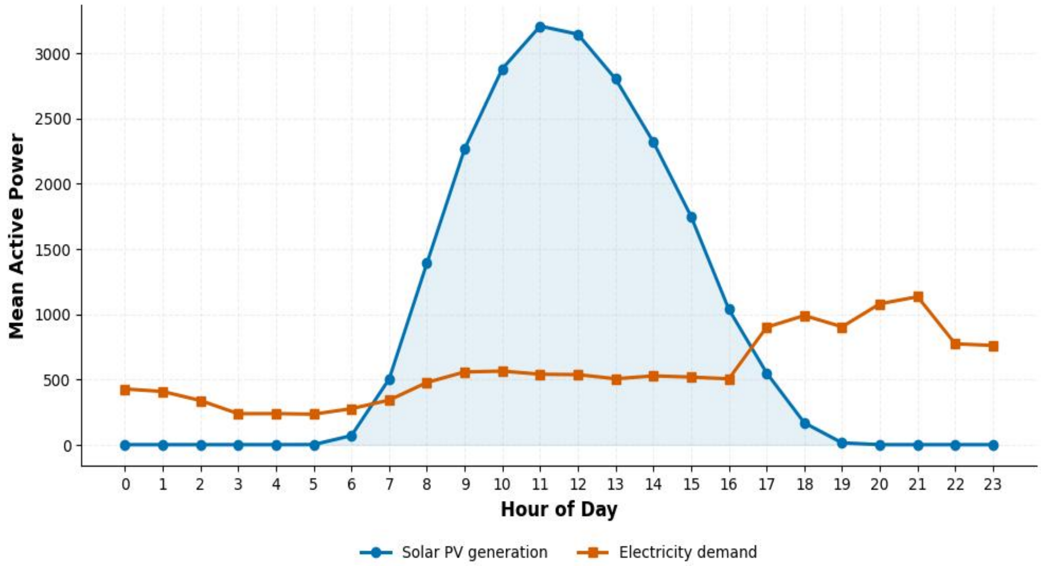

Figure 1. Hourly profile of solar PV generation and electricity demand across the sampled measurement days.

3.3. Time-Weighted Solar–Demand Energy Balance

There were 69,434 valid intervals with a total of 571.65 hours of time-weighted integration. Total PV energy was 526,208.84 power-unit-hours; total load energy was 328,127.06 power-unit-hours. Matched PV-load energy was 114,705.35 power-unit-hours, while surplus PV energy was 411,503.49 power-unit-hours. Direct PV demand coverage was 34.96%, PV self-consumption was 21.80%, and the PV surplus share was 78.20%. Table 2 lists the main time-weighted indicators of solar–demand energy balance.

Table 2. Time-Weighted Solar–Demand Energy-Balance Indicators

Energy-balance indicator	Value	Unit
Total PV energy	526,208.84	Power-unit-hours
Total load energy	328,127.06	Power-unit-hours
Matched PV-load energy	114,705.35	Power-unit-hours
Surplus PV energy	411,503.49	Power-unit-hours
Unmet load energy	213,421.71	Power-unit-hours
Net energy balance	198,081.78	Power-unit-hours
Direct PV demand coverage	34.96	%
PV self-consumption	21.80	%
PV surplus share	78.20	%

3.4. Hourly Demand Coverage and Energy-Balance Patterns

Hourly direct PV demand coverage varied substantially across the day. Coverage exceeded 50% from 07:00 to 16:00 and reached its highest mean value of 99.99% at 11:00. The direct contribution of PV to electricity demand is plotted in Figure 2A for every hour of the day. The PV surplus energy rose during the morning and was the highest at 11:00, with a mean of 2,661.85. Unmet load energy increased during the evening and reached its highest mean value of 1,133.43 at 21:00. The PV surplus and unmet load energy vary by hour, as seen in Figure 2B.

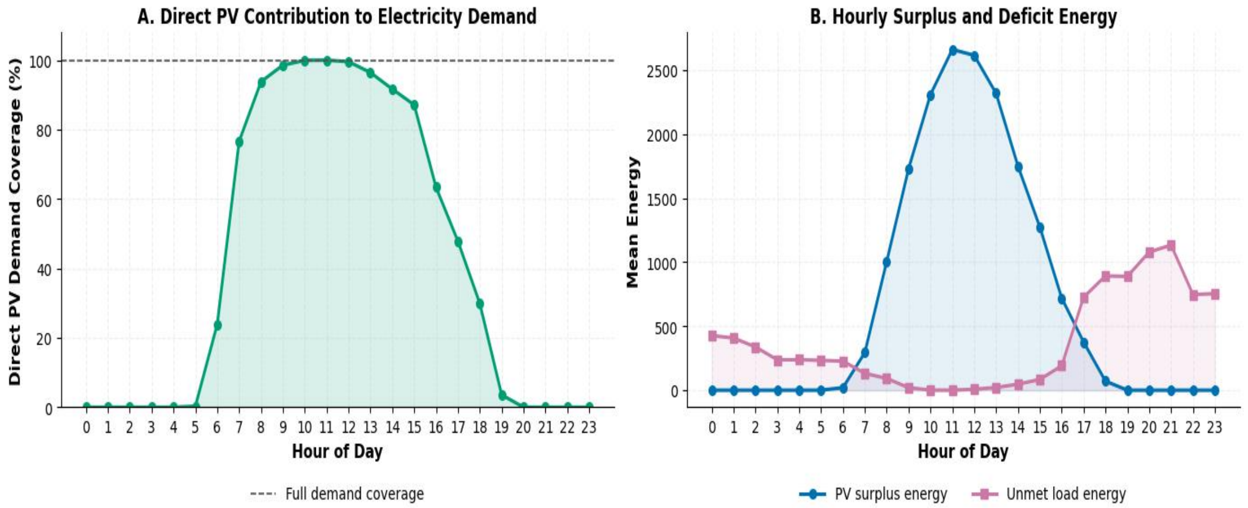

Figure 2. Hourly solar–demand energy balance (A) direct PV contribution to electricity demand and (B) hourly PV surplus and unmet load energy.

3.5. Day-Level Statistical Comparison and Associations

Mean daily PV energy was 21,925.37 power-unit-hours, while mean daily load energy was 13,671.96 power-unit-hours. The paired difference was normally distributed (Shapiro–Wilk p-value = 0.0738). The paired samples t-test indicated that there was a significant difference between daily PV and load energy ($t = 3.118$, $p = 0.005$, Cohen's dz = 0.636). Table 3 presents the day-level statistical comparison and association of the energy indicators. The demand coverage ($\rho = 0.721$, $p < 0.001$) was positively related to PV energy. Demand coverage was negatively correlated with load energy ($\rho = -0.465$, $p = 0.022$) and PV self-consumption was positively correlated with load energy ($\rho = 0.568$, $p = 0.004$). The other associations tested were not statistically significant.

Table 3. Day-Level Statistical Comparison and Associations

Analysis	N	Statistic	Coefficient	p-value
Daily PV energy vs daily load energy	24	Paired-samples t-test	3.118	0.005
PV energy vs load energy	24	Spearman ρ	−0.096	0.657
PV energy vs demand coverage	24	Spearman ρ	0.721	<0.001
Load energy vs demand coverage	24	Spearman ρ	−0.465	0.022
PV energy vs self-consumption	24	Spearman ρ	−0.178	0.405
Load energy vs self-consumption	24	Spearman ρ	0.568	0.004
Demand coverage vs self-consumption	24	Spearman ρ	0.012	0.955

Note: Shapiro–Wilk p = 0.0738; Cohen's dz = 0.636 for the paired daily PV–load energy comparison

3.6. Daily Variation in Energy-Balance Performance

The net energy surplus occurred on 18 of the 24 days of measurements (75.0%), and a net energy deficit occurred on 6 days of measurements (25.0%). The highest surplus was on 1 June 2022, with 24,110.58 power-unit-hours, and the highest deficit was on 3 February 2023, at −22,847.13 power-unit-hours. The percentage of PV demand covered varied between 8.16% and 74.77%, with the peak being reached on 1 June 2022. The daily change of net energy balance and of direct PV demand coverage during the measurement period is presented in Figure 3.

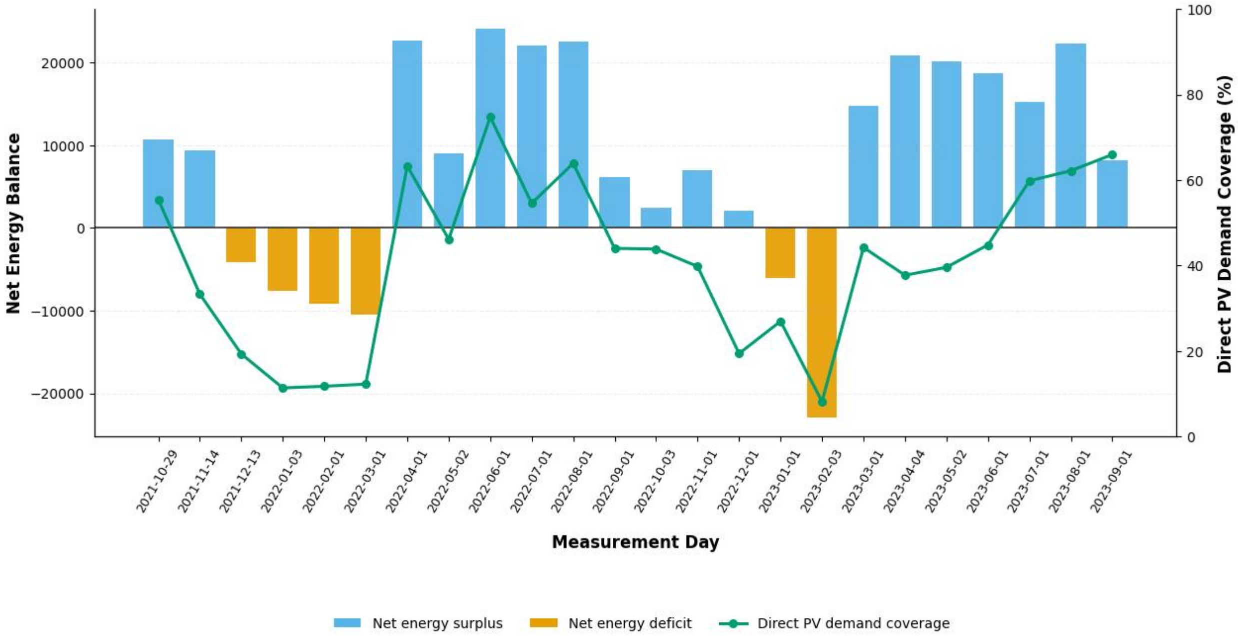

Figure 3. Daily variation in net solar–demand energy balance and direct PV demand coverage across the 24 measurement days.

4. Discussion

The findings clearly show a mismatch between the solar PV generation and electricity demand over time. The power generation from the solar plant surged during the morning and peaked at 11:00, while the electricity consumption peaked during the evening at 21:00, causing a time difference of 10 hours between the morning and evening peaks. This trend is the reason that a positive aggregate energy balance did not result in high direct use of PV electricity. Despite the greater amount of total PV energy, only 34.96% of the total energy consumed by the load was produced concurrently (simultaneous PV generation). PV self-consumption was 21.80%, while 78.20% of PV generation remained as contemporaneous surplus. The hourly results reinforce this pattern, as direct PV demand coverage approached 100% around midday but declined sharply toward the evening as PV output fell while electricity demand increased. The day-level results also demonstrate that the relative energy balance was not constant throughout the sampling period. The net loss or gain was positive on 18 days of the 24 days of measurement, and negative on 6 days. There was also a wide range of direct PV demand coverage from 8.16% to 74.77%, showing significant time-shift mismatch between PV generation and consumption. The daily PV energy showed a strong correlation with better demand coverage, while the load energy showed a negative correlation with the demand coverage. There was no clear correlation between PV and load energy, so the generation and consumption were, to a certain extent, independent between the measurement days. Conversely, higher load energy was positively correlated with PV self-consumption, indicating that days with greater electricity demand tended to utilize a larger proportion of the available PV generation.

The results are similar to previous studies demonstrating that in addition to renewable energy generation capacity, the time profile of demand is a key determinant of energy-balancing performance. The significant hourly fluctuation in demand and generation here makes the importance of periodic generation and demand patterns highlighted by Javaid et al. (2024) evident. Temporal coordination is also highlighted as a key challenge for the successful integration of renewables in the broader literature on renewable supply–demand balancing (Gan et al., 2020). The combination of high PV availability during daytime hours and elevated electricity demand during the evening therefore represents a characteristic balancing challenge in PV-dominant systems. The results also confirm the value of flexible demand and storage for better utilization of local PV generation. Lund (2018) demonstrated that the performance of storage is sensitive to the size of the storage and the load profile shape, as well as to the matching of storage size and PV production. The

low self-consumption of PV and high share of PV surplus in this analysis suggests that storage may be able to help to shift excess PV generation to later times of the day. A number of related studies have demonstrated the potential for using locally generated solar energy, if loads are flexible, with storage to optimize energy use (Ye et al., 2024). This is especially important with respect to the PV contribution during the peak that was observed at 21:00, when the contribution from PV became 0.
The day-to-day variability also aligns with evidence that the generation from solar and electricity demand are affected by variation in temporal conditions. Studies of forecasting variability in European power systems have shown that both demand and solar generation have significant sub-seasonal variability, and their interaction can have an impact on system operation and planning (Bloomfield et al., 2021). Solar generation also depends on the environment and operational circumstances, which can shift the amount of electricity produced from one day to another and make it difficult to match the solar power with the demand (Matushkin et al., 2020). The significant variability in the daily demand coverage seen here is thus in line with the assumption that PV–load alignment will vary under different operating conditions. Complementarity analysis has also demonstrated that the share of electricity demand to be covered by renewables can be largely dependent upon the time alignment between electricity demand and supply profiles. The results of Couto and Estanqueiro (2020) showed that the use of VRR can enhance demand matching with a lower limitation of a single generation profile. The present analysis only covered solar PV, but the difference between the PV surplus during the day and the PV deficit at night is stark, indicating that additional generation technologies may help to offset the imbalance.
The applications are quite simple. Energy balance needs to be improved, with more than just more PV generation. Load shifting to high generation hours may lead to higher direct demand coverage from PV and lower PV surplus. Renewable energy generation could shift to times of peak demand, and demand-response could shift flexible demand. The results also indicate that the Net Energy Balance, Direct Demand Coverage and PV self-consumption should be taken together, as the positive Net Energy Balance does not mean that solar energy is effectively used locally.
Some limitations need to be recognized. The analysis was performed with 24 sampled measurement days, not over the complete 2-year period of operating the prosumer system. There were no meteorological variables to explain the causes of the fluctuations observed daily, nor was there any information on storage behavior, electricity tariffs or demand at the level of the individual appliance. Further work could be based on longer continuous data sets and include other factors such as weather, storage, tariff, and flexible-load data. A comparative evaluation over a number of prosumers would also give insights into the consistent application of solar–demand interaction under various consumption profiles.

5. Conclusion

The electricity demand and PV generation were also observed to have a clear temporal mismatch, with electricity demand being at its maximum at 21:00 and PV generation at its maximum at 11:00. In all the sample periods, total PV energy was greater than total load energy, but only 34.96% of the load energy was directly provided by the simultaneous generation of PV energy. PV self-consumption was 21.80%, and 78.20% of PV-generated energy was contemporaneous surplus. The energy-balance performance was also found to be significantly different for different days, with 75% of the sampled days having a net surplus and the coverage of direct PV demand ranging from 8.16% to 74.77%. Daily PV energy was strongly positively associated with demand coverage, whereas daily load energy showed a moderate negative association with demand coverage. These findings demonstrate that aggregate energy availability alone is insufficient to ensure effective energy balancing. Better synchronization of generation and consumption should be achieved, including the use of load shifting, demand response and the right size of storage. Further research is needed to assess extended periods of continuous monitoring and to include weather, tariff, storage, and flexible-load data to enhance energy management decisions in a variety of prosumer systems.

References

1. Ahmad, T., & Zhang, D. (2020). A critical review of comparative global historical energy

consumption and future demand: The story told so far. Energy Reports, 6, 1973-1991.
2. Ahmadi, M. H., Ghazvini, M., Sadeghzadeh, M., Alhuyi Nazari, M., Kumar, R., Naeimi, A., & Ming, T. (2018). Solar power technology for electricity generation: A critical review. Energy Science & Engineering, 6(5), 340-361.
3. Al-Ezzi, A. S., & Ansari, M. N. M. (2022). Photovoltaic solar cells: a review. Applied System Innovation, 5(4), 67.
4. Bedi, J., & Toshniwal, D. (2019). Deep learning framework to forecast electricity demand. Applied energy, 238, 1312-1326.
5. Bloomfield, H. C., Brayshaw, D. J., Gonzalez, P. L., & Charlton-Perez, A. (2021). Sub-seasonal forecasts of demand and wind power and solar power generation for 28 European countries. Earth System Science Data, 13(5), 2259-2274.
6. Castillo, V. Z., De Boer, H. S., Muñoz, R. M., Gernaat, D. E., Benders, R., & Van Vuuren, D. (2022). Future global electricity demand load curves. Energy, 258, 124741.
7. Couto, A., & Estanqueiro, A. (2020). Exploring wind and solar PV generation complementarity to meet electricity demand. Energies, 13(16), 4132.
8. Deryugina, T., MacKay, A., & Reif, J. (2020). The long-run dynamics of electricity demand: Evidence from municipal aggregation. American Economic Journal: Applied Economics, 12(1), 86-114.
9. Gan, L., Jiang, P., Lev, B., & Zhou, X. (2020). Balancing of supply and demand of renewable energy power system: A review and bibliometric analysis. Sustainable Futures, 2, 100013.
10. Hasanuzzaman, M., Zubir, U. S., Ilham, N. I., & Seng Che, H. (2017). Global electricity demand, generation, grid system, and renewable energy polices: a review. Wiley Interdisciplinary Reviews: Energy and Environment, 6(3), e222.
11. Hayat, M. B., Ali, D., Monyake, K. C., Alagha, L., & Ahmed, N. (2019). Solar energy—A look into power generation, challenges, and a solar-powered future. International journal of energy research, 43(3), 1049-1067.
12. Heydari, M., Heydari, A., & Amini, M. (2023). Solar power generation and sustainable energy: a review. International Journal of Technology and Scientific Research, 12(03), 342-349.
13. Javaid, S., Kaneko, M., & Tan, Y. (2024). Energy balancing of power system considering periodic behavioral pattern of renewable energy sources and demands. IEEE Access, 12, 70245-70262.
14. Kumar, R., Mishra, S. K., Sahoo, A. K., Swain, S. K., Bajpai, R. S., Flah, A., ... & Elnaggar, M. F. (2025). Data driven prediction based reliability assessment of solar energy systems incorporating uncertainties for generation planning. Scientific Reports, 15(1), 9335.
15. Hadjidemetriou, L., Asprou, M., & Nikolaou, P. (2023). Photovoltaic generation and load demand datasets with 30 seconds resolution from an actual prosumer in Cyprus [Data set]. Zenodo. https://doi.org/10.5281/zenodo.8348862
16. Lund, P. D. (2018). Capacity matching of storage to PV in a global frame with different loads profiles. Journal of Energy Storage, 18, 218-228.
17. Matushkin, D., Bosak, A., & Kulakovskyi, L. (2020). Analysis of factors for forecasting electric power generation by solar power plants.
18. Minai, A. F., Husain, M. A., Naseem, M., & Khan, A. A. (2021). Electricity demand modeling techniques for hybrid solar PV system. International Journal of Emerging Electric Power Systems, 22(5), 607-615.
19. Panagoda, L. P. S. S., Sandeepa, R. A. H. T., Perera, W. A. V. T., Sandunika, D. M. I., Siriwardhana, S. M. G. T., Alwis, M. K. S. D., & Dilka, S. H. S. (2023). Advancements in photovoltaic (Pv) technology for solar energy generation. J. Res. Technol. Eng, 4(3), 30-72.
20. Singh, B. P., Goyal, S. K., & Kumar, P. (2021). Solar PV cell materials and technologies: Analyzing the recent developments. Materials Today: Proceedings, 43, 2843-2849.
21. Ye, A., Zhao, Z., Liu, S., Liu, X., Zhang, T., Liu, X., & Wang, J. (2024). Flexible energy utilization potential of demand response oriented photovoltaic direct-driven air-conditioning system with energy storage. Energy and Buildings, 323, 114818.