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Dual Battery Storage System: An Optimized Strategy for the Utilization of Renewable Photovoltaic Energy in the United Kingdom

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Received: 15 August 2018; Accepted: 5 September 2018; Published: 7 September 2018



Abstract: The increasing world human population has given rise to the current energy crisis and impending global warming. To meet the international environmental obligations, alternative technological advances have been made to harvest clean and renewable energy. The solar photovoltaics (PV) system is a relatively new concept of clean technology that can be employed as an autonomous power source for a range of off-grid applications. In this study, the dual battery storage system is coupled with a solar PV system and a low voltage grid, benefitting from the feed-in tariff (FIT) policy. The main outcomes of this study are: (I) A novel dual battery storage system for the optimal use of the PV system/energy is proposed; (II) The problem is formulated in the form of a mathematical model, and a cost function is devised for effective cost calculation; (III) An optimal cost analysis is presented for the effective use of PV energy; (IV) real-time data of a solar PV taken from the owner and the demand profile collected from the user is applied to the proposed approach, with United Kingdom (UK) tariff incentives. This system works in a loop by charging one system from the solar PV for one day, and discharging the other system. This model gives certainty that power is exported to the grid when the solar PV generates an excess amount; batteries are utilized during the peak hours, and power is purchased when the demand is not met by the batteries, or when the demand is higher than the generation. This study examined the economic knowledge of solar PV and battery storage systems by considering the FIT incentives.

Keywords: solar PV; feed-in tariff; battery storage system; demand profile

1. Introduction

1.1. Energy Spread and Photovoltaic Technology/PV Energy and World Demand

The increase in energy demand of developing countries is expected to be 65% by 2040, indicating the emerging growth, prosperity, and developing economies of such areas [1]. In contrast, the energy demand in the world will increase to 35% with the increase in population. The Intergovernmental Panel on Climate Change (IPCC) shows that there has been a 40%, 150%, and 20% increase in the concentrations of CO₂, methane, and nitrous oxide, respectively, since pre-industrial times. As of 2015, two-thirds of global CO₂ emissions are produced by the combustion of fuel, of which electricity generates 42%. A considerable amount of anthropogenic greenhouse gases are released from the industrial zones (IZ) in different countries [2]. The detrimental effects of the unsustainable

patterns of energy on social, health and environmental have been reported in [3–6]. According to [7], it is economically and technically feasible for renewable energy technologies (RETs) to be an alternate source for the present fossil fuel electricity infrastructure. The international energy agency (IEA) reported that the total installed capacity of the solar photovoltaics (PV) system in 2009 was 23 GW, which was ramped up by five times to 137 GW in 2013, followed by an increase in capacity to 177 GW in 2014. In 2016, the total global PV capacity was 303 GW, with 106 GW from European Union (EU), 77.4 GW from China, 42.8 GW from Japan, and 40.9 GW from United States of America (USA) [8–11]. Of all the electricity produced in the world in 2016 from the renewable energy sources, which amounts to 24.5%, the share of electricity from the PV is 1.5%.

Advances in science and technology have provided several alternative means of producing energy on a sustainable level [12]. More attention is being paid towards PV technology, due to the decrease in the cost of PV modules, the long lifetime service, and the widely flexible applications [13,14]. The solar panels consist of a number of PV modules, which convert solar energy into electrical energy [15–17]. Different types of commonly used materials for PV modules nowadays include mainly monocrystalline, polycrystalline, and thin film technologies [18–20]. Amorphous silicon technology is thin film technology, which is low-cost and the most environmentally friendly, and its cost can be as low as to 0.06–0.09 €/WP [21–23]. Solar PV technology can be considered as a backbone to shift our conventional energy sources to renewable and sustainable energy sources. The earth receives approximately 8×10^8 TW hr energy from the sun each year, which equals to potentially around 8000 times more than the energy demand of the world [24]. PV energy and energy efficiency play a key role in global energy usage. A common example of this are solar street lighting systems. They reduce the load of the conventional energy system and are an important contributor to improve the energy efficiency. Pinter et al. [25], investigated the economic analysis of the installation of a solar PV system for street lighting purposes in a Hungarian village comprising of 900–1200 residents, and encouraged the deployment of the PV system.

1.2. Energy Storage and Its Effective Utilization

The sporadic nature of PV systems is the main drawback in matching intermittent energy production with load demand. To overcome this drawback, a hybrid system is utilized, which consists of solar PV and a dual energy storage system connected with load [26,27]. The installation of the hybrid PV and energy storage system is economically feasible to meet the consumer load demand, as more generating capacity uses solar and wind energy [28]. Nizetic et al. [29], investigated the design and performance of the hybrid system for different operating conditions, with the conclusion that the hybrid system can be a cost-effective solution for small- and medium-scale applications.

Energy storage system (ESS) refers to a transformation of electrical energy from a power network or renewable energy sources (RES) into a form that can be stored and utilized during peak hours, or when the generating source is unavailable. According to [30–33], large-scale energy storage technologies, such as thermal storage, pumped hydro storage, fuel cell storage, and supercapacitors, have financial and technical problems. Currently, the battery energy storage system (BESS) is the main focus, because of the ease of installation compared to other storage technologies [34]. The analysis of the study in [35] shows that the optimal management of hybrid PV and BESS connected with the utility grid resulted in reduced electricity costs. The study of the work in [36], developed a technology selection and operation (TSO) optimization model to find out the optimal selection of PV and battery systems in the commercial buildings. A multi-period mixed-integer linear program (MILP) model for the scheduling and planning of the PV-battery storage system to magnify the net cash flow was studied in [37,38]. The optimal flow of power management for the distributed energy resources with batteries to meet the consumer demand at low cost was presented in [39,40]. Pamparana et al. [41], developed a novel MILP model to optimize the operational costs of the induction of PV and battery energy storage with a semi-autogenous grinding mill. The advantages of the operational planning of

nonconventional sources (wind power and PV) and the ESS has been discussed in [42,43]. The uptake of solar PV and BESS, and its profitability, is likely to eliminate dependence on power from the grid, and make independent homes or microgrids a possibility [44].

1.3. Batteries and Feed-In-Tariff Incentives/Effective Cost, and the Impact of the PV System

Nevertheless, most of the available literature in this area neglected the cost evaluation of tariff incentives. The operational planning of nonconventional sources (wind power and PV) and ESS has been discussed in. The use of batteries with PV systems to increase the self-consumption of electricity has expanded, particularly in Germany, Japan, Australia, and the USA [45,46]. Thus far, the batteries used in power system applications are deep cycle batteries (lithium-ion, lead-acid, flooded type, valve regulated type, sodium sulfur, metal ion, lithium-iron-phosphate, and flow batteries) having energy capacity in the range of 17 to 40 MWh and efficiencies of approximately 70–80% [47]. Lithium-ion batteries are used most frequently with the PV system [48]. Lithium-ion batteries are promising technology because of their high reliability, high energy density, low toxicity, high reliability, high efficiency, and long-life cycle [24,49]. The average cycle stability based on the depth of discharge (DOD) for lithium-ion is 6000 (80% DOD) and for the olivine-type-LiFePO₄, is 10,000 (100% DOD) [28].

A feed-in tariff (FIT) is a scheme for the deployment of renewable energy technologies to support renewable energy producers by offering long-term purchase agreements [50–53]. According to [54], FIT policies have led to the establishment of more than 15,000 MW of PV power and more than 55,000 MW of wind power from 2000 to 2009 in the European Union (EU), and are responsible for approximately 75% and 45% of global PV and wind deployment, respectively. The USA was the first country that considered the Public Utility Regulatory Policies Act (PURPA) in 1978, which was based on the purchase of electricity generated from the Renewable Energy facilities at pre-established rates. In 1990, Germany's Electricity Feed-in Law implemented the Stromeinspeisungsgesetz (StrEG) policy to purchase electricity from the non-utility renewable energy generators at a fixed percentage of retail electricity [55].

The current need is to move away from non-replenishing energy sources, which pollute the environment by releasing large amounts of CO₂ gases, towards the environmentally sustainable plants to mitigate the energy crisis, mainly in the power sector. The induction of batteries with a solar PV system serves as an alternate solution for the reduction of greenhouse gases, and to tackle peak shaving. Many different master plans have been developed to make use of PV energy with optimal results. Previous studies [41,45] have examined the fruitful techno-economic analysis of integration of solar PV and battery storage systems as an independent power source to tackle the peak demand. In the proposed setup, two batteries were managed smartly by charging one system from the solar PV, while the other is used to meet the demand, and the process and charging and discharging is switched to make use of the system optimally. The capacity of the PV generating system is 3 kW and the capacity of each battery used in our proposed optimized model is 270 Ah. A mathematical model is devised for this system to determine the optimal cost for the proposed system.

2. Material and Methods

2.1. Problem Formulation

The increasing demand for energy has prompted several research groups to evaluate different renewable energy resources as a whole or as a share. Solar energy is one of the cheapest and easiest way to generate electricity to mitigate the energy crisis. On the other hand, the generation of electricity from solar energy is not continuous within a certain threshold, and has become a bottleneck depending upon the time of day, the thermal–environmental conditions, and the duration of light. Therefore, it can be regarded as a variable generator source throughout the year. Consequently, the generation capacity of a solar energy source sometimes leads or lags the demand, as shown in Figure 1.

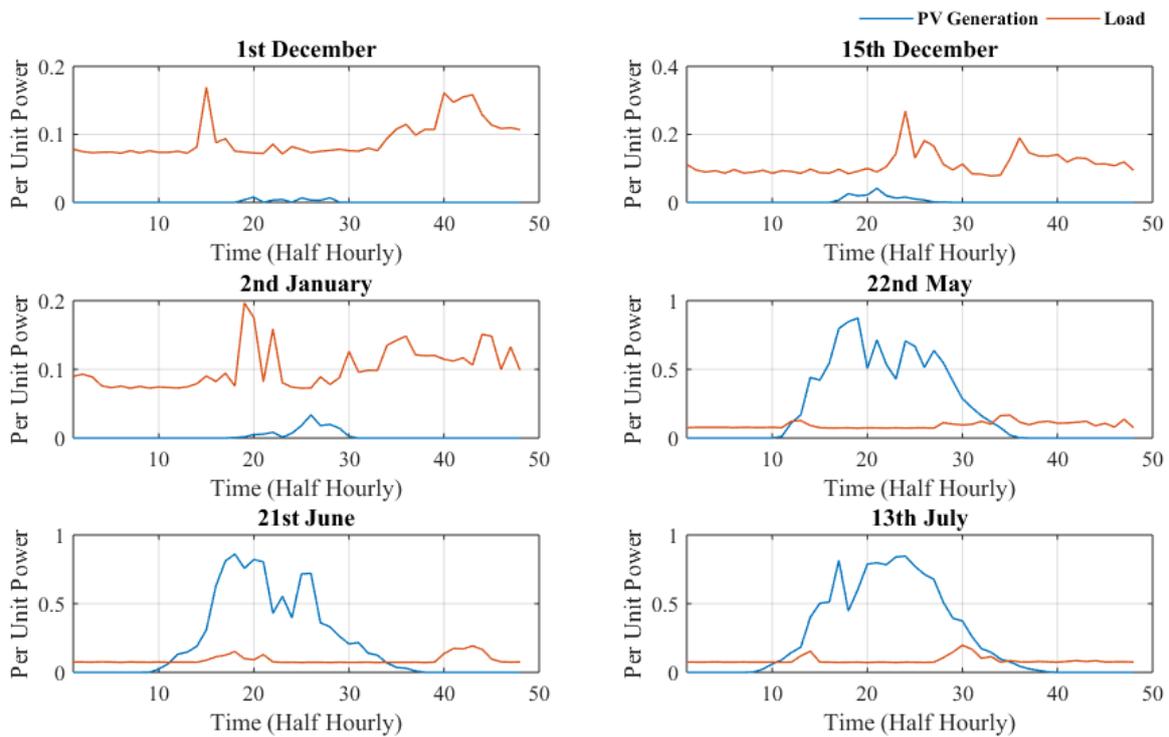


Figure 1. Per unit power profile of solar photovoltaics (PV) generation and the load of different days in a year.

The plots were taken for the different months of the year. In this figure, the blue lines show the generation of solar PV and the purple lines show the demand profile of the consumer. The plots in the top row from left to right were taken on 1 and 15 December, and the plot on the left of the second row was taken on 1 January, which indicates that solar PV generation lagged in demand, and power were provided by the grid also to fulfil the demand. The plots in the right of the second row were taken on 22 May, and the plots on the lower row were taken on 21 June, and on 13 July, indicating an excess of solar PV generation with respect to demand, which is exploited to charge batteries. The extra power was shifted to the grid utility when the charge in the batteries reached the maximum. This pattern showed that a solar plant can deliver power for an onsite load, it can export power when it exceeds the demand of certain area, and it can purchase electricity from the grid to supply a particular area during the time with less solar generation. Therefore, a mathematical function catering to this variability in the requirement of a solar energy unit is presented in Equation (1). In this study, a cost function J_1 is defined to represent the revenue generated by the solar panels:

$$J_1 = \max_{d,t} \sum [P_g(d,t) \times p_{g_FIT} + P_e(d,t) \times p_{e_FIT} - P_i(d,t) \times p_{i_FIT}] \Delta \times t \tag{1}$$

where d represents the date of the year, t represents the specific time of the day, P_g is the generation power from the solar plant, p_{g_FIT} is the generation tariff, P_e is the excess power, i.e., the difference of generation and demand, p_{e_FIT} is the export tariff, P_i represents the power required by the grid to feed the load during unmet demand, and p_{i_FIT} is the import tariff rate.

This paper proposes the idea of utilizing two separate energy storage systems (batteries) S_1 and S_2 . The solar energy is stored in one storage unit, and the second one is used to deliver the power to a specific area for a specific time. In the second stage, the batteries are swapped; the first is used to supply power and the second is reserved for storage if excess power is generated. Thus, this system works in the loop, which is shown in Figure 2.

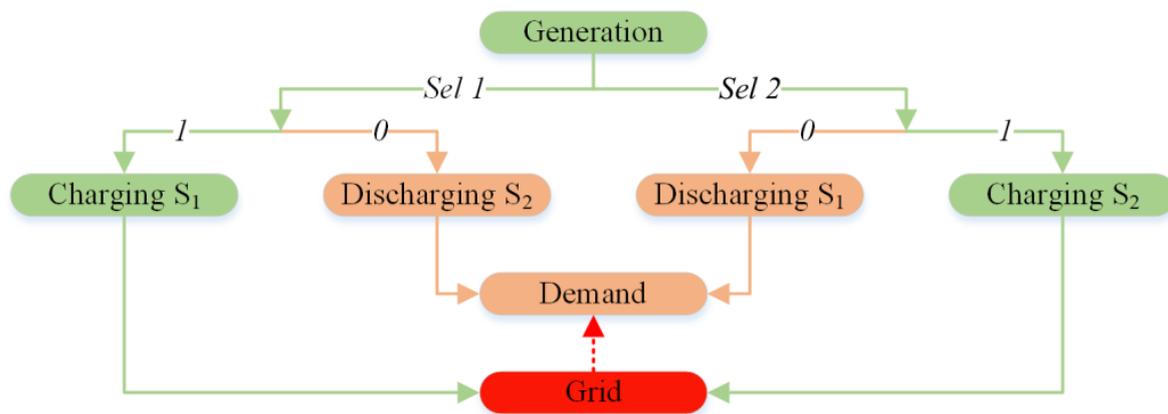


Figure 2. Schematic of charging and discharging for two energy centres, S₁ and S₂.

Overall, despite the increase in capital cost, the overall cost decreases.

The cost function, J_2 , is defined as:

$$J_2 = \max \sum_{d,t} \left[P_g(d,t) \times p_{g_FIT} + P_1^{in}(d,t) \times p_{in_FIT} + P_2^{in}(d,t) \times p_{in_FIT} + P_1^{out}(d,t) \times p_{o_FIT} + P_2^{out}(d,t) \times p_{o_FIT} + P_e(d,t) \times p_{e_FIT} - P_i(d,t) \times p_{i_FIT} \right] \times \Delta t \quad (2)$$

subjected to:

$$P_i(d,t) \geq 0,$$

$$0 \leq mn_c(s_k) \leq P_k^{in} \quad k = 1, 2,$$

$$0 \leq P_k^{out} \leq mx_c(s_k) \quad k = 1, 2,$$

where P_k^{in} and P_k^{out} represent the power that is used to store and to feed in, respectively, for the storage unit $k = 1, 2$; $mx_c(s_k)$ and $mn_c(s_k)$ represent the maximum and minimum storage capacities, respectively, and P_i represents the power that is imported from the grid, P_e represents the power excess power that is exported to the grid.

2.2. Methodological Detail

In the United Kingdom (UK), there are various means, such as reduced value-added tax (VAT), capital grants for householders, and schemes like Renewable Obligation (RO), and feed-in-tariff to embrace these microgeneration technologies [56]. This paper examines the deployment of batteries with the PV system under FIT incentives and time-varying electricity tariffs with the aim to reduce electricity bills. Figure 3 shows the power flows to the load from the utility grid, coupled with the PV and the energy storage system. The equipment and materials used for the flexible storage system include: PV modules, PV-inverters, a battery-inverter, a battery, a frame on the roof, cables, and outlets [28]. Solar PV modules consist of an assembly of solar PV cells, which convert the solar energy into direct current (DC) through the photovoltaic effect. The DC current was inverted by the power electronic inverter into alternating current (AC) to feed the load. The solar PV power was utilized onsite to provide power to the load. When there is excess power, it is prioritized by storing the power in the batteries first, until the batteries reach the maximum state of charge (SOC). The surplus power is then exported to the grid at the prescribed export tariff. The batteries are employed to backup to meet the demand, if the demand is not met by the solar system. When the SOC of the batteries falls below the prescribed limit, the power from the battery is curtailed and the power is imported from the grid at the described tariff.

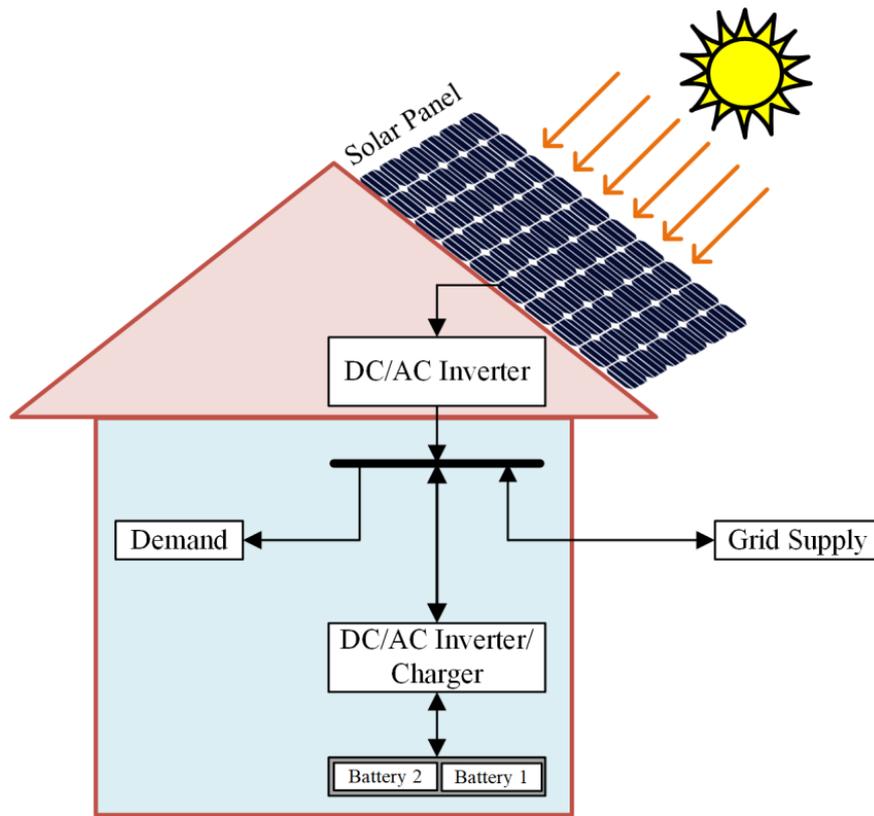


Figure 3. Schematic of the photovoltaic and battery storage systems (BESS).

Figure 4 shows the implementation of two batteries with a PV system and a utility grid. In this system, different tariff schemes were implemented to generate electricity from the PV panels, to store the excess power in the batteries, and to meet the unmet demand, which is provided by the grid, where C_g is the generation tariff in £/kWh; C_{s1} is the rate in £/kWh at which storage, S_1 , is charged; C_{s2} is the rate in £/kWh at which storage, S_2 , is charged; C_{r1} is the retail tariff in £/kWh met by the storage, S_1 ; C_{r2} is the retail tariff in £/kWh met by the storage, S_2 ; C_{gr} is the tariff in £/kWh at which power is imported from the grid to meet the demand, and C_e is the tariff at which power is exported to the grid.

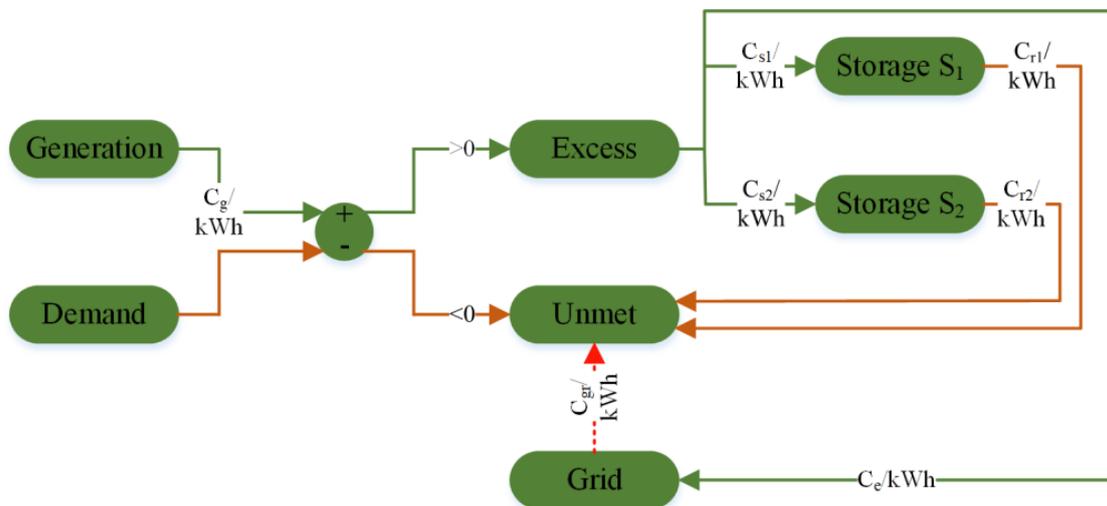


Figure 4. Implementation of two batteries with the PV system and utility grid.

2.3. Tariff Details

2.3.1. The Time-Of-Use Tariff

The time-of-use (TOU) tariff is an alternative way to tackle the energy storage (ES) problem and provides opportunities for ES advancement. In the TOU tariff, there is a hike in the electricity cost during peak hours but a lower cost during non-peak hours. By taking up the TOU tariff, consumers can curtail inflated peak hours and switch to electricity during non-peak hours to reduce the energy crisis. With the closure of coal power plants, reducing the country's carbon footprint has a great impact on the amounts of energy that the UK can generate. Envisaging the energy shortages in the years to come, the TOU tariff can play a key role in mitigating the demand and reducing the pressure on the UK energy infrastructure [57].

A case study on the TOU tariff has been done in some European countries, and in some states of the USA, such as the Gulf Power Select Program (GPSP), showing a 41% fall-off in electricity usage during peak hours [58]. According to the Statewide Pricing Pilot (SPP) examined in California [59], there is a decrease in the energy from 7.6% to 27% during peak hours by implementing the TOU tariff. In Norway, there was an 8–9% decrease in electricity use during the peak period by applying the TOU tariff.

2.3.2. Export Tariff

The export tariff allocates a revealed wage for every kilowatt-hour (kWh) of electricity exported, which is assigned by the authority. The generators in this system have a contract for the said period. This is beneficial to the consumers linked to this system for exporting the excess power to the utility grid. In this paper, the export tariff was fixed to 0.0464 £/kWh.

2.3.3. Import Tariff

Power is imported from the grid when there is lack of solar PV generation to meet the unmet demand. Electricity is imported from the grid at the prescribed rates. The half-hourly electricity readings were collected for the entire year from the ELEXON portal [2]. The solar insolation data was gathered from the Sheffield solar microgeneration database [60]. In this model, the Economy 7 tariff [61], was used as the time-of-use tariff, having a peak time period of 7 h commencing from 7:00 to 22:00, is levied at 0.15.8 £/kWh, and the remaining time constituting the off-peak hours is charged at 0.06 £/kWh, as shown in Figure 5.

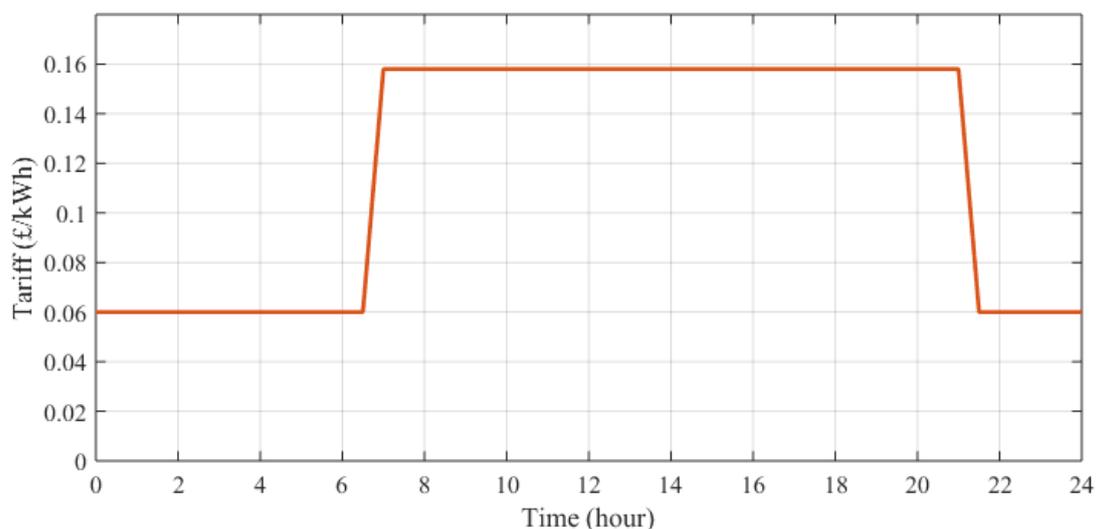


Figure 5. Economy 7 tariff.

3. Results and Discussion

With the increase in technological development energy needs, and to overcome the concerns of global warming, researchers have begun to consider changing from limited and hazardous energy sources to environmentally compatible energy sources, such as solar PV.

Figure 1 shows the solar PV generation and the demand profile of the consumers, for the various days of the different months. During the period of low PV, the purchase of power from the grid is required to meet the consumer demand. When the intensity of the solar irradiance is high, and the consumer demand is low, the power needed for the onsite demand is evaluated, and the remaining power is sold to the grid. There is significantly higher electricity generation in the summer, as shown in the lower middle and right plots in Figure 1. The lower value of onsite demand allows us to charge the batteries according to the proposed methodology, and to export the remaining power at the prescribed export rate of 0.06 £/kWh. On the contrary, there is notably low PV generation and increased consumer demand during the winters as shown in the upper left and middle plots in Figure 1. When the onsite consumer demand is greater than the PV generation, the batteries are utilized to supply power. The import of power from the grid is evaluated if the charge in the batteries to meet the demand reaches a minimum threshold level. Figure 2 shows the selection of the batteries for charging the first one on one day, and discharging the other for the other day. On the next day, the process is swapped by discharging the first one and charging the other, and this process works in a loop. Figure 4 reveals the pictorial view of our mathematical process, with a different rate for the generation, storage, export, and import of power.

The demonstration of three cases has been studied as:

3.1. Case 1

In this case, there is no solar PV or battery storage system feeding the consumer demand during the peak or non-peak hours. The demand is solely provided by the utility grid with the Economy 7 tariff applied. The power utilized to meet the demand is purchased at the rate of 0.06 £/kWh during the off-peak and at the rate of 0.158 £/kWh during peak hours. Figure 6 shows the grid-purchased electricity for the whole year, and recorded the highest demand of 19.8 kW in the month of January. Table 1 lists the cost of the electricity bought from the utility grid to meet the demand.

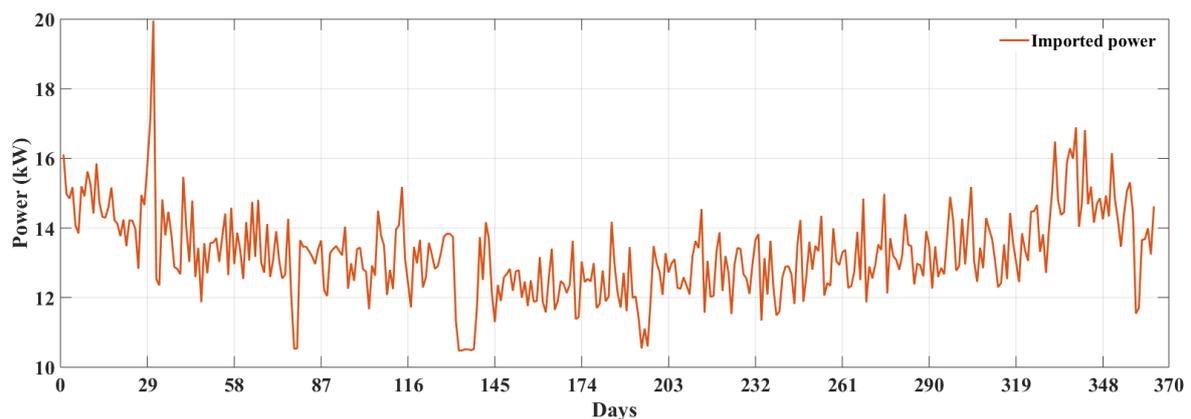


Figure 6. Power utilized without PV and battery system.

3.2. Case 2

In this case, there is no battery storage, and the load is connected with the solar PV system and the utility grid directly. The load demand of the system is met by the PV system first. If the PV cannot meet the total load demand, then the remaining energy is imported from the grid at the Economy 7 tariff. When the PV system output is more than load demand, the remaining PV energy is exported to

the grid at the prescribed export tariff of 0.04 £/kWh. Figure 7 shows the import and export profile for the entire year. Table 1 sums up the imported, exported, and net cost for this particular case.

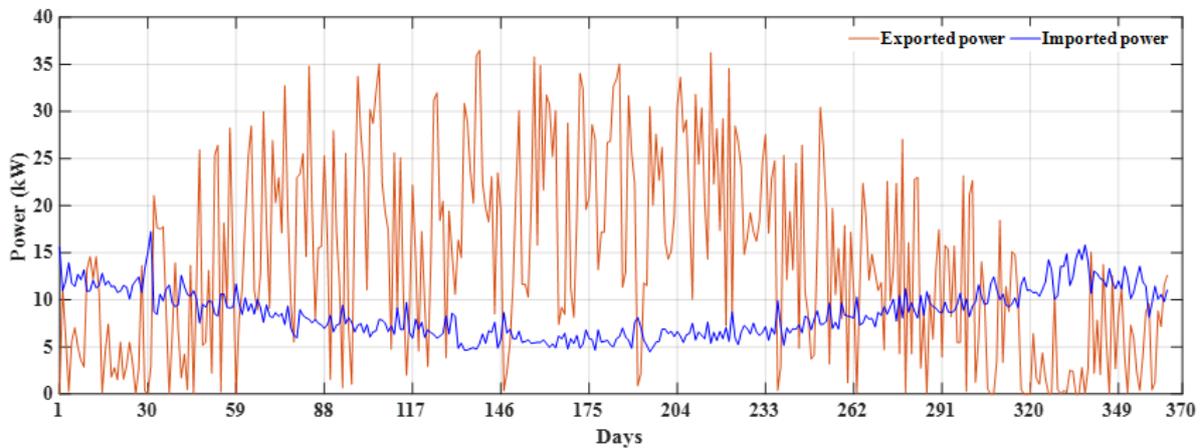


Figure 7. Import and export of the power profile with solar PV and no battery.

3.3. Case 3

In this case, the proposed hybrid PV and battery storage system is utilized. The batteries are charged and discharged according to the proposed methodology discussed above. Figure 8 shows the SOC of both batteries for the whole year. when the battery SOC reaches 100%, i.e., from day 55 to day 301, the power is exported to the grid at prescribed export tariff, and if the SOC of the battery decreases to its minimal level, i.e., from day 9 to day 46 and from day 314 to day 365, the power is imported from the grid at the Economy 7 tariff. The battery discharge pattern is proposed in such a way that minimum power is imported during peak hours, which will decrease the cost of the electricity purchased. Table 1 shows the import, export, and net cost for the proposed methodology.

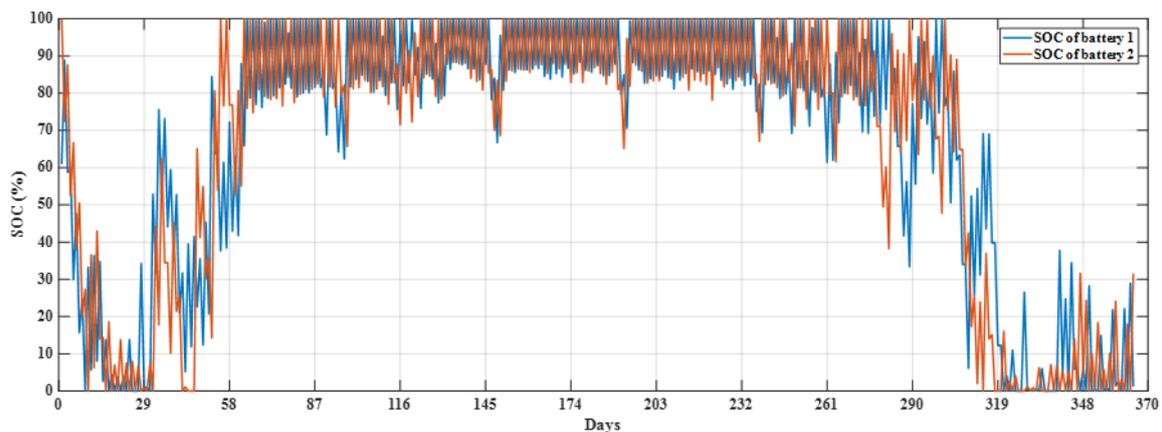


Figure 8. State of charge of the two batteries.

Table 1. Results of Cases 1, 2, and 3.

Case	PV Installed	Battery Installed	Economy 7 Tariff Applied	Cost of Importing Electricity (£) (A)	Cost of Exporting Electricity (£) (B)	Net Value (£) (C = A – B)
1	No	No	Yes	382.244	Nil	384.244
2	Yes	No	Yes	164.218	102.520	61.698
3	Yes	Yes	Yes	24.086	64.781	−40.695

The table shows the cost analysis of three cases. In Case 1, when no battery or PV was installed, the total cost of purchasing electricity was 384,244 £. In Case 2, when the PV was installed, the cost of buying the electricity was 164,218 £ and the cost of selling the extra power was 102,520 £. In Case 3, when both PV and batteries were employed, the cost of electricity purchase was 24,086 £ and the cost of selling the extra power was 64,781 £. The net value in Case 3 was $-40,695$ £; the negative sign indicated that the amount earned from the exported tariff was greater than the cost of the electricity imported.

The statistical analysis of the scheme was examined for buying, selling or reserving the power for 365 days. It is worthwhile to mention that some statistical parameters were added to analyze this study and its benefits in detail. A very interesting study by Malvoni et al. [62], discussed the forecasting of PV power generation using weather input data techniques. Since the sporadic nature of weather conditions has a great impact on the PV system and their forecast, therefore, skewness and kurtosis would be important parameters that could define the probability distribution related to the import, export, and storage of power. The bigger values of kurtosis represent the narrow probability distribution and the smaller value correspond to a relatively flat distribution, and thus, a large number of small forecast errors [62]. The skewness indicated that the forecasting of the model was over/under-forecast. The negative skewness represented the right-skewed distribution and the under-forecast model. On the contrary, positive skewness showed the left-skewed distribution and the over-forecast model. The skewness value near zero indicated the symmetric distribution. Table 2 shows the values of these statistical parameters, as described in [62] for all the three cases. The values of the statistical parameters shown in Table 2 depict that the skewness was negative for all the three cases. In Case 1, all of the electricity is fulfilled by the grid. In the early hours, the demand is relatively low, and as the day passes, the demand starts to increase. Therefore, the probability distribution is right-skewed with negative skewness. In Case 2, the initial demand is provided by the grid, but, as the day passes on, the solar PV system supports/shares the power demand generating the negative skewness for the import. But during midday, most of the demand is met by the solar PV system, and excess is transferred to the grid resulting in the delayed probability distribution. During the peak hours, the export is less right-skewed than the import. In Case 3, the load demand is initially less, and energy is stored in the battery system for the peak hours. This is in keeping with the fact that during initial hours, the battery is fully charged based upon the previous day's storage. Therefore, the energy is exported initially, resulting in a lesser right-skewed probability distribution of export than the import and the storage. Similarly, most of the demand in the early hours is fulfilled through the energy storage system. Thus, the current-day storage slowly increases as per the available energy of the solar PV system, resulting in the right-skewed probability distribution. Finally, as the most of the demand is met by the energy storage system, the import of power is required in the later hours of the day, resulting in a more right-skewed probability distribution of import. Therefore, the skewness, in this case, is minimum. Kurtosis in Case 1 shows that most of the demand is provided by the grid, which is comparatively less than Case 2, as in Case 2, some of the demand is shared by the solar PV system. In Case 3, the import is less, and low kurtosis shows the relatively flat probability distribution. Similarly, the kurtosis of the storage is high because the solar energy is low in the early daytime, at peak during midday, and reduces again during the later hours, generating a narrow probability distribution with a high kurtosis value. During the early hours, most of the energy (available) is used to increase the storage, and the remaining is exported to the grid. Similarly, the import of energy is required only in the case of low storage resulting in the relatively flat probability distribution of export and import.

Table 2. Statistical parameters of Cases 1, 2, and 3.

Case	Skewness			Kurtosis		
	Import	Export	Storage	Import	Export	Storage
1	-0.1	NA	NA	3.8	NA	NA
2	-0.3	-0.1	NA	5	4.2	NA
3	-1.6	-0.3	-0.4	6.3	7.3	7.6

It is pertinent to mention that one of the important issue that could rise while implementing the approach is the capital cost. As we have proposed a dual battery system, it will burden a certain increase in the one-time capital cost, but is fruitful as the uninterrupted supply is provided at the low cost in addition to net profit and contrast with the conventional approaches.

4. Conclusions

Solar energy is considered to be an entirely clean and favorable technology that can be used as an autonomous power source for various off-grid applications, to mitigate the energy crisis. In this work, an optimization model for the hybrid dual battery storage system with solar PV was presented. The proposed system operated optimally by charging the one battery and discharging the other, and a mathematical cost function of the system was devised. Real data of the irradiance and load profile was collected from the consumers, and the influence of the two storage systems on the demand was evaluated. The proposed algorithm allowed the maximum usage of battery power during the peak hours and examined the cost analysis of all the three cases. The proposed dual battery with the solar PV system resulted not only in an uninterrupted supply, but also resulted in a good profit margin. The consequences of the comprehensive analysis of the proposed scheme over the conventional schemes, i.e., without the use of PV or the storage system, resulted in net savings, in addition to satisfying energy demands. The statistical analysis of import and export of power, and the energy storage presented in this study, favor the proposed methodology.

Author Contributions: Conceptualization, S.H.N., M.A.K., M.U.A. and H.J.K.; Data curation, S.H.N. and M.-S.K.; Investigation, S.H.N. and D.-H.K.; Methodology, S.H.N., M.A.K. and M.U.A.; Software, M.A.K., M.U.A. and M.-S.K.; Supervision, H.J.K.; Visualization, D.-H.K.; Writing—original draft, S.H.N.; Writing—review & editing, S.H.N. and A.H.

Funding: This research received internal funding from 2-year Research Grant of Pusan National University.

Acknowledgments: This work was supported by a 2-Year Research Grant of Pusan National University.

Conflicts of Interest: The authors declare no conflict of interest.

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