Assessing Techno-Economic Value of Battery Energy Storage with Grid-Connected Solar PV Compensation Schemes for Malaysian Commercial Prosumers

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Abstract- Recently, many efforts have been dedicated to modeling the solar photovoltaic (PV) integrated with battery-energy-storage-system (BESS). However, some of the models did not consider the operation of solar PV-BESS with compensation schemes, different electricity tariff rates structures and BESS unit costs. Therefore, this paper presents three different solar PV compensation scheme models to address the techno-economic value of adopting BESS at flat and dynamic tariff rate structures such as Enhanced-Time-of-Use (ETOU)) and real-time wholesale tariff. A university building was selected as a case study that holds prosumer role and flat tariff is simulated with the presence of BESS using existing compensation scheme in Malaysia, i.e., Self-Consumption (SELCO), Net-Energy-Metering (NEM 2.0 and NEM 3.0) for 25 years lifetime. The results show that the usage of BESS's assisted in greater peak shaving up to 50% annually under flat tariff due to fix energy price and maximum demand (MD) charge for the entire year. Under the ETOU tariff, BESS dispatch ability assisted on annual electricity bills savings for about 64% compared to grid-only condition. On the recent NEM 3.0 techno-economic contract capacity, the adoption of BESS in energy arbitrage had created economic value especially in ETOU tariff. The results show project benefits in levelized-cost-of-energy (LCOE) of RM 0.304/kWh (USD 0.07/kWh), internal-rate-of-return (IRR) of 13.4%, return-of-investment (ROI) of 9.7% and discounted payback of 6.69 years for 253kWh designed BESS capacity case. This study can be used effectively by prosumers and utility owner to provide positive insights on the techno-economic value of adopting BESS in the behind-the-meter application.

Keywords Techno-economic, Battery energy storage, Solar PV, Net-energy-metering, Self-consumption, Electricity tariff.

1. Introduction

Exploring sustainable and clean energy is now crucial due to expanding global energy demand, energy security and environmental issues [1]. Malaysia, for instance, is striving to reach 40% renewable energy (RE) penetration target by 2035. However, the RE progress in this country has been at a slow pace, with only 7.6% (excluded large hydropower) shared in energy mix generation [2]. The inferior participation and acceptance of consumers in RE adoption might delay the national 2035 RE target and lower the pace towards becoming a carbon-neutral country in 2050. In the aspect of RE compensation scheme, it is common for the communities to get benefit payments on every project involved. Starting with Feed-in-Tariff (FIT) introduced in 2011, the government had gone through several series of revising the compensation scheme mechanisms. The first version of NEM was brought in 2016, which had seen reluctance in user's engagement compared to FIT [3], [4]. This happened due to prosumers must sell the excessive solar PV energy generated at prevailing displaced cost (RM0.31/ kWh) to grid authority. Hereof, NEM had evolved to NEM 2.0 in 2019 and NEM 3.0 in 2021 to continue the initiative of solar PV rooftops [5].

Malaysia is still at its early stage in adopting the grid-connected solar PV hybrid with BESS. In most cases, solar PV-BESS usage is concentrated at the off-grid area whereby grid connection is almost impossible due to geographical constraints [6], [7]. However, the usage of batteries as energy storage has gained more attention due to rapid declining on its cost [8]. By coupling the batteries with solar PV in grid connected system, it will further benefits reducing peak demand especially when associated with time varying electricity tariffs such as Time of Use (TOU), Peak Time Rebate (PTR) and Critical Peak Pricing (CPP) [9]. Contrary to the conventional electrical tariff (i.e., flat tariff), it was designed without considering the prices fluctuation during day and different sessions. Many researchers have reported outstanding techno-economic analysis for solar PV with batteries management under the TOU rates. For instance, in the USA, McLaren et al. analyzed the economic benefits obtained from 16 commercial building types that have solar PV combined with batteries energy storage and tested under 73 utility tariff rates [10]. The simulation concluded that the most favorable economic results were obtained for solar PV battery system during TOU at its demand charge rates. Sharma et.al., [11] identified that the demand side management (DSM) scheduling under the TOU enabled industrial consumers to minimize the environmental impact and electricity cost without jeopardizing their production target. Since the highest solar PV production occurs during peak time, dynamic energy pricing could provide significant electricity bill savings [12]. Despite the extensive literature conducted, there were only few comparative analyses on compensation schemes for solar PV-BESS been conducted.

In China, Zhang and Tang [13] developed an optimization model to analyze FIT scheme revenue for existing and new solar PV rooftop with BESS integration at residential area. Subramani et.al., [14] had designed the MD reduction model for a university building in Malaysia using a genetic algorithm (GA). The optimal sizing results obtained for solar PV-BESS will determine the new MD limit to be compensated with NEM scheme at TOU pricing zone. Similarly, by deploying GA, Hassan et.al., [15] studied on the optimal sizing for solar PV with BESS and its energy scheduling management affecting its reliability and financially. Another aspect that has been reported in the literature is the usage of Transient System Simulation (TRNSYS) tool in finding the optimum energy management strategy by Liu et.al., [16]. In this study, different sizes of BESS in China's low energy building have been analyzed at a TOU pricing. Meanwhile, Zou et.al., [17] had systematically compared the performances of battery discharge/charging, techno-economic, distribution of energy import/export, battery aging and FIT incentive impact for three (3) strategies i.e., SELCO, TOU and dynamic programming rule based.

In order to assess the techno-economic value of BESS when integrated with grid-connected solar PV, the incentives offered such as compensation schemes must be well attractive [18]. As the RE compensation schemes in Malaysia are being constructed and revised, an empirical analysis must be conducted to facilitate which schemes that prosumer are better off. Despite the extensive studies on solar PV-BESS, lack of research integrating dynamic tariff with compensation schemes has been conducted in Malaysia. Furthermore, the performance of NEM 3.0 in providing attractive compensation scheme for solar PV-BESS is yet to be quantitively studied. Therefore, this study work overcomes the abovementioned gaps in state of the art by assessing the techno-economic value of BESS for grid-connected solar PV. Additionally, the most optimal compensation scheme framework is identified based on its techno-economic matrices performance. As for the case study, an institutional building has been chosen to play the prosumer role and holds a commercial C1 flat tariff. Next, three (3) types of existing solar PV-BESS compensation scheme models (i.e., SELCO, NEM 2.0 and NEM 3.0) are developed to evaluate the prosumers' economic and energy used profile. The analyses will also examine the impact of each model on prosumer electricity cost under flat tariff, new dynamic tariff structure (i.e., enhanced-time-of-use (ETOU)) and real-time wholesale tariff.

2. Methodology

The solar PV-BESS compensation schemes models (i.e., SELCO, NEM 2.0 and NEM 3.0) are designed using HOMER Grid software to assess their techno-economy performance. The usage of HOMER Grid in this research is capable of optimising behind-the-meter hybrid grid connection considering all aspects such incentives, peak shaving, and dynamic grid pricing tariffs to reduce the energy cost and improve grid resilience [19]. The 15-minutes commercial electricity load profiles were initially quantified from Bangunan Wawasan (BW) building in Universiti Teknologi Mara (UiTM), Selangor. Since BW is an institutional building, the C1 (flat) tariff category is used for electricity bill calculation [20]. Additional data input required to run the simulation are grid prices (flat, ETOU and wholesale average SMP) and solar PV-BESS technical and economic parameters. The solar resource data are imported from the NASA database while HOMER Grid scales and calculates the PV production [21]. Prices for solar PV, inverter and Li-ion BESS are based on the report from Sustainable Energy Development Authority (SEDA) and National Renewable Energy Laboratory (NREL) [22], [8]. On the financial model, Table 1 shows the input defined in this simulation.

Table 1. Financial parameters declared in simulation

Parameter	Value
Discount rate	6%
Inflation	2%
Project Lifetime	25 years
Incentives	Investment Tax Credit (ITC) for solar PV and storage (10%)

2.1. System Modelling

The grid-connected system modelled in this case study is illustrated as Fig. 1, which includes solar PV, BESS, inverter, and BW building load. The algorithm build in HOMER Grid seeks to optimise the BESS charging and discharging to maximise the prosumer's revenue. The objective function of the simulations is to attain the optimum value of economic parameters based on the lowest net present cost (NPC) and LCOE, higher ROI and its shortest payback year for solar PV prosumer with and without BESS. On the technical part, the peak shaving controller will provide the optimal grid demand limit hence reducing the MD charge.

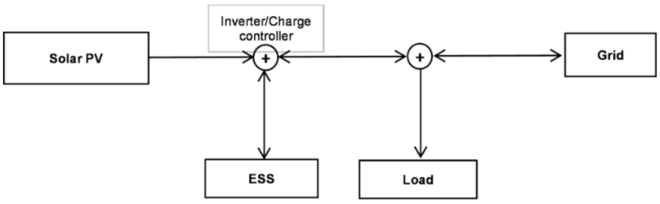


Fig. 1. Solar PV-battery grid connected system configuration [23]

The objective functions are being assessed under three (3) compensation schemes (i.e., SELCO, NEM 2.0 and NEM 3.0) and evaluated for two (2) cases (i.e., flat tariff and ETOU tariff). The ROI for each compensation scheme model is expressed as in Eq. (1) while Eq. (2) is used to determine the LCOE in kWh produced by grid-connected solar PV-BESS [24], [25].

$$ROI = (\sum_{i=o}^{R_{life}} C_{i,base} - C_i) / (R_{life}(C_{cap} - C_{cap,ref})) \tag{1}$$

Whereby;

- $C_{i,base}$ = annual cash flow for base system
- R_{life} = project lifespan
- C_i = current annual cash flow
- C_{cap} = capital cost
- $C_{(cap,ref)}$ = capital cost for base system

$$LCOE = (Cost_{annual}) / (\sum E_{load}) \tag{2}$$

- $Cost_{annual}$ = total annualised cost for solar PV-BESS
- E_{load} = energy load demand for the building

For every compensation scheme model, the solar PV grid-connected was sized based on Malaysian Energy Commission (EC) guidelines which stated that the maximum capacity for inverter output should be between 75% to 100% of consumer annual average MD [26]. The solar PV sizing for every compensation scheme should adhere Eq. (3), whereby the value of *k* is a derating factor for solar PV array power output in real operating conditions. Eq. (3) is derived from SEDA Malaysia Grid Connected Photovoltaic System Design Course which stated that the typical value for Malaysian solar PV grid-connected derating factor, *k* should be within *0.75 ≤ Crystalline modules ≤ 0.8* and *1.0 ≤ Thin film modules ≤ 1.30* [26]. The project lifespan for solar PV panels is defined as 25 years, while for inverters, the replacement is required on every 15 years.

$$P_{nom\_inv} = k \times P_{array\_stc} \tag{3}$$

Table 2 shows the energy trading prices used for all models and tariffs involved. The SMP prices correspond to the wholesale real-time electricity tariff obtained from the Malaysian Single Buyer (SB) website [21]. The SMP is the highest price of the most expensive Marginal Generator (except RE plant) scheduled to meet demand every half-hour [27]. On the other hand, the dynamic ETOU rate description for weekdays and weekends is illustrate in Fig. 2.

Table 2. Energy trading pricing for each compensation scheme

Model Scheme	Features	FLAT TARIFF		ETOU TARIFF	
		Grid Price RM/kWh (USD/kWh)	Sell-back Price RM/kWh	Grid Price RM/kWh (USD/kWh)	Sell-back Price RM/kWh

			(USD/kWh)		(USD/kWh)
SELCO	Unidirectional energy trading (trading for surplus energy is NOT allow)	0.365 (0.086)	0	0.365 (0.086)	0
NEM 2.0	Bidirectional energy trading (trading for surplus energy is allow)	0.365 (0.086)	0.365 (0.086)	ETOU rate	ETOU rate
NEM 3.0	Bidirectional energy trading (trading for surplus energy is allow)	0.365 (0.086)	Real-time average SMP[1]	ETOU rate	Real-time average SMP[1]

[1] *subject to real-time wholesale prices for SMP* [21]

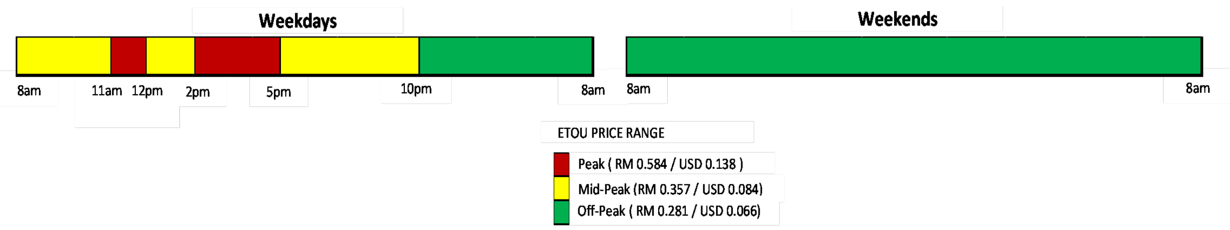


Fig. 2. ETOU rate description for weekdays and weekends [28]

On the matter of electricity bills, the compensation scheme model under flat tariff is designed following the net metering transaction type whereby the net charge period was calculated over the period of a month (refer Eq. (4)). While for the ETOU tariff, Eq. (5) shows that the electricity bills are based on real-time instantaneous energy imports and exports.

$$
Flat\ Tariff = \begin{cases} SELCO_{net\_charge} = (Energy_{consumption} - Energy_{import}) \\ \qquad \times 0.365_{flat\_tariff}) \\ \text{NEM2.0}_{net\_charge} = (Energy_{import} - Energy_{export}) \\ \qquad \times\ 0.365_{flat\_tariff}) \\ \text{NEM3.0}_{net\_charge} = (Energy_{import} \times 0.365_{flat\_tariff}) \\ \qquad -(Energy_{export}\ \times\ average\ SMP) \end{cases} \tag{4}
$$

$$
ETOU\ Tariff = \begin{cases} SELCO_{net\_charge} = (kWh_{consumption} - (kWh_{import}) \\ \qquad \times ETOU_{rate\_tariff}) \\ \text{NEM2.0}_{net\_charge} = (kWh_{import} \times ETOU_{rate\_tariff}) \\ \qquad -(kWh_{export} \times ETOU_{rate\_tariff}) \\ \text{NEM3.0}_{net\_charge} = (kWh_{import} \times ETOU_{rate\_tariff}) \\ \qquad -(kWh_{export} \times average\ SMP) \end{cases} \tag{5}
$$

2.2. Model Constraints

Optimization for each compensation scheme model includes charging and discharging battery storage which subject to the following constraints (see Eq. (6) – Eq. (10)). The optimum battery size is obtained based on building load and solar PV profiles. As stated in Eq. (6), the battery energy state of charge (E_{soc}) at each time step must be greater than battery minimum energy state of charge (E_{SoC_min}) and less than battery maximum energy state of charge (E_{SoC_max}). As suggested by Mora and Hegedus, the battery E_{SoC_min} and E_{SoC_max} were defined as 20% and 100% accordingly [29].

$$E_{SOC\_\min} \le E_{SOC} \le E_{SOC\_\max} \tag{6}$$

$$P_{\min\_charge} \le P_{charge\_BESS} \le P_{\max\_charge} \tag{7}$$

$$P_{pv\_export} \le P_{pv\_generated} \tag{8}$$

$$P_{grid\_import} \le P_{unmet\_load} \tag{9}$$

$$P_{pv} + P_{batt\_discharge} + P_{grid\_import} = P_{load} \tag{10}$$

Once the optimization is executed, a set of solutions for techno-economic efficiency at different tariff structures and compensation schemes is produced to examine the impact on energy savings. The bi-directional converter was chosen due to its lower cost compared if using two (2) uni-directional converters [23]. Technically, during the charging process, the bi-directional converter will act as a converter (AC-DC) and inverter (DC-AC) during discharge. All models were designed according to solar PV and battery data parameters as shown in Table 3.

Table 3. Solar PV and battery data parameters

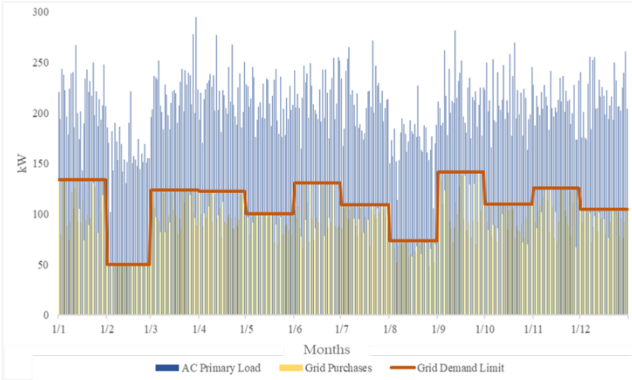
Parameters	Value
Solar PV cost	RM 3800/kWp (USD 896/kWp)

Solar PV Lifetime	25 years
Inverter cost	RM 500/kW (USD 118/kW)
Inverter Lifetime	15 years
Inverter Efficiency	95%
Battery cost	RM 1200/kWh (USD 283/kWh)
Battery Lifetime	15 years
Battery Cyclic Lifetime	10000 cycles
Battery Energy Maximum State of Charge	100%
Battery Energy Minimum State of Charge	20%

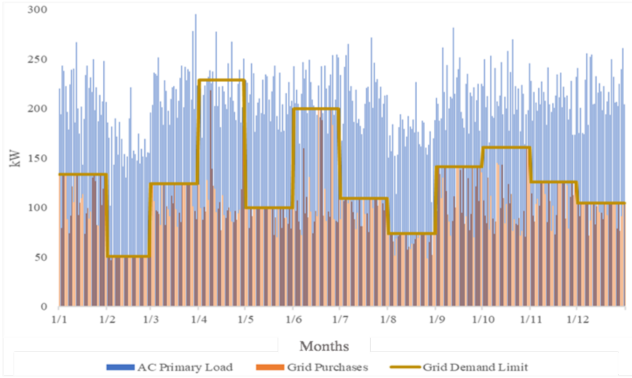
3. Results and Discussions

HOMER Grid is a powerful and valuable tool that uses two-days look ahead prediction for load behavior and solar PV generation dispatch algorithm. Based on one (1) month quantified data, the average annual MD recorded for BW's building was 303kW. Therefore, for this analysis, the inverter has been sizes for 300 kW (i.e., 100% annual average MD) according to Malaysian EC standard. On average, the building location receives 5.5 kWh/m^2 per day for its solar irradiance. Through simulation, HOMER Grid optimized the Li-ion size for 2 hours autonomy that has a capacity of 253kWh. The clear value observed through adopting BESS with solar PV are peak shaving effect, attractive energy trading and electricity bill savings. the operation of BESS can be categorized under charging period and discharging period. Typically, the batteries will charge during off-peak period whereby the energy is available at lower price, while discharge during peak period during the electrical energy at its higher price.

Taking example with the recent NEM 3.0 compensation scheme, Fig. 3 shows the peak shaving effect at a flat and ETOU tariff rate. A greater peak shaving effect is observed for flat rate due to fix energy price and MD charge throughout the entire year. The usage of BESS at this flat rate has less value in energy trading because its only used to reduce the MD charge. In contrast, with ETOU rate, the adoption of BESS integrated with solar PV is not only reducing the MD charge but also performing a great energy trading activities between excess solar PV, BESS and grid. Under ETOU rate tariff, the BESS will charge during off-peak period whereby the energy is available at lower price, while discharge during peak period during the electrical energy at its higher price. Similarly, comparing each compensation schemes (i.e., SELCO, NEM 2.0 and NEM 3.0) for flat tariff (refer Fig. 4 (a)) and ETOU tariff (refer Fig. 4 (b)), the results supported the above finding.

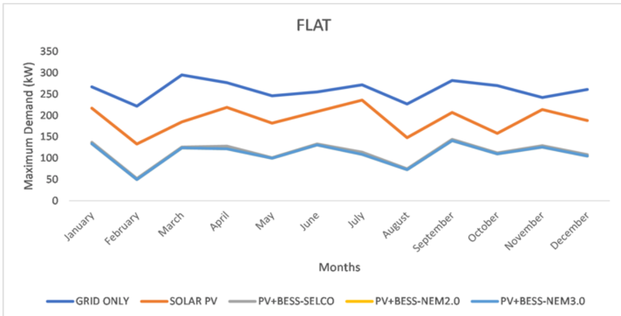


(a)

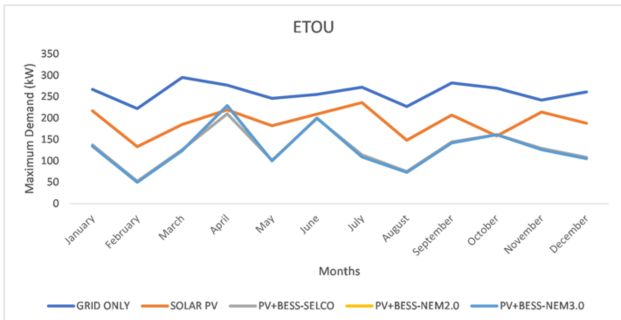


(b)

Fig. 3. Peak shaving effect using; a) Flat rate tariff; (b) ETOU rate tariff



(a)

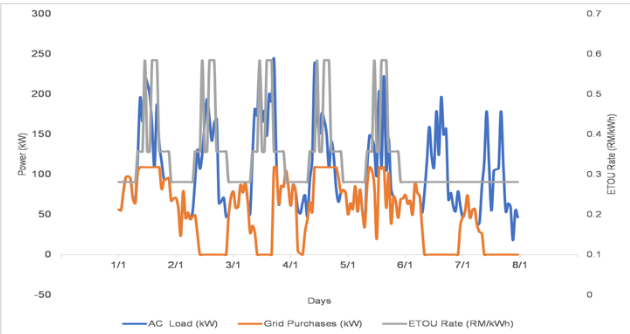


(b)

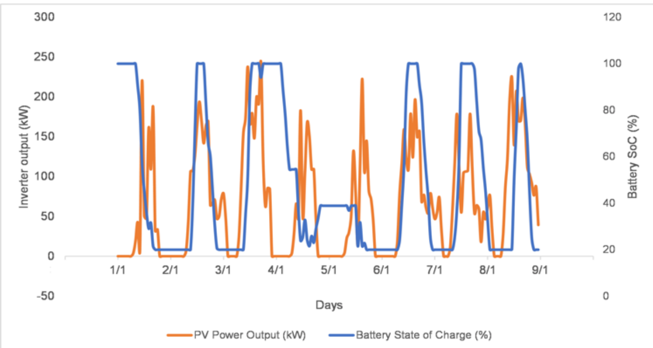
Figure 4. Changes in MD by month and compensation schemes using; a) Flat rate tariff; (b) ETOU rate tariff

To gain a better understanding of how this solar PV-BESS works under ETOU rate on a typical weekday, Fig. 5

(a) and (b) presents the sample of energy trading for one week at 2 hours battery autonomy for NEM 3.0 compensation scheme. At the lower price of ETOU, the load is mostly met by purchasing the electricity from the grid and small portion from the BESS until the SoC decreases to its minimum value declared i.e., 20%. When the solar PV production starts, the load will be powered by grid and solar PV. At the highest of solar PV production (exceeding load), it was observed that zero energy had been purchased from the grid. The excess solar PV will charge the BESS until it reaches 100% SoC and the remaining will be exported to grid. As the solar PV production decreases towards the evening, the battery will begin discharging and supply the loads combined with energy supplied from the grid. In the event of BESS charging, it can be charged from solar PV and purchased from grid.



(a)



(b)

Fig. 5. Energy dispatch for solar PV-BESS under ETOU tariff rate; a) AC load, grid purchases and ETOU rate. b) Solar PV inverter output and battery SoC.

The dispatch algorithm built-in HOMER Grid will balance the energy trading and peak shaving to minimize the electricity bill. Fig. 6 shows the annual electricity bill savings obtained through the adoption of solar PV-BESS under ETOU rate tariff at BW building. The usage of solar PV-BESS for ETOU rates offers an accrued bill saving of about 64% with more than 50% energy charge reduction compared with the base case (grid only). A slightly higher value for demand charge is expected for the ETOU rate than the flat rate due to its higher charge for MD, especially during the high-peak period.

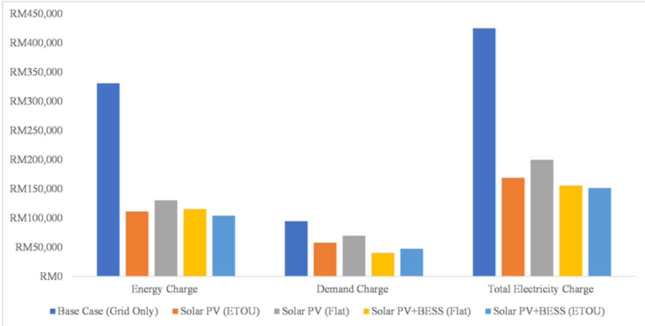


Fig. 6. Annual Electricity Bill Summary using ETOU and Flat rate tariff for NEM 3.0

The integration of solar PV-BESS with ETOU rate tariff can be one of the advantageous options in reducing grid dependency. As shown in Fig. 7, the energy sold to grid for solar PV at flat and ETOU tariff are same since there is no energy storage available for energy trading. By integrating the BESS with solar PV, the continuously supply and dynamic income generation through energy trading activities can be performed effectively. It is observed that the energy sold to grid is slightly increased especially when associated with dynamic electricity tariff. The BESS control algorithm contributes to this advantage since the deployment can shift the energy usage at its lower price, thus enabling peak shaving and increasing the energy sold to grid. The operational flexibility energy dispatch strategy facilitated the critical operating tariff zones period, allowing the assessment to of techno-economic efficiency at any RE compensation scheme offered by the government.

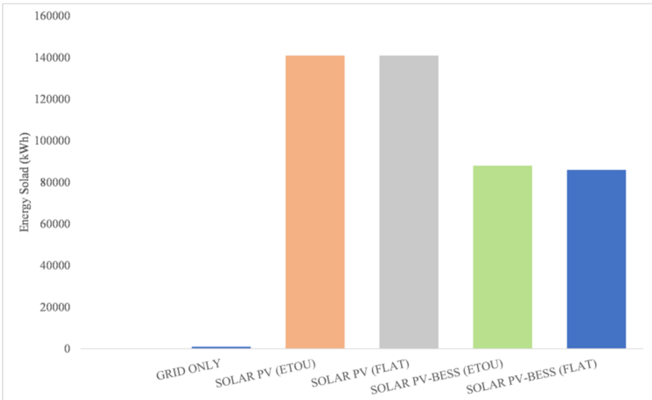


Fig. 7. Comparison amount of energy sold to grid

Even the other types of batteries are more affordable, but usually Li-ion and lead-acid (LA) are the best options for peak shaving effect [30]. As energy storage technologies are emerging, the cost for grid-connected battery storage is expected to reduce, which will make these systems more economical to be deployed [8], [31]. Therefore, further analysis was performed by varying difference percentages of BESS cost reduction with the solar PV to address its grid parity relative to baseline case (grid only) at flat and ETOU rate. By referring to the baseline (grid only) LCOE, it was found that the grid parity for commercial prosumers can be realized by adopting solar PV-BESS. Additionally, as the battery cost is declining, the value for LCOE is reducing, especially under ETOU rate tariff as illustrate in Fig. 8.

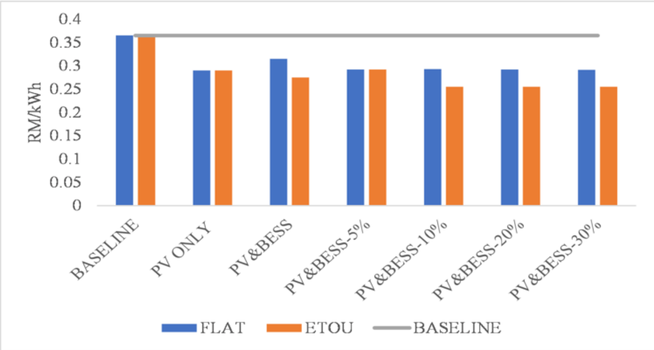


Fig. 8. LCOE prices by BESS cost reduction

In order to evaluate the business case for solar PV-BESS, Table 4 and Table 5 presents the energy profile and financial results at different compensation schemes and rate tariffs. The lifetime of the project for each compensations schemes in this analysis is declared as 25 years with 6% and 2% discount and inflation rates respectively. To support the adoption of solar PV and BESS, 10% of investment tax credit (ITC) has been set initially, allowing prosumers to apply the credit to their income tax. The results discovered that NEM 2.0 scheme offered the lowest payback period and LCOE, highest ROI and IRR for solar PV-BESS project. On the other hand, slightly lower economic efficiency value on NEM 3.0 compensation scheme is observed. This is happened because the sell-back price for NEM 3.0 adheres with average SMP that depends on real-time marginal generator. The SMP pricing typically has a lower value than flat and ETOU rates.

Table 4. Energy trading pricing at different compensation schemes (FLAT TARIFF)

Energy profile and financial results of 400 kW PV & 300 kW inverter at different schemes									
	Energy Import (kWh)	Energy Export (kWh)	Net Energy (kWh)	CAPEX RM (USD) million	NPC RM (USD) million	IRR (%)	ROI (%)	LCOE (RM/kWh)	Payback (years)
SELCO	402,128	0	402,128	1.79 (0.42)	4.41 (1.04)	11.6	8.2	0.376 (0.09)	7.65
NEM 2.0	402,128	85,953	316,175	1.79 (0.42)	4.00 (0.94)	13.9	10.1	0.312 (0.07)	6.65
NEM 3.0	402,128	85,953	316,175	1.79 (0.42)	4.13 (0.97)	13.3	9.6	0.322 (0.08)	6.91

Table 5. Energy trading pricing at different compensation schemes (ETOU TARIFF)

Energy profile and financial results of 400 kW PV & 300 kW inverter at different schemes									
	Energy Import (kWh)	Energy Export (kWh)	Net Energy (kWh)	CAPEX RM (USD) million	NPC RM (USD) million	IRR (%)	ROI (%)	LCOE (RM/kWh)	Payback (years)
SELCO	403,095	0	403,095	1.79 (0.42)	4.18 (0.99)	12.3	8.8	0.357 (0.08)	7.26
NEM 2.0	433,381	116,422	316,959	1.79 (0.42)	3.62 (0.85)	15.1	11.2	0.274 (0.06)	6.18
NEM 3.0	403,095	86,002	317,093	1.79 (0.42)	3.90 (0.92)	13.4	9.7	0.304 (0.07)	6.69

4. Conclusion

This study has successfully investigated the value of BESS integrated with grid-connected solar PV for commercial prosumer under different compensation schemes and electricity market tariff structures using HOMER grid. Based on the simulated results, the findings are summarized as follows:

- The results show project benefits in LCOE of 0.274/kWh (USD 0.06/kWh), IRR of 15.1%, ROI of 11.2% and discounted payback of 6.18 years. BESS's optimized design value at BW building is 253kWh at 2 hours autonomy. From the analysis, it has eventually pointed NEM 2.0 under ETOU tariff structure as a winning system in terms of its techno-economic matrices performances.
- The recent NEM 3.0 compensation scheme provides slightly lower techno-economic efficiency than NEM 2.0 due to the lower value of energy export set by the Malaysian SB (average SMP). Although there were differences in techno-economic benefit between NEM 3.0 and NEM 2.0 under several tariff structures, the adoption still shows virtuous outcomes in reducing MD, providing attractive energy trading, and reducing electricity bills.
- The inclusion of SELCO in this study has shown that NEM 2.0 and NEM 3.0 users can further sustain their electricity bill savings after the netting offset period expires. The analysis found that the SELCO project at ETOU tariff provides the project

benefits of higher ROI and IRR while shortening its payback period and lower LCOE.

- BESS usage at a flat rate has less value in energy trading because it is only used to reduce the MD charge. However, due to its fixed energy price and MD charge throughout the year, the flat rate tariff has a more prominent peak shaving affect up to 50%. While on the other hand, under the ETOU tariff, BESS dispatch ability assisted in annual electricity bill savings of about 64% compared to grid-only condition.
- The finding indicates that the profitability of solar PV-BESS is highly dependent on tariff rates, battery technology and its prices. By adopting solar PV-BESS, the value of LCOE can be reduced, and when the capital cost is further decreased up to 30%, the rate for LCOE will further decline.

Finally, the findings in this study show that a decisive compensation scheme under different tariff structures is crucial to be formed by the government and its respective agencies. The prosumer's decision-making in adopting BESS can be assisted at optimal tariff structure while supporting the government and policymakers in designing attractive solar PV-BESS compensation schemes. Failure to do so may discourage the prosumers from producing more clean energy, hence delaying the national RE target.

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