Systematic Techno-Economic Analysis of Medium-Voltage PV-BES Prosumers Operating Under NEM Policy

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Abstract—**Net-metering (NEM) is one of the most widely known support mechanisms aiming to promote the installation of distributed photovoltaic (PV) systems. However, due to the increasing penetration of PVs, challenges related to the secure operation of the power system are emerged. For this reason, battery energy storage (BES) systems are installed alongside PVs to tackle these technical problems. In this paper, a systematic assessment analysis of NEM policy in medium-voltage (MV) prosumers with PV-BES systems is conducted in both technical and economic terms. In the analysis, annual generation and consumption timeseries of university campuses of the Democritus University of Thrace, Greece, are employed and various scenarios of PV-BES systems are investigated, to evaluate the profitability of NEM policy in MV PV-BES prosumers and consequently determine the optimal investment plan in monetary terms.**

Keywords — Battery energy storage systems, medium-voltage, net-metering, photovoltaics, techno-economic analysis.

I. INTRODUCTION

The ever-increasing electricity costs due to the soaring gas prices constitute nowadays the transition from conventional fossil-fuel power plants to renewable energy sources (RES) more crucial than ever [1]. During the last decades, various support mechanisms have been proposed, e.g., feed-in tariff (FiT), net-billing (NEB), net-metering (NEM), to promote the installation of RES, especially photovoltaics (PVs), at the distribution level [2]-[4]. Nevertheless, the advent of PVs in distribution networks may lead to technical challenges, e.g., voltage violations, jeopardizing the reliable and secure operation of the grid [5]. These issues can be addressed by installing battery energy storage (BES) systems in the prosumers' premises. However, the total investment cost of a PV-BES system is significantly higher to that of a standalone PV system [6], highlighting the need for an in-depth and systematic techno-economic assessment of this solution.

Emphasizing on the NEM scheme, it originally referred to household PV systems. As a result, the economic viability of NEM policy for low-voltage (LV) residential prosumers has been thoroughly investigated in the literature. In particular, in [2]-[4], the impact of NEM on residential prosumers is systematically compared to other support mechanisms (NEB and FiT), or energy policies. In [7] and [8], an assessment framework has been proposed to evaluate the economic impact of different NEM policies on the prosumer's profits and counsel policy makers to formulate accordingly their NEM schemes. In [9], a techno-economic model is developed to determine the optimal PV-BES system size by maximizing the NEM and NEB LV prosumers' profits. On the other hand, there are very few works regarding the viability assessment of MV prosumers. In [10], a generalized methodology is introduced incorporating also the real-world operating properties of the grid, by conducting quasi-static simulations. However, BES systems are not considered in this analysis.

Considering [2]-[4], [7]-[10], it can be realized that the electricity billing mechanism of MV prosumers is more complicated compared to LV prosumers. For example, in Greece, LV prosumers are charged according to their netted energy, while MV prosumers are charged on the basis of both energy and the real power peak demand [11]. This implies that the electricity bill of the MV prosumers may be reduced by properly utilizing BES for peak-shaving [12].

Based on the above, it can be realized that the profitability of the NEM policy for MV PV-BES prosumers constitutes a very interesting scientific topic that has not been examined in detail. This paper investigates the techno-economic viability of MV PV-BES prosumers and in particular university campuses under the NEM policy. Different scenarios regarding the PV capacity and BES costs are examined to determine the optimal investment plan in monetary terms. In the conducted analysis, annual consumption and generation timeseries of the nine campuses of the Democritus University of Thrace (DUTH), Greece are used.

The rest of the paper is organized as follows. Section II describes the pricing policy of MV end-users and the NEM policy in Greece. The technical as well as the economic indices used to evaluate the viability of the NEM investment are analyzed in Section III. In Section IV, the consumption and the production timeseries of the nine DUTH campuses, as well as the BES operation model are presented. Finally, the obtained results and the most significant conclusions of the paper are discussed in Sections V and VI, respectively.

II. ENERGY POLICY OF MV PROSUMERS IN GREECE

A. *Pricing Policy of MV End-Users*

In Greece, electricity suppliers, e.g., the public power corporation (PPC) [11], offer several electricity tariffs

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depending on the MV end-users' needs. In particular, the BG tariff is an indicative electricity tariff with reduced electricity pricing proposed by PPC to MV end-users presenting increased consumption levels, e.g., university campuses, and it is published on a monthly basis [11]. According to the BG tariff, the total electricity cost (C_{total}) consists of three categories: (i) supply charges (C_{supply}), (ii) regulated charges ($C_{\text{regulated}}$) and (iii) municipal fees and taxes ($C_{\text{municipal}}$):

$$C_{\text{total}} = C_{\text{supply}} + C_{\text{regulated}} + C_{\text{municipal}} \tag{1}$$

In particular:

- C_{supply} include the cost and other expenses for the supply of power to end-users. Specifically, they are calculated considering the cost of power ($C_{\text{supply}}^{\text{power}}$) and the cost of energy ($C_{\text{supply}}^{\text{energy}}$). $C_{\text{supply}}^{\text{power}}$ is estimated according to power data measured by the Greek distribution system operator (DSO). $C_{\text{supply}}^{\text{energy}}$ is calculated by dividing the end-user's consumed energy (E^{cons}) into two time zones, namely the base and peak load time zones. Note that, different prices are considered for each time zone.
- $C_{\text{regulated}}$ are approved by the state and apply to all end-users using the national electricity system. They consist of: (i) the transmission network charges (C_{TN}), (ii) the distribution network charges (C_{DN}), (iii) the services of general interest (C_{SGI}), (iv) the greenhouse tax (C_{GhT}) and (v) other charges (C_{OC}).
- $C_{\text{municipal}}$ contain the municipal fees (C_{MF}) and taxes (C_{MT}).

More information for the different types of costs is provided in [10].

B. NEM Legislation for MV PV-BES Prosumers

Regarding MV PV-BES prosumers in Greece, the following general rules apply [12], [13]:

- Energy netting is applied irrelevant if energy production and consumption occur at the same time.
- If prosumer's consumption is higher than its production, the electricity tariff is calculated according to the prosumer's consumed netted energy. In case the consumption is lower, the excess amount of the produced energy is transformed to renewable energy credits (*RECs*) and it is credited to the electricity account of the next billing period.
- NEM is performed on a 3-year basis. After the 3-year period, remaining *RECs* of the previous netting periods are not compensated or credited to the next electricity accounts. This process can be repeated for 25 years.
- If the prosumer is charged according to a multi-time zone electricity tariff, NEM is applied in such a way, to ensure the most profitable economic impact on the prosumer.
- The installed PV size can be equal to the installation capacity contract. Nevertheless, the PV size cannot be higher than 1 MWp.
- The nominal apparent power of the BES converter should not exceed the PV installation capacity as well as 30 kVA.
- BES should not exchange directly energy with the grid. The BES charging process is activated only in case of PV production excess; BES discharges only if there is excess of load demand.

C. NEM billing process

The algorithm for the billing process of a MV prosumer under NEM policy is illustrated in Fig. 1. The total prosumer's injected/absorbed energy to/by the grid (E^{inj} and E^{abs}) and produced energy (E^{prod}) are measured by the DSO every month. According to E^{abs}, the $C_{\text{supply}}^{\text{power}}$, the $C_{\text{regulated}}$ (apart from C_{SGI}) and the $C_{\text{municipal}}$ are estimated. Then, the total prosumer's E^{cons} is calculated as follows:

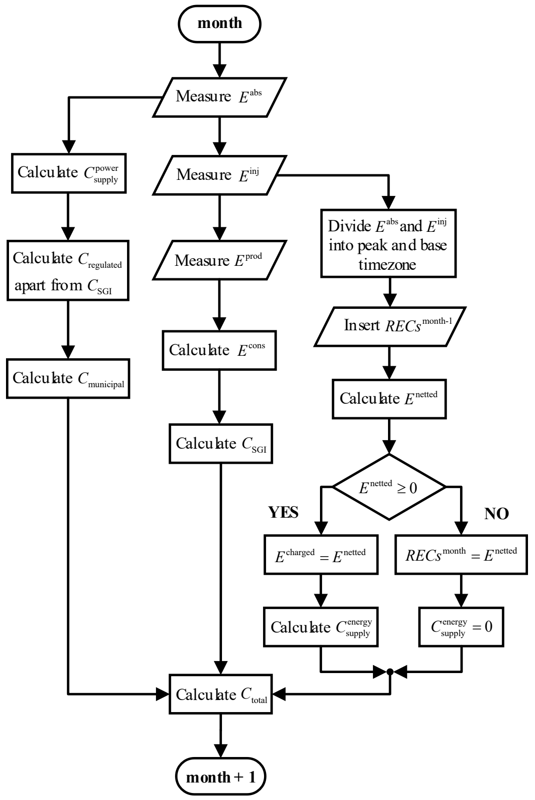

Fig. 1. Flowchart of NEM scheme for a MV PV-BES prosumer.

$$E^{\text{cons}} = E^{\text{abs}} + E^{\text{prod}} - E^{\text{inj}} \tag{2}$$

Based on E^{cons}, the C_{SGI} is determined. The netted energy of the prosumer (E^{netted}) is calculated according to (3):

$$E^{\text{netted}} = E^{\text{cons}} - E^{\text{prod}} - RECs^{\text{month-1}} \tag{3}$$

where $RECs^{\text{month-1}}$ are the *RECs* from the previous month. If E^{netted} is negative, the *RECs* of the current month are determined and the prosumer is not charged on the $C_{\text{supply}}^{\text{energy}}$. Note that, the estimated $RECs^{\text{month}}$ are credited to the electricity account of the next month. Also, at the end of every netting period, i.e., every 3 years, *RECs* become zero. On the other hand, if $E^{\text{netted}} \geq 0$, the $C_{\text{supply}}^{\text{energy}}$ is estimated on the basis of the consumed netted energy E^{charged}. Finally, C_{total} is calculated. This process is repeated on a monthly basis.

III. TECHNO-ECONOMIC INDICES

A. Technical Indices

In the literature, two main technical indices are used to assess the sizing of PV-BES systems according to the prosumer's demand [14]. These are the self-consumption rate (*SCR*) and the self-sufficiency rate (*SSR*) defined in (4) and (5), respectively.

$$SCR(\%) = \frac{C+E}{B+C+D} \tag{4}$$

$$SSR(\%) = \frac{C+E}{A+C+E+F} \tag{5}$$

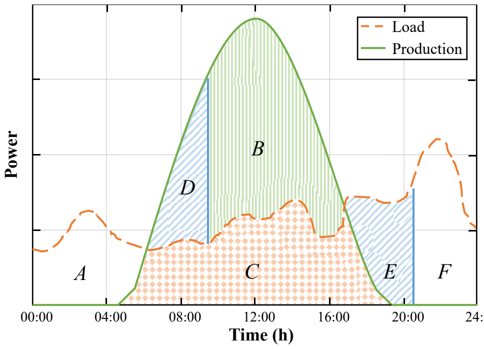

Fig. 2. Indicative daily power profiles of a PV-BES prosumer

TABLE I. CAPACITY CONTRACT OF UNIVERSITY CAMPUSES

City	Name of campus	Capacity contract (kW)
Alexandroupoli	Makri	1500
	Chili	400
Komotini	Komotini	1500
	Tsaldari	500
Orestias	Evripidou	1250
	Orestias	650
Xanthi	Q. Sophia Str.	1300
	Dep. of Civil Eng.	1600
	Kimmeria	800

From Fig. 2, it can be seen that *A* and *F* indicate the total demand covered by the grid, *B* stands for the surplus of the PV produced energy, *C* is the self-consumed energy, *D* denotes the excess PV energy stored in the BES and *E* is the energy supplied to the load by the BES. Note that, in case of PV prosumers the corresponding *D* and *E* values are zero. In general, *SCR* is employed to assess the PV produced energy that is directly consumed on-site or stored in the BES system; *SSR* is used to evaluate the load energy covered by the PV-BES system.

B. Economic Indices

To evaluate the economic impact of the NEM scheme on the MV PV-BES prosumers, three indices are calculated: (i) the net present value (*NPV*), (ii) the internal rate of return (*IRR*) and (iii) the discounted payback period (*DPP*).

In particular, *NPV* denotes the difference between the present value of revenue and expenditure over the lifetime (*N*) of an investment and it is calculated as follows [8], [10]:

$$NPV\left(€\right)=-OC_o+\sum_{n=1}^{N}\frac{(S_n-OM_n)(1\quad f)^{n-1}}{(1+d)^n} \tag{6}$$

where OC_o is the overall capital investment cost, OM_n are the operation–maintenance costs at year n, S_n are the savings in electricity billing due to the NEM policy at year n, f and d are the inflation rate and the discount rate, respectively.

IRR is employed to evaluate the economic performance of a potential investment during its lifetime. *IRR* is estimated by solving the equation $NPV = 0$ (See eq. (6)) considering an unknown *IRR* value of d [8], [10]. In case *IRR* is higher than d, the examined investment plan can be accepted. On the contrary, if $IRR \leq d$, the investment is not considered profitable.

DPP is defined as the necessary time span for the full repayment of an investment plan and it is calculated by setting (6) equal to zero and solving the corresponding equation for the unknown *DPP* value of N [8], [10]. This index is utilized to assess the feasibility of an investment.

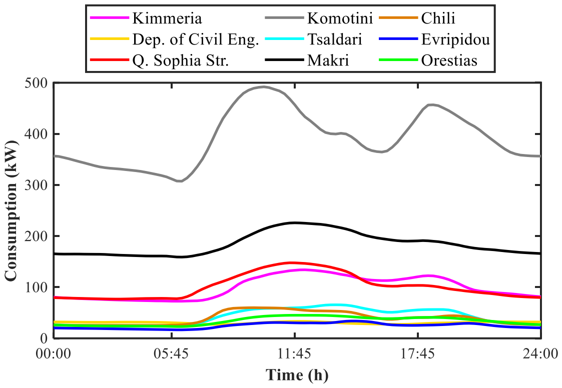

Fig. 3. Average daily demand profile of DUTH campuses.

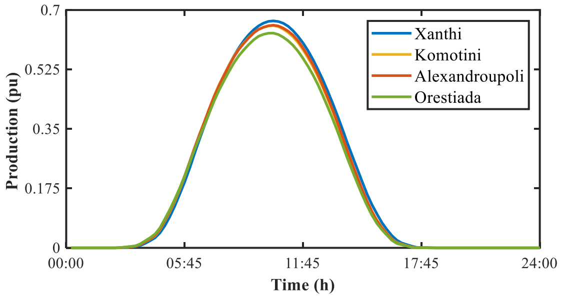

Fig. 4. Normalized daily production profile for each city of DUTH.

IV. SYSTEM UNDER STUDY

A. University Campuses Data

In this work, the annual electricity demand data of the nine DUTH campuses are used [10]. Power data refer to 2014. Table I summarizes the city of each university campus as well as its capacity contract. In Fig. 3, the average daily demand profiles of the examined university campuses are illustrated. In general, it can be seen that four campuses, i.e., Kimmeria, Makri, Komotini and Q. Sophia Str., present significantly higher consumption levels compared to the campuses of Chili, Evripidou, Dep. Of Civil Eng., Orestias and Tsaldari.

B. PV Production Data

From the online simulation tool of [15], four different annual PV production timeseries are obtained; one for each city of DUTH (Alexandroupoli, Komotini, Orestiada and Xanthi). The normalized average daily demand profiles (scaled to 1 kW, i.e., 1 per unit (pu)) for 2014 are presented in Fig. 4. It can be generally seen that the depicted PV curves almost overlap. This is attributed to the fact that all PV systems are installed in the same geographical region of Greece, i.e., Thrace.

C. BES Operating Model

In this study, each MV prosumer can employ either a PV or a PV-BES system. The operation of the BES system is simulated in terms of (7). Specifically, the state-of-charge (*SoC*) of the BES at each time instant t is calculated as:

$$SoC\left(t\right)=SoC\left(t-1\right)+\eta_{\mathrm{ch}}\frac{P_{\mathrm{ch}}\left(t\right)\Delta t}{E_{\mathrm{nom}}}-\frac{P_{\mathrm{dch}}\left(t\right)\Delta t}{\eta_{\mathrm{dch}}E_{\mathrm{nom}}} \tag{7}$$

where Δt is the selected time step of the analysis, E_{nom} is the BES nominal capacity, η_{ch} and η_{dch} is the charging and discharging BES efficiency, respectively; P_{ch} and P_{dch} is the corresponding BES charging and discharging power.

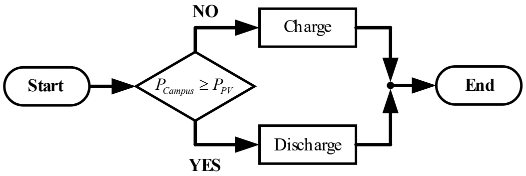

Fig. 5. Flowchart of the BES control scheme.

TABLE II. PV AND BES SYSTEM COST ANALYSIS

	Type of Cost	€/kWp	
PV System	PV Module	Equation (8)	
	Inverter	350	
	Balance of System	65	
	Installation & Administrative	115	
	O&M	3% (of the overall cost)	
BES System	Inverter	450	
	BES Replacement	Equation (9)	
	O&M	2% (of the overall cost)	
		€/kWh	
		Scenario 2	**Scenario 3**
	BES Module	250	125

It is assumed that the BES operates under a specific control scheme described by the flowchart of Fig. 5. In fact, the BES discharges when the campus load demand (P_{Campus}) is higher than PV production (P_{PV}). In such case, P_{dch} is equal to P_{Campus} - P_{PV}. Otherwise, BES charges with $P_{\mathrm{ch}} = P_{\mathrm{PV}} - P_{\mathrm{Campus}}$. In every case, the constraints regarding the maximum permissible BES charging/discharging power ($P_{\mathrm{ch}}^{\max}$ / $P_{\mathrm{dch}}^{\max}$) should not be violated. Note that, this control scheme is also in compliance with the Greek legislation regarding MV PV-BES prosumers under NEM policy (See Section II.B) [12].

V. NUMERICAL RESULTS

A. *Examined Scenarios and Analysis Assumptions*

A techno-economic analysis is conducted to assess the viability of the MV PV-BES system under the NEM scheme by examining three scenarios. In particular:

- Scenario 1: all campuses are PV prosumers. The analysis is based on [10].
- Scenario 2: all campuses are PV-BES prosumers. The BES system cost is taken with current market prices.
- Scenario 3: all campuses are PV-BES prosumers. Compared to Scenario 2, a lower BES cost is taken, taking into account current trends in the reduction of the BES cost [6], [16].

Considering that the duration of NEM contract is at maximum 25 years, as well as that the nominal PV system lifetime comes up to 20 years, the analysis period is assumed equal to 21 years. In each scenario, $d = 5$ % and $f = 2$ % and the installed PV size (PV_{size}) varies from 50 to 1000 kW. In both Scenario 2 and Scenario 3, for all examined PV sizes, $P_{\mathrm{ch}}^{\max}$ and $P_{\mathrm{dch}}^{\max}$ are equal to 30 kW, according to the constraints set by the Greek legislation. The BES power to energy ratio is 25 % and the BES $\eta_{\mathrm{ch}} = \eta_{\mathrm{dch}} = 0.95$. In all examined scenarios, prosumers are charged with the electricity tariff described in Section II.A; the corresponding cost category prices are derived from [10]. Furthermore, the PV and BES system costs considering 24 % VAT are presented in Table II.

Also, two additional fees of 992 € and 400 € for the connection of the PV and BES systems to the grid, respectively, are taken into account [12].

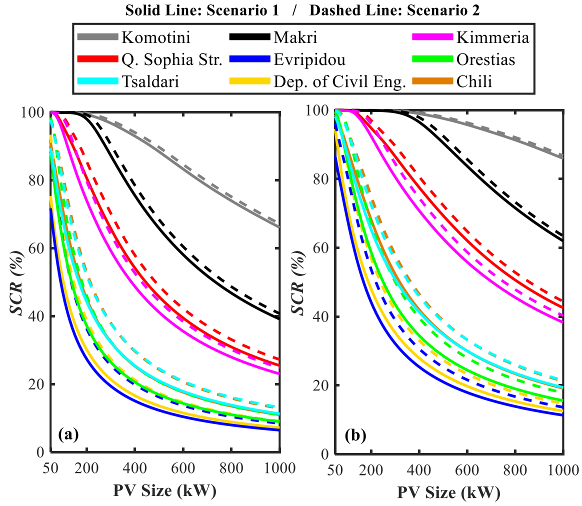

Fig. 6. *SCR* against PV_{size}. Results for the (a) 1st and (b) 21st year of the analysis.

Regarding the PV module cost (€/kWp), it is calculated as a function of PV_{size} by employing the empirical formulae of (8), which has been estimated by applying linear interpolation to known PV_{size} – cost data sets, ranging from 300 kWp – 0.6 €/W to 550 kWp – 0.5 €/W, respectively.

$$PV_{cost} = 818.4 - 0.248 \cdot PV_{size}. \tag{8}$$

Considering the BES replacement cost (*BRC*), it is estimated in present value according to (9) [17].

$$BRC(€) = \sum_{r}^{R} \frac{E_{\mathrm{nom}} BFC_r \left(\mathrm{VAT}+1\right)}{\left(1+d\right)^{y_{rep}-y_0}} \tag{9}$$

Here, *R* is the total number of replacements during the analysis period, y_{rep} is the year of the replacement, y_0 is the year where the analysis is conducted (y_0=0) and *BFC* is the BES future cost in €/kWh at the *r* replacement and is calculated as [17]:

$$BFC = \begin{cases} 0.95\left(y_{rep} - y_0\right) BMC & ,\text{if } y_{rep} - y_0 \leq 10 \\ \left[9.5 + 0.975\left(y_{rep} - y_0\right)\right] BMC & ,\text{if } y_{rep} - y_0 > 10 \end{cases} \tag{10}$$

where *BMC* is the BES module cost at year y_0 (See Table II).

Finally, the annual growth of the load demand is assumed equal to 1 % and the annual PV and BES degradation are both considered equal to 2 %. This implies that after 10 years the capacity of the BES units will be reduced by 20 %, indicating their end of life [18]. For this reason, one BES replacement is considered in the analysis.

B. *Techno-Economic Assessment*

In this section, results regarding the techno-economic assessment of NEM policy for the examined DUTH campuses are presented. The *SCR* variation of Scenarios 1 and 2 against PV_{size} for the 1st and 21st (last) year of the analysis is illustrated in Figs. 6a and 6b, respectively. It should be indicated that *SCR* results for Scenario 3 are identical to those of Scenario 2. It is shown that the *SCR* of all cases decreases with PV_{size}. In addition, for both scenarios higher *SCR* values are generally obtained for campuses presenting high consumption levels, i.e., Komotini, Makri, etc. On the other hand, for campuses with low demand, high *SCR* values, e.g., ≥ 60 %, are observed only for PV_{size} lower than 200 kW. Comparing Figs. 6a and 6b, it can be seen that the *SCR* for the 1st year of

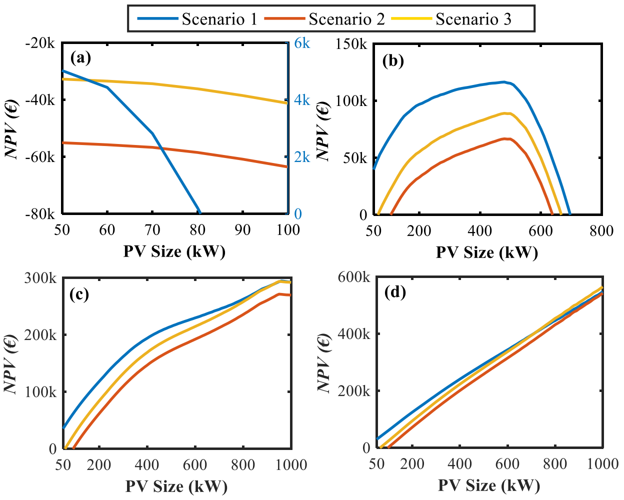

Fig. 7. *NPV* against PV_{size} for Scenarios 1, 2 and 3 for the campus of (a) Evripidou, (b) Kimmeria, (c) Makri and (d) Komotini.

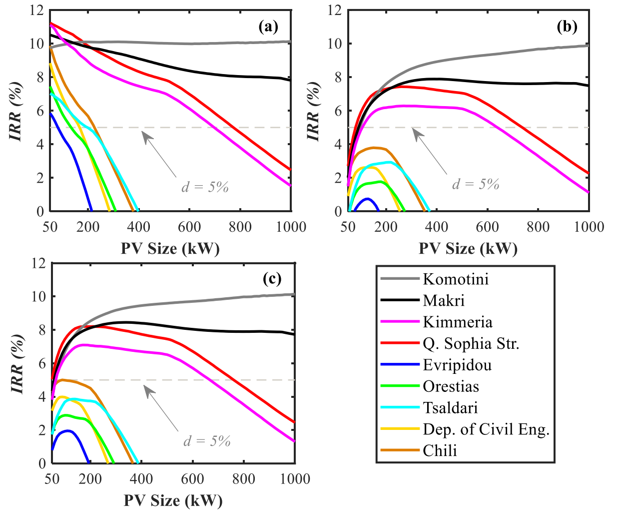

Fig. 8. *IRR* against PV_{size} for (a) Scenario 1, (b) Scenario 2, and (c) Scenario 3.

the investment is lower than the *SCR* of the 21st year. This is attributed to the lower rate of annual load demand growth than the PV-BES degradation. Furthermore, by comparing the *SCR* results of Scenario 1 and Scenario 2, it can be deduced that the use of BES leads to increased *SCR* values. This is more marked considering campuses with lower consumption. Similar remarks apply also for the *SSR* index.

The investment appraisal indices are discussed next. In Fig. 7, the *NPV* variation of the examined scenarios against PV_{size} is illustrated indicatively for the campuses of Evripidou, Kimmeria, Makri and Komotini. It can be seen that Scenarios 2 and 3 lead to decreased *NPV* compared to Scenario 1, due to the increased capital costs (purchase and replacement) of the BES systems that cannot be recuperated. This is mainly observed in the corresponding results of Evripidou (Fig. 7a), where the *NPV* is negative for all cases. Results for the campuses of Kimmeria and Makri (Figs. 7b and 7c) reveal that *NPV* increases with PV_{size} up to a certain value; for higher PV_{size} values, the *NPV* starts decreasing. This is mainly owed to the fact that according to the Greek legislation, the excess amount of produced energy is not credited or compensated at prosumer's profits. Regarding the *NPV* of Komotini (Fig. 7d), it can be seen that for high PV_{size} (>700 kW), Scenarios 1 and 2 present similar *NPV* and Scenario 3 results into the highest the end of the netting period; thus, the additional costs of the

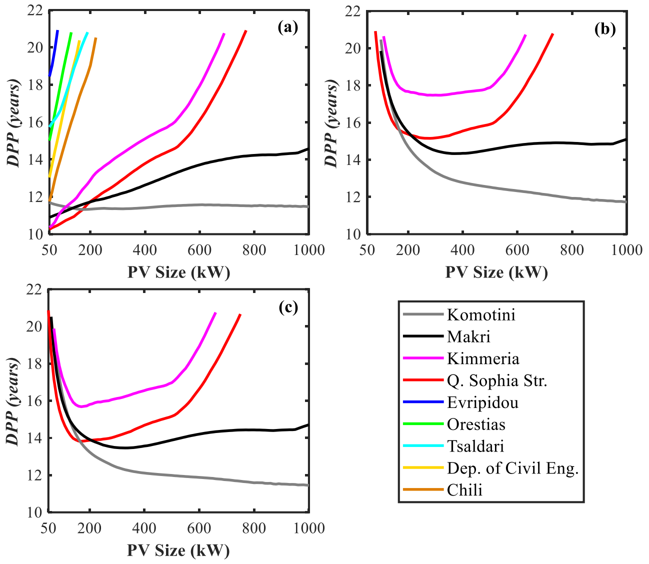

Fig. 9. *DPP* against PV_{size} for (a) Scenario 1, (b) Scenario 2, and (c) Scenario 3.

PV-BES system cannot be depreciated, leading to reduced *NPV*. This is attributed to the even lower costs, i.e., $C_{\text{regulated}}$ and $C_{\text{supply}}^{\text{power}}$, of the electricity bill due to the BES employment, leading to increased savings for the campus and consequently to higher profits during the lifetime of the investment [12]. Here, it should be highlighted that the reduce of $C_{\text{supply}}^{\text{power}}$ is owed to the peak shaving achieved by the BES operation. Moreover, the increased *SCR* of the PV-BES prosumers leads to lower amounts of energy absorbed by the grid and consequently to decreased $C_{\text{regulated}}$.

In Figs. 8a, 8b and 8c the *IRR* of Scenarios 1, 2 and 3 are presented, respectively; in these figures *d*, i.e., the discount rate limit, is also depicted. Results of Scenario 1 show that *IRR* decreases as PV_{size} increases (See Fig. 8a); the *IRR* of Scenarios 2 and 3 increases up to a certain value, and then starts decreasing (See Figs. 8b and 8c). Comparing Figs. 8a-8c, it can be realized that Scenarios 1 and 2 present the highest and the lowest *IRR*, respectively. If *IRR* acquires values higher than *d*, *NPV* becomes positive, revealing that the investment can be considered profitable. On the other hand, for cases that *IRR* is lower than *d*, the corresponding *NPV* becomes negative and the investment cannot be considered viable. This is mainly observed in Scenarios 2 and 3, when campuses presenting low consumption levels are examined.

In Fig. 9 the variation of *DPP* against PV_{size} is presented for Scenarios 1 to 3. Note that the plotted *DPP* curves refer to investments that can be depreciated in the examined analysis period, i.e., 21 years. For all plotted cases *DPP* is higher than 10 years. Regarding Scenario 1, the *DPP* increases with PV_{size} (Fig. 9a); for Scenarios 2 and 3 (Figs. 9b and 9c) the *DPP* decreases with the PV_{size} up to a certain value and for higher PV_{size} values, the *DPP* increases. This is not the case for Komotini, where the *DPP* of Scenario 1 remains relatively constant to 11.5 years and the corresponding *DPP* of Scenarios 2 and 3 decreases with PV_{size}.

In Table III, the maximum *NPV* and the corresponding *DPP* of each campus are summarized for all scenarios. It is shown that Scenario 1 results into the most beneficial investments for the majority of the examined campuses. These investments present an average repayment period of ~15 years; this time period is considered acceptable for investment plans referring to the MV level. Nevertheless, the installation

TABLE III. *NPV* AND *DPP* FOR DUTH CAMPUSES

	Scenario 1			**Scenario 2**			**Scenario 3**		
Campus	**PV_{size} (kW)**	***NPV* (€)**	***DPP*(years)**	**PV_{size} (kW)**	***NPV* (€)**	***DPP*(years)**	**PV_{size} (kW)**	***NPV* (€)**	***DPP*(years)**
Komotini	1000	547,440	11.46	1000	542,238	11.73	1000	564,552	11.45
Makri	960	294,354	14.35	950	271,218	14.86	950	293,532	14.45
Q. Sophia Str.	510	163,373	14.59	510	125,061	15.96	510	147,375	15.23
Kimmeria	480	116,406	15.71	480	66,662	17.78	480	88,975	16.84
Chili	90	35,862	13.99	90	-22,266	21+	90	47.132	20.99
Tsaldari	90	17,258	16.62	100	-40,525	21+	100	-18,211	21+
Dep. of Civil Eng.	60	25,123	13.74	80	-34,610	21+	80	-12,296	21+
Orestias	60	15,406	15.71	70	-47,305	21+	70	-24,991	21+
Evripidou	50	5,022	18.44	50	-55,086	21+	50	-32,773	21+

of BES in campuses presenting high consumption levels leads also to significant profits for the prosumers. In particular, if future predictions of reduced BES costs are accurate (results of Scenario 3) [16], the profits of Komotini are anticipated to increase by 3.13 % compared to Scenario 1. On the contrary, PV-BES systems operating under NEM scheme cannot be considered as a profitable investment for campuses with low demand, e.g., Chili, Tsaldari, Evripidou, etc., since *NPV* acquire negative or nearly zero values for all examined PV_{size}. This is attributed to the fact that prosumer's savings during the investment lifetime cannot fully compensate the initial costs of the investment.

VI. CONCLUSION

In this paper a systematic techno-economic analysis investigating the profitability of the NEM policy for MV PV-BES prosumers in Greece is conducted.

By examining the cases of nine university campuses of DUTH, it is concluded that the NEM scheme may lead to significant profits for prosumers presenting high consumption, i.e., Komotini, Makri, Kimmeria and Q. Sophia Str. Results also reveal that the BES system cost significantly affects the profitability of the investment. Under current circumstances, i.e., relatively high BES market prices, an investment in standalone PV systems is more beneficial in monetary terms for prosumers, instead of PV-BES systems, as higher profits are estimated (higher *NPV*). Considering reduced BES system costs, this situation may be reversed. In particular, since BES systems provide peak shaving services and improve the *SCR* of the prosumer's installation reducing further the imported energy from the grid, increased savings in the prosumer's electricity bill is achieved resulting into higher profits during the lifetime of the investment; this is also verified by the corresponding *IRR*.

On the contrary, investment plans referring to NEM policy alongside BES systems in campuses with generally low demand, i.e., Chili, Dep. of Civil Eng., Evripidou, Orestias and Tsaldari, cannot be considered attractive. This is mainly owed to the fact that the initial investment costs cannot be repaid during the lifetime period.

Finally, according to the obtained results, it can be realized that the BES employment lead to increased *SCR* values. Nevertheless, these investment plans may not be beneficial for the prosumers, as well as the economic viability of these investments cannot be ensured. This is attributed to the fact that considering the Greek legislation and the current market prices, the profits of the PV-BES prosumers do not necessarily recuperate the capital investment costs.

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