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Electric Vehicle Impact on the Sustainable Development Goals Considering Renewable Energy Sources Integration

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Abstract:

An Electric Vehicle (EV) is considered as the solution for environmental limitation by integrating alternative resources. Besides, traditional vehicles are running against the Sustainable development goals that making a negative impact which can be overcome. This paper focus on the impacts on Renewable Energy Sources (RESs) and EV integration for meeting sustainable development goals such as Sustainable Developments Goal (SDG7) and Climate Action Goal (CAG13) by integrating EV and PV. The aforementioned sustainable developments Goals can be obtained by strategizing methos using Rule-Based Energy Management Strategy (RB-EMS) when integrating RESs into the proposed system. Thus, this study assists to measure the use of alternative sources as discussed in the result section in order to reduce the cost and emission and meet sustainable development goals.

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Keywords: EV, RESs, SDG7, CAG13.

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Introduction

Electric Vehicle (EV) and Renewable Energy Sources (RESs) integration is a hot topic due to the provided benefits on meeting the Sustainable Developments Goals (SDGs) [1]. The aforementioned process led to exploiting the smart grid rather than traditional networks in order to mitigate the limitations of conventional grid and have sustainable environment. The adoption of replacing the EV instead of the Internal Composition Engine Vehicle (ICEV) is due to the incremental in prices of fuel and oil along with the environmentally negative impact that causes [2]. The utilization of EV is widely found while in the Arabic countries are faced with fewer limitations such as the infrastructure [3]. Optimization techniques is coupled with the EMS in order to overcome the sizing and power limitations [4]. The EMS is strategies can be employed in order to strategies the flow of the power in the systems.

Besides, the EMS is classified into Rule-Based Energy Management Strategy (RB-EMS), Optimization-Based Energy Management Strategy (OB-EMS), and Learning-Based Energy Management Strategy (LB-EMS) [5]. Monte Carlo is one of the stochastic methods that working with RB-EMS based on the random selection to estimate the behavior on the uncertain number of EV integrated into the charging station [6]. Sustainable manner can be obtained when integrating smart grid considering alternative energy sources [7]. Various studies considered EV stability using various controlling techniques such as Proportional Integral Derivative ID (PID) and fuzzy PID to gain a stability in the EV integrated system[8]. The suspension system is exploited in EV connecting system to model and control the EV driven by in-wheel motor [9]. The integration technology of the EV has been conducted in different studies along with other topologies for exchanging the power between the EV and devices as reported in [10].

Nationally, many scholars were conducting various studies for different countries in order to estimate the impact of EV into low voltage distribution system such as Turkey [11] and British. EV integration causes an impact on the distribution system with the Energy Storage Unit (ESU) and RESs [12]. The microgrid as on-grid and off-grid systems integration components can be sized using different nature-inspired metaheuristic algorithms [13]. For the sharing EV products in the market as an innovation technique to meet sustainable development goals [14]. Using AI techniques to size and control RESs integration systems become an important due to their provided accurate result [15], through connecting EV in different areas for charging as presented in [16].

The article is contributed by performing an energy management strategy in order to meet the sustainable development goals with help of RESs integration. The rest of the article is organized as follows. The proposed system with the collected data is placed in Section 2. Section 3 represents for the utilized methodology for strategies the power flow in the circuit. Section 4. The results and discussion of the obtained result has been figured ot and discussed in Section 5. Concluded with the conclusion summary followed by the list of the recent references.

Proposed system and data collection

The utilization of RESs integration reduces the negative impacts on the network, economy, and environment. The proposed configuration that is illustrated in Figure 1 is connecting PV, BT, and EV in order to meet the sustainable development goals. The monthly load demand data for the utilized case study is plotted in Figure 2. The data description of the exploited components on the system are tabulated in Table 1. Various studies in the literature were conducted different types of RESs with EV in order to measure the impact as presented in [17].

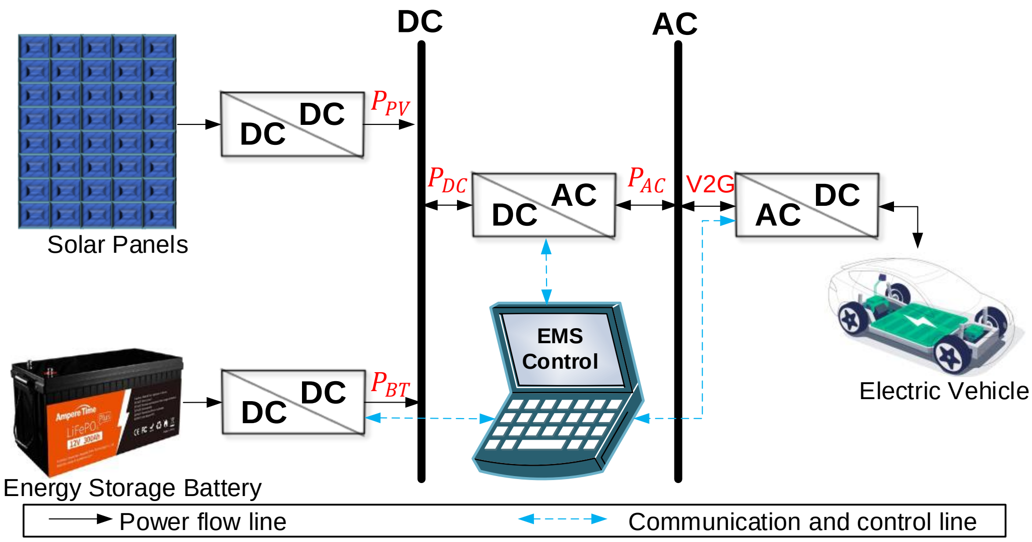

Figure 1 The Proposed diagram.

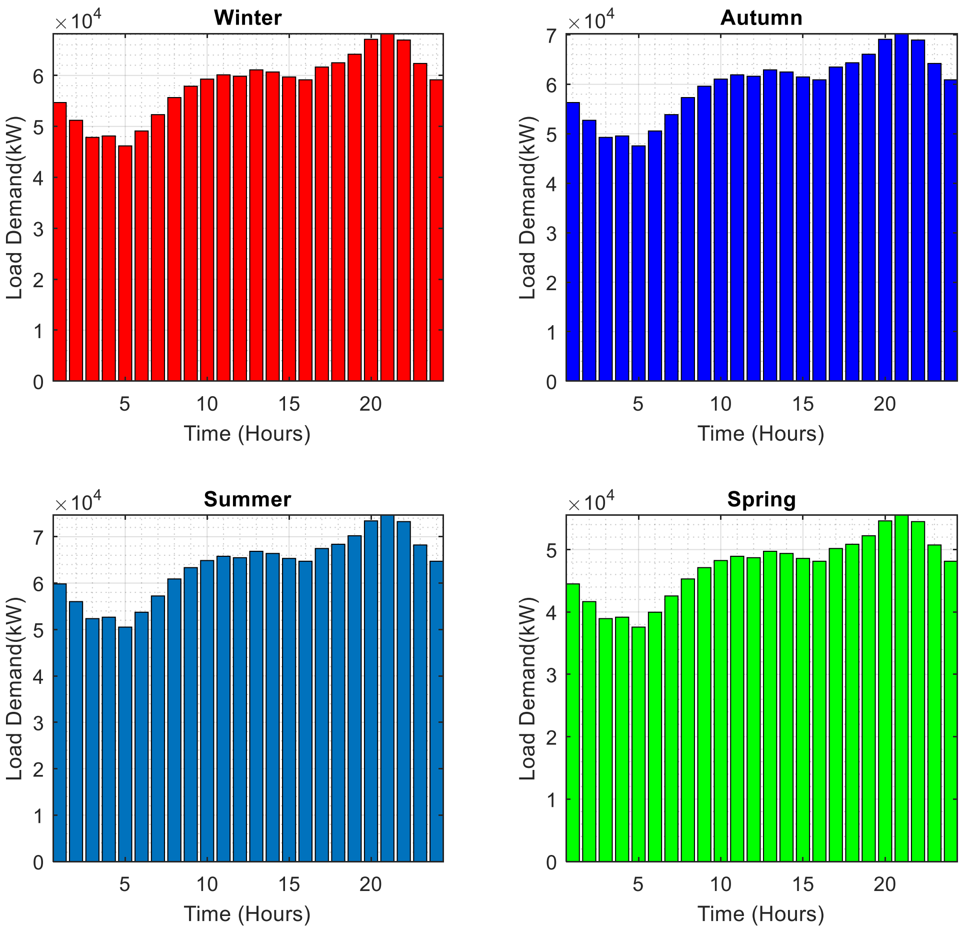

Figure 2 Seasonal load demand for the case study.

Table 1 Description of system integration configurations.

Description	Values	Unit
PV		
Model	Sanyo H250E01[18]	
maximum power	250	W
Maximum efficiency	18	%
output power	180	W/m^2
module area	1.386	m^2
BT [6]		
maximum SoC	100	%
minimum SoC	30	%
Replacement cost	280	$/year
Maximum DoD	70	%
O&M Cost	1	$/%
EV Battery (Li-ion) [19]		
Energy	100	Wh
Volume	220	I
Power	245	W
Weight	430	kg
Rated voltage	3.7	V

Methodology

The EMS can be defined as the algorithm for planning various strategies for an integration system to meet the objectives. Additionally, It has the features necessary to guarantee that energy is supplied through generation, transmission, and distribution at the most affordable price. The implemented RB-EMS in this study is based on three operation strategies as formulated in Table 3.

Table 2 Operation strategy modes.

Strategy modes	Operation strategy	If	Then
Mode 1	BT2V	$P_{BT}(t) > [P_{PV}(t) - P_l(t)] * \eta_{inv}$	$P_{BT}(t) > [P_{PV}(t) - P_l(t)] * \eta_{inv}$ $to\ P_l(t)\ and\ EV(t)$
Mode 2	RESs2V	$P_{PV}(t) > P_l(t)$	$P_{PV}(t)\ to\ P_l(t)\ and\ EV(t)$
Mode 3	V2G	$E_{grid} > EV_{dem}$	$E_{grid} > EV_{dem}\ to\ grid\ (V2G)$

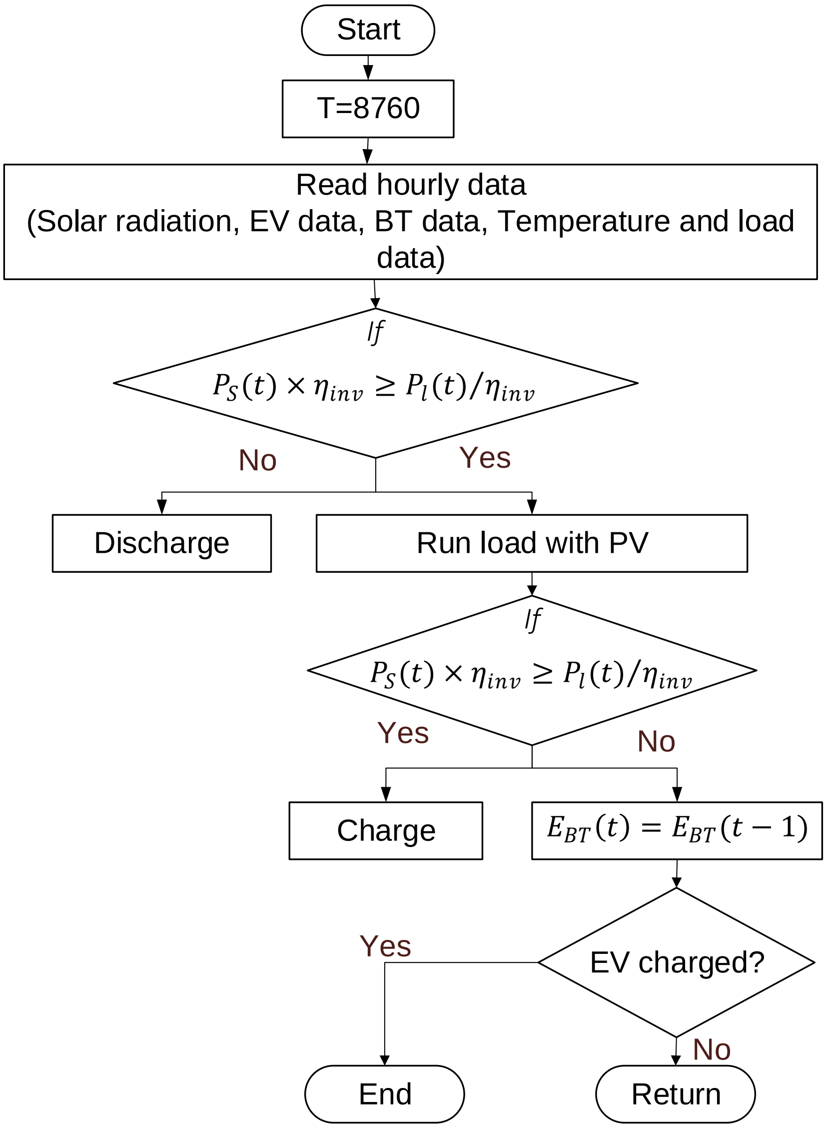

Figure 3 Flowchart of the Energy Management Strategy.

The aforementioned figure is demonstrated the flow strategy using RB-EMS starting by setting the process period of the project along with reading the needed collected data for the climatology changes, components (PV, BT, and EV), and load demand. Based on human planned strategy, the running process of the algorithm will be iterating till the objective obtained.

Results and Discussion

As a result of the implemented method for strategies the power flow as tabulated in Table 2 and figured out in Figure 3, the result is obtained. The first strategy that refers to (mode 1) for utilizing BT is known as the Battery-to-Vehicle. As a winter season, the utilization of the battery is demonstrated in Figure 4 with two periods of charging and discharging. The peak of utilizing the battery is at 16:00 pm which is the most sufficient time to feed-in the EV and other appliances, while from 17:00 to 23:59 pm is the insufficient time for the BT to meet the demand.

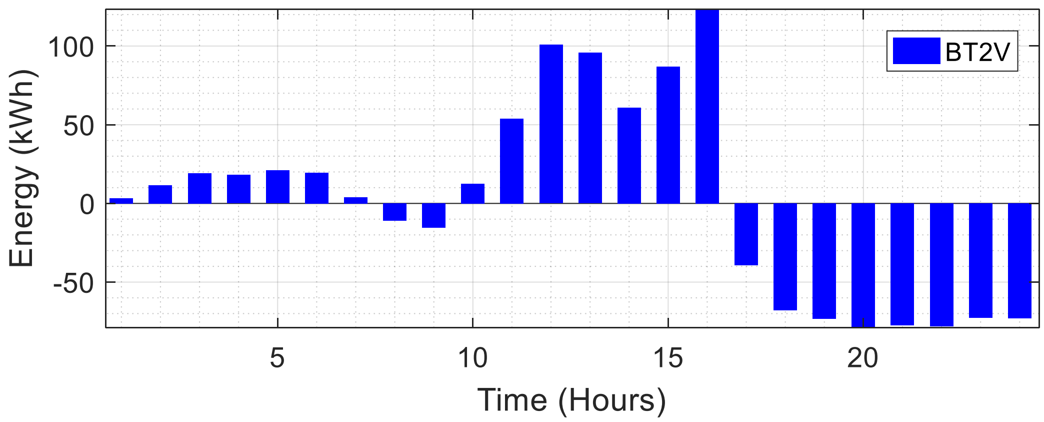

Figure 4 Battery-to-vehicle result.

The second strategy refers to (mode 2) that utilizing the alternative sources to charge the EV and other appliances. Based on aim of facing to the sustainable development goal, the PV is one of the tools that utilized as illustrated in Figure 5.

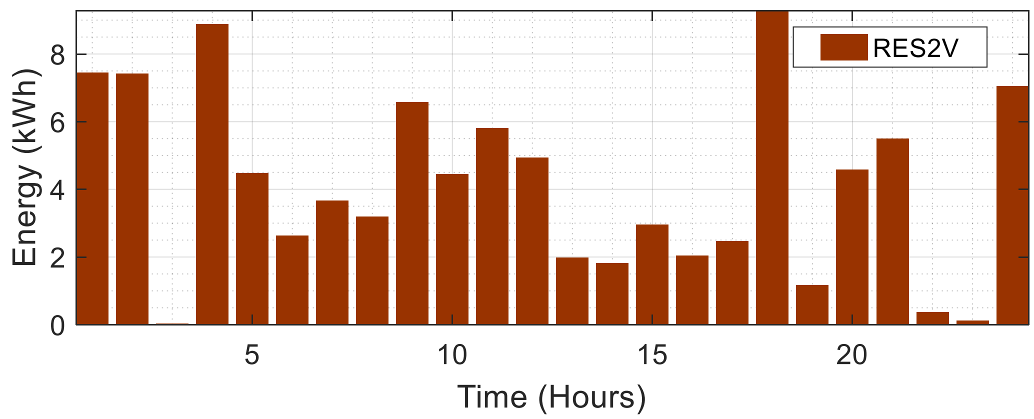

Figure 5 Renewable Energy Strategy-to-Vehicle result.

Eventually, the third strategy refers to mode 3 that represents the Vehicle-to-grid operation. Based on the desire of EV, various situations are plotted in Figure 6.

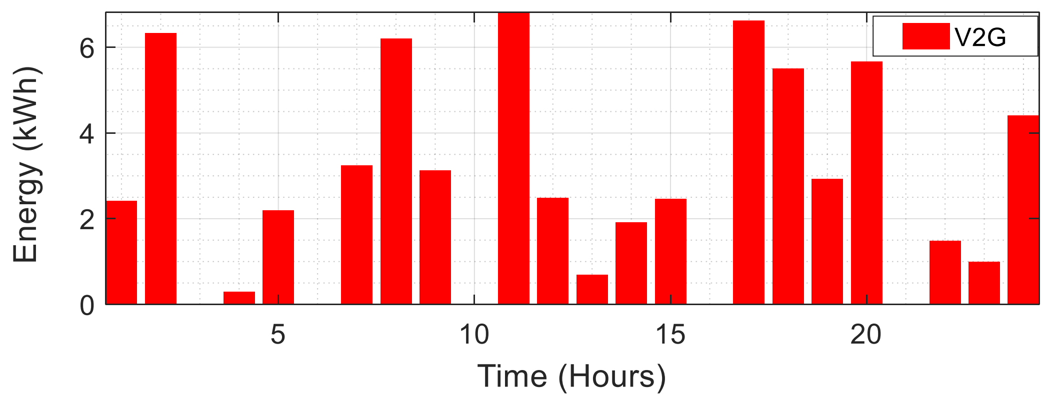

Figure 6 Vehicle-to-Grid result.

Conclusion

Without coordination, when EVs dominate the automotive market, the distribution network system may become overburdened. The aforesaid overcome by adopting EV with the RESs under professional process of EMSs in order to support the new loads and meet the sustainable development goals. The gained result from the three mentioned strategies (BT2V, RESs2V, and V2G) meet the main aim of the proposed system. For future recommendation, this article recommends utilizing supercapacitor batteries with integrating more alternative sources.

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