



## A Theoretical Detailed Analysis for a Proposed 5kW PV Grid-Connected System Installed in Iraq Using PVsyst Tool

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### ABSTRACT

In this study, PVsyst simulation software is used to analyze a PV grid tied system in a typical primary school in Iraq. The proposed system is 5kW which is affordable and applicable from the cost and required area points respectively. The monthly averaged electrical load for a typical school is approximately calculated. The system simulation has been done for thirteen Iraqi provinces while it is described and its performance is analyzed in details for Baghdad city as an example. The performance ratio for the system in Baghdad is 0.825 and about 9.82MWh is generated by the system per year, 62.7% is consumed by the load and the remaining is injected to the national grid. The results showed that the initial capital cost is \$5,442 which is returned after five and a half years. The cost of 1 kWh if the system operates for 10 years is \$0.058. This study clearly demonstrates that photovoltaic power system can effectively assist the peak load on the grid. In addition, these systems are very economical/no maintenance project and can be hooked to any the peak time load.

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### INTRODUCTION

In recent years, among different renewable energy technologies, photovoltaic (PV) technologies have grown faster and getting more attention in research, development. PV industry has shown rapid growth [1,2]. PV power has a wide capacity range and various applications from powering a small calculator to a mega scale power plant [3]. Prices of PV system components are decreasing with a fast rate as the production increases new technologies comes on the market. This explains the impressive R&D and application of PVs worldwide.

Photovoltaic power systems are classified mainly into three types of systems: Grid connected also called on-grid or grid-tied systems, Stand-alone (or off-grid) systems and Water pumping systems. This study focuses on photovoltaic grid-tied systems (shortly GTS) which consist of Photovoltaic panels, MPPT, solar inverters, power conditioning units and grid connection equipment. PV GTS feed the excess power, beyond consumption by the connected load to the utility grid. Small scale GTS are simple to install and operate, less components, more effective solar power utilization, longer term life than off grid/ stand-alone systems [4-7]

The energy yield of a grid-connected PV system depends on various factors. PV system components,

installation configuration, location and meteorological characteristics, operation defects [8, 9]. Many studies can be found in the literature which investigate the energy performance, cost assessments and environmental impact of different PV grid connected systems. Studies may be found in literature for countries with climate near to climate of Iraq like in Kuwait [9, 10], Jordan [11], Egypt [12], Saudi Arabia [13], Turkey [14], Oman [15] and United of Arabian Emirates [16]. A detailed summary for the recent studies involving grid tied PV system with or without battery storage are reported in literature [15].

Since the last decade, Iraq went through a series of failed attempts to solve problems not only in the electrical energy production but also in the transmission and distribution of electricity. Iraq's electricity infrastructure was severely damaged during the Gulf War and further in the following war in 2003. In 2008, the Ministry of Electricity reported that the peak demand was 12 GW of power; however, only 6 GW was supplied [17]. Iraq's demand/supply gap is 133.33% on average, and progressive provinces have experienced a gap in excess of 150%. The average energy usage per capita is expected to increase because Iraq has a growing economy [18].

In Iraq, electricity is almost completely generated using fossil fuels ignoring few small hydro-electric stations. As has been seen in the pioneer countries in solar power generation sector, there is an impetus to

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exploit as much as possible of buildings roofs and even facades to install small to relatively PV arrays. This eliminates the cost of land from the capital initial cost. In this study, the suggestion is to install small GTS for governmental primary schools which are featured with the following points:

1. In Iraq, governmental schools usually have large unexploited space areas roof, grounds etc., as shown in Fig. 1.



**Figure 1.** Satellite image for typical schools in Iraq

2. Daily load coincides with the peak load on the grid [19, 20].
3. The project can be funded by local or international "environment or climate changes organizations".
4. Rising children in a building with new, clean and promising energy source like solar energy.

The number of primary schools in Iraq was 14,048 in 2010/2011 while the number had reached about 15,807 in 2013/2014 about 12.5% increase. Government schools are 97% and 3% are private schools [21]. The Iraqi ministry of education stated that in 2012/2013 there were 14,830 primary schools, number of pupils 5,288,845, while the school buildings were 10,873. So we can consider about 500 pupils per school [22]. Electrical energy demand of the schools on the national grid may be reduced even can be eliminated by installing a PV GTS with appropriate size of GTS on each school.

PV simulation tools (such as PVsyst) are useful to perform preliminary detailed analysis of systems performance under various operating conditions. Some tools do shading analysis on the PV array, investigate different load profiles, verify systemsizing for optimal performance and evaluate the viability of a PV system in terms of energy production and life cycle cost of the system. Some studies used the benefits of quick process of simulation using PVsyst to compare different options provided by the software [23-27]. Some studies worked on tilt angle adjustments like fixed tilt angle on annual or monthly basis or using of tracking adjustments. Some authors worked on different components like varying the PV modules types like mono-crystalline, poly-crystalline or amorphous silicon. Other studies compared different brands or manufacturers of PV modules and inverters and so on.

In this study, a Five KW Photovoltaic grid tied (connected) system is proposed to cover the electrical demand of a typical primary school in Iraq. The system contributes a reduction in the peak load demand on the national grid. PVsyst (V 6.6.8) simulation software is selected to perform the analysis of the system.

## SIMULATION METHODOLOGY

The first step in sizing any PV GTS for a building is to know the annual or monthly accumulated energy (kWh) from electricity bills or meters. In this study, this type information is not available so instead we considered a nominal 5kW GTS. This system size has been selected mainly based on the installing area and the initial cost which can be considered acceptable for a building such as school. The simulation steps using PVsyst software are as follows:

1. Specifying location and importing the meteorological data (global solar irradiance on horizontal plane, diffuse component of solar irradiance and ambient temperature) from satellite data sources. In this study, Metronome 7.1 with data range 1985-2002 was selected [28].
2. Defining the orientation of PV modules (tilt angle and azimuth angle).
3. Identifying system components such that PV modules and inverters.
4. Optional USER'NEEDS requirements for grid tied system.
5. Optional choice to adjust the losses types values.

### PV Panel orientation

All solar energy collectors (PV panels, thermal) are installed to face the sun as possible increase the amount of radiation intercepted and reduce reflection and cosine losses [29]. This is done by calculating optimum azimuth angle and tilt angle. Fixed PV array due to the south without any tracking has been selected to minimize capital cost, less maintenance and limited land area of school buildings [30,31]. PVsyst gives in the orientation step, the optimum tilt angles values for annual and seasonal adjustment. For Baghdad, 30° is the optimum tilt angle while winter is 50°. In this study, 40° tilt angle was considered because of schools' load is expected to hardly decrease in summer. Where the larger tilt angle, the more irradiance gets captured in winter. In addition to that larger tilt angle means less soiling, dust accumulation and better natural cooling [32].

### System Description

Selecting the system components in this project study take into consideration high efficiency, reliability, brand reputation (share in the market and number of sold items recently) and it should have affordable cost to make the system economically feasible [33].

For this system, The PV grid tied inverter is a 5kW string inverter which is from SUNGROW (see Table 1 for inverter specification). SUNGROW is a Chinese leading inverter solution supplier for renewables with over 49GW installed worldwide as of June 2017 and was in top five inverter suppliers in the world [34].

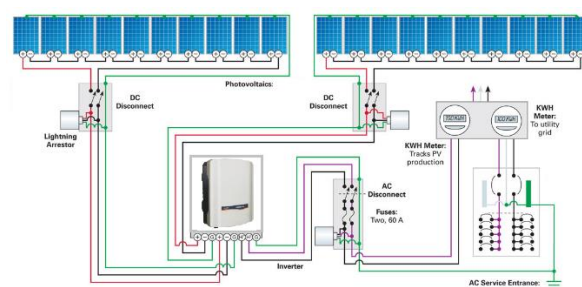
**TABLE 1.** Specifications of SUNGROW (SG5KTL-D) inverter

Input DC PV	DC power	Nominal power	AC Grid voltage	5.00kW
Maximum PV input power	6500W		230V	
Minimum MPP voltage	125V	Frequency/Phase	50Hz/monophased	
Nominal MPP voltage	345V	Maximum Efficiency	97.5%	
Maximum MPP voltage	560	Operating ambient temperature	-25 - 60°C	
No. of MPPTs 2		Protection	IP65	

The modules also from china which are polycrystalline silicon from SUNTECH which is world-class manufacturer and their modules are tested for harsh environments (salt mist, ammonia corrosion and sand blowing testing). Twenty PV modules overall each one 270Wp poly-crystalline its specifications at standard test conditions STC (cell temperature 25 °C, solar irradiance 1000 W/m<sup>2</sup> and air mass 1.5) are tabulated in Table 2. The modules were connected in two strings each string has ten modules connected in series. Each string is connected to a built in maximum power point tracker (MPPT) in the inverter. The complete connection diagram of the system is shown in Fig. 2.

**TABLE 2.** Specifications of SUNTECH (STP270-20/WFV) PV module at STC

Maximum Power at STC (Pmax)	270 W	Solar Cell	Polycrystalline silicon 6 inches
Optimum Operating Voltage (Vmp)	31.1 V	No. of Cells	60 (6 × 10)
Optimum Operating Current (Imp)	8.69 A	Dimensions	1650 × 992 × 35mm (1.637m <sup>2</sup> )
Open Circuit Voltage (VOC)	37.9 V	Frame	Anodized aluminum alloy
Short Circuit Current (Isc)	9.15 A	Junction Box	IP68 rated (3 bypass diodes)
Module Efficiency	16.5%	Front Glass	3.2 mm tempered glass
Operating Module Temperature	-40 °C to +85°C	Weight	18.3 kg
Power Tolerance	0.+5 W	Nominal Operating Cell Temperature (NOCT)	45±2°C
Temperature Coefficient	Pmax -0.41 %/°C Voc -0.33 %/°C Isc 0.067 %/°C		



**Figure 2.** System connection diagram

The required ground/roof area for the array diverse depending on modules layout, the projection of single module is about 1.27m<sup>2</sup> considering modules dimensions and the cosine of the tilt angle. For 40 tilt angle, it is recommended to avoid shading to have about 3m spacing between every two consecutive rows based on literature [35].

### Approximated monthly averaged load profile

Despite Iraq characterized with very hot summer which implies intensive cooling loads. But according to the annual statistical report from Iraqi Ministry of Electricity for 2010, the peak load varies and it not always occurs in summer [36]. For example, the peak load was in January for Karbala, Al-Anbar, Diyala, Wasit, Maysan and while for Nenavah, Kirkuk and Saladin the peak was in December. Other provinces the peak was in summer between July and August. In 2016, the peak was in November and December in Karbala, Al-Najaf, Al-Qadisyya and Al-Anbar, for the rest of provinces the peak was in mostly in July [37].

USER'S NEED option in PVsyst allows to do a calculation for wide choices of load requirement with hourly distribution, Table 3 list out the important electrical loads those are usually found in most of primary schools in Iraq.

**TABLE 3:** Electrical loads in a typical school

load	item per room				Watt age	Tot al Power
	Classrooms	Administration	Rest Rooms	Tot al		
CFL Light Bulb	36	12	10	58	40	2320
Ceiling Fan	36	4	0	40	75	3000
Air Conditioner	0	4	0	4	3000	12000
Desktop Computer/TV	0	4	0	4	100	400
Refrigerator	0	2	0	2	330	660

The hourly load distributions are specified in PVsyst considering the load starts when the school opens from

7AM to 3PM for five days per week. Also, heating or cooling load time are assumed based on average room temperature. The load profile is presented in Fig. 3.

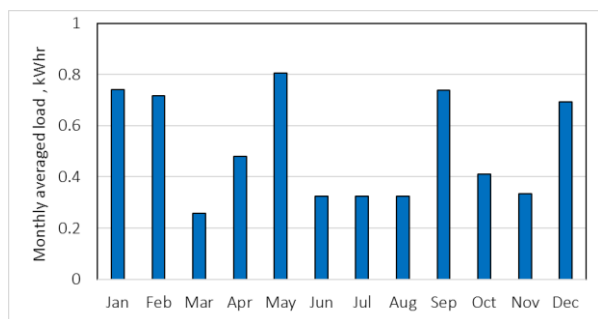


Figure 3. Monthly averaged load demand profile

Months like March, October and November were the load is minimum, means neither heating nor cooling are used. Considering summer vacation, months from June to August the overall load is low but still cooling load works at its peak. May and September months where the end/start of the school, the load is high as long as the weather considered hot comparing to winter months.

## RESULTS AND DISCUSSIONS

This section presents the simulation report detailed tables and plots as presented by PVsyst. The case of Baghdad city is considered in this study while the summary for thirteen provinces is tabulated at the end of the section.

### PV module temperature

The thermal behavior of PV modules strongly influences their electrical performance where the output voltage decreases drastically and slight increase in the output current. The resultant is a decrease in PV power. PVsyst determines the cell temperature based on very simplified energy balance as shown in Equation 1 [38]. Part of the amount of the absorbed irradiance by the PV is converted to electrical power and the remaining power heats up the cell itself. This heat eventually transferred to the ambient:

$$T_c = T_a + \frac{\alpha G_{eff} A_m (1 - \eta)}{U} \quad (1)$$

where,  $T_a$  is the ambient temperature, from the meteorological data.  $G_{eff}$  is the effective irradiance absorbed by the PV cell.  $\alpha$  is absorption coefficient (assumed 0.9).  $\eta$  is the module efficiency and  $U$  is Thermal Loss factor  $U_c$  assumed constant 20.0 W/m<sup>2</sup>K.

PVsyst provides a plot of the number of hours at which the PV module reached a specific temperature (see Fig. 4). Simulation results shows that about 3081 hours/year is the array running/operation time. About 71% of the time the module temperature reaches more than 45°C which is the nominal operating cell

temperature and it is higher than STC temperature with 20°C. Notice that According to PV module data sheet, the power drops from 270 W at STC to 198 W at Nominal Operating Cell Temperature conditions (NOCT conditions: Irradiance 800 W/m<sup>2</sup>, ambient temperature 20°C, air mass 1.5, wind speed 1 m/s).

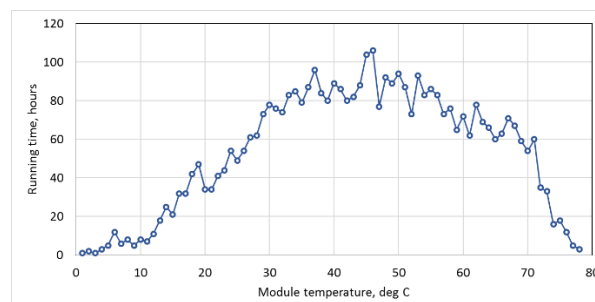


Figure 4. The time in hours where the cell temperature reached to a specific value

In practice, for Baghdad city, the module temperature rarely found to be less 10°C only for the time right after the sunrise unfortunately the irradiance is not high enough. To sum up, the results shows that high solar irradiance and low operating module temperature hard to meet together.

### Irradiance analysis

PVsyst calls the horizontal global irradiation, horizontal diffuse irradiation and ambient temperature from Meteorological data either from NASA or Meteonorm. Next, it performs the transposition (global, diffuse, albedo irradiances) from horizontal to the tilted the collector plane, using solar angles calculation and Perez model [39].

PVsyst applies corrections for the beam component such that the horizon correction, shading effect (if near shading is defined), Air Mass factor. If soiling loss is defined, PVsyst applied the soiling factor correction to all components (global, diffuse, Albedo). This leads to "Geff", the irradiance effectively and successfully reaching the PV cell surface after optical corrections.

From Fig. 5, it can be seen that the monthly averaged daily horizontal solar radiation varies from 2.7 kWh/m<sup>2</sup> in December to 7.65 kWh/m<sup>2</sup> in September. In January About 60% is the enhancement in capturing solar radiation due to the 40° tilt angle. In April and August, both tilt and horizontal nearly coincides only three months the horizontal is greater than tilt reaching about 18% in June.

Fig. 6 shows the cumulative effective irradiance in kWh/m<sup>2</sup> for every 1 W/m<sup>2</sup> insolation in one year. This figure shows that it is not about how high irradiance the array can capture but the important is the period in which the energy is collected. For example, the module will produce very much similar energy whether the insolation



is 100 W/m<sup>2</sup> or 1000 W/m<sup>2</sup> since the time that the module receives 100 W/m<sup>2</sup> is higher than 1000 W/m<sup>2</sup>. The maximum energy collected along a year is 190 kWh/m<sup>2</sup> for insolation 800 W/m<sup>2</sup> which means this insolation is the most frequent value. Notice that so far, the module works at 45°C and 800 W/m<sup>2</sup> which are the NOCT conditions for most of the time.

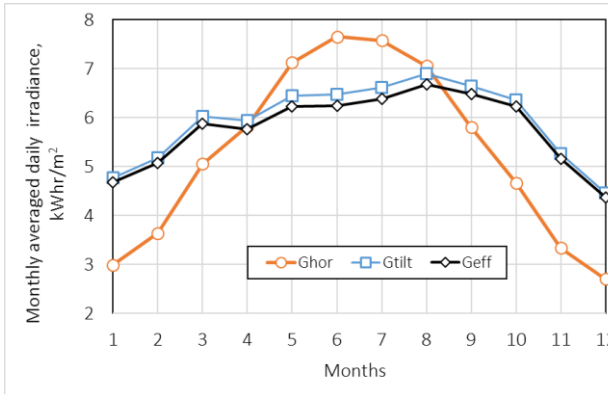


Figure 5. Monthly averaged daily global horizontal, global on tilted panels and effective irradiance

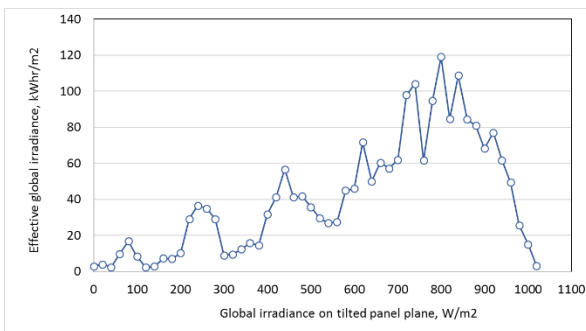


Figure 6. Effective irradiance collected by the array for each global irradiance on tilted plane.

**System energy production**

The DC energy produced by the array of modules in kWh is given by:

$$E_{array} = N G_{eff} A_m \eta \tag{2}$$

where *N* is the number of modules, *A<sub>m</sub>* the total area of the modules about (32.5 m<sup>2</sup> for this system). Then this energy encounters a series of losses as provided by PVsyst in the simulation report (Fig. 7) reaching the grid as AC energy *E<sub>grid</sub>*.

To describe the system performance two terms usually used the overall system efficiency (OSE) and the performance ratio (PR). OSE is the ratio of the useful output energy from the inverter which is either consumed by a local load or injected to the national grid to the input energy:

$$OSE = \frac{E_{grid}}{E_{tilt} A_m} \tag{3}$$

Performance ratio (PR) is the ratio of the produced energy by the system to the energy which would be produced by a "perfect" system continuously operating at STC [40].

$$PR = \frac{E_{grid}}{E_{grid}|_{STC}}$$

Monthly Overall system efficiency and performance ratio for Baghdad city is presented in Fig. 8. OSE and PR have the same behavior, both drastically decrease in summer as the loss due to high cell temperature is greater, OSE and PR decreased from 14.95% and 90.1% in January to 12.74% and 76.7% in August, respectively. Annual averaged values for OSE and PR are 13.79% and 83.03%, respectively; which is quite acceptable compared with other system found in literature [23-25, 40-43].

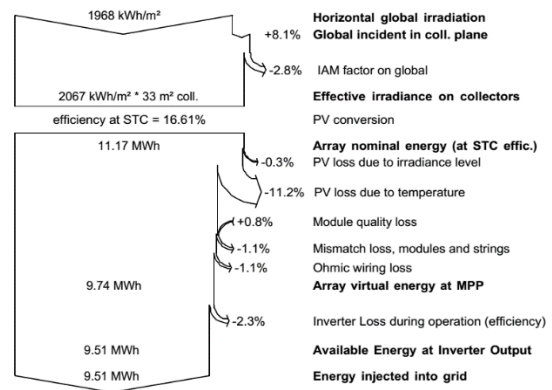


Figure 7. Loss diagram for one-year operation

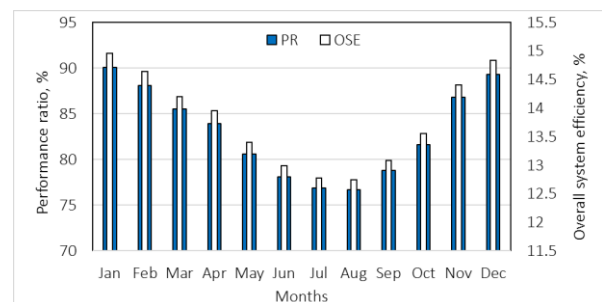


Figure 8. Monthly performance ratio and overall system efficiency for first year from operation

Another performance indicator is the final yield (*Y<sub>f</sub>*) which is the energy output of the system in kWh which is supplied by a PV array of capacity in kW<sub>p</sub>.

$$Y_f = \frac{E_{grid}}{PV_{rated}|_{STC}}$$

Fig. 9 shows the monthly final yield for the first year of operation in Baghdad city. The system produced maximum energy 177 kWh for each 1 kWp while the lowest is in December  $Y_f$  is about 25% less because the low global irradiance as shown in Fig. 5. Annual average  $Y_f$  is 163 kWh/kWp/year.

Very important plot that PVsyst provides is Fig. 10a which clears how the output of a PV system has large fluctuations and instability in winter months. Notice that the peak daily yield was 33.13 kWh in March 10<sup>th</sup> in which the high irradiance and low temperature may have occurred [44].

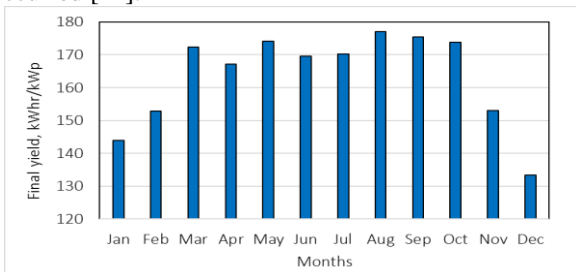


Figure 9. Monthly final yield of the proposed system in Baghdad city

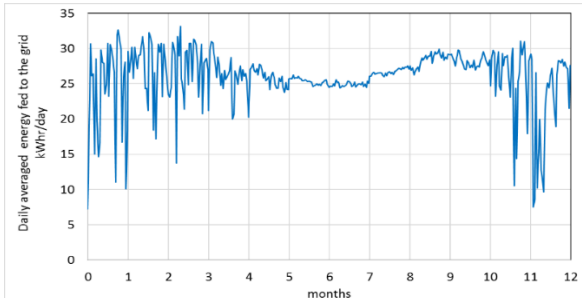


Figure 10a. Daily averaged energy fed to grid from 1<sup>st</sup> January to 31<sup>th</sup> December

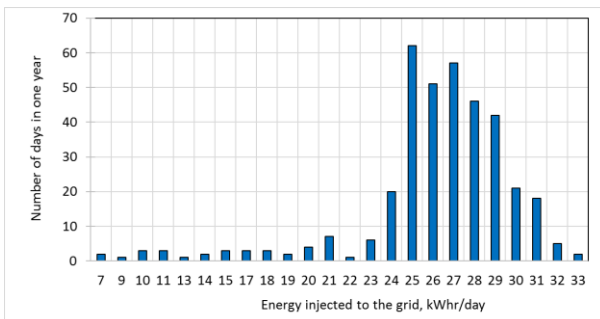


Figure 10b. Day frequency of a specific energy injected to the grid

During May and June, the energy production is lower as it is expected due to high ambient temperature (cell temperature may reach over 65°C) and the slightly large tilt angle compared to optimum summer tilt angles (around 10° to 15° for Baghdad city). Fig. 10b is extracted from Fig. 10a where the number of days that the system generated a specific energy per day. About 17% of the days the system generated 25 kWh. Only 27 days (7.4%) the system generates equal or less than 20kWh which shows how effective the system performs. Due to aging and material degradation especially in hot climate regions [45,46], module's nominal power output decreases SUNTECH warranty for their PV modules to provide the nominal power is 97.5% for the first year and about 0.7% per year, ending with the 80.7% in the 25th year. Therefore, equation 6 can determine the energy produced by the life time  $E_{LT}$  of the system as:

$$E_{LT} = E_{grid} \sum_{i=0}^n (0.975 - 0.007i) \quad (6)$$

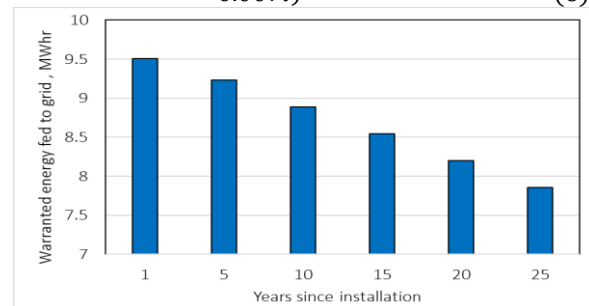


Figure 11. Annual degradation in PV modules yield

At the end, same analysis procedure using PVsyst is repeated for twelve other provinces in Iraq. Table 4 summarizes the results and Al-Anbar in the west of Iraq has the highest energy generated 9.977MWh since it has the highest monthly averaged global horizontal irradiance. The lowest is Nenevah (in the north of Iraq) with 8.843 MWh. We can say that if the system installed on the roof of 25% of 10,873 number of school buildings, the project will generate about 25.85 GWh/year, 35.2% is excess energy and fed to the national grid and the remaining can supply the schools load requirement.

### ECONOMIC ANALYSIS OF THE SYSTEM

In order to assess the benefits of investment in PV power systems, the economic aspects should also be taken into account. Among different measures of the economic value of an investment, an appropriate economic analysis such as life-cycle cost (LCC), levelized cost of energy (LCOE) and payback period can guarantee the profitability of the investment in the PV systems.

**TABLE 4.** Summarized one-year simulation results for thirteen Iraqi provinces

Province	Lat. <sup>o</sup> N, Long. °E	Ghor kWh/m <sup>2</sup>	Gtilt kWh/m <sup>2</sup>	Geff kWh/m <sup>2</sup>	Earray MWh	Egrid MWh	P.R.	Net Metering MWh
Al-Anbar	33.44 43.28	1987.9	2252	2192.9	10.21	9.977	0.82	3.823
Babylon	32.47 44.43	1967.8	2191	2131.9	9.87	9.645	0.82	3.491
Baghdad	33.26 44.38	1967.5	2204.6	2145.5	10.05	9.817	0.83	3.661
DhiQar	31.04 46.27	1981.5	2170.8	2111.3	9.67	9.455	0.81	3.301
Karbala	32.60 44.01	1961.8	2184.4	2125.5	9.91	9.687	0.82	3.536
Kirkuk	35.46 44.39	1855.7	2077.8	2019.8	9.48	9.259	0.83	3.104
Maysan	31.84 47.16	1955.9	2153.2	2093.9	9.57	9.351	0.80	3.197
Muthanna	31.33 45.38	1993.6	2196.4	2136.9	9.76	9.541	0.80	3.386
Najaf	32.02 44.34	1993.1	2214.8	2155.2	9.92	9.692	0.81	3.539
Nineveh	36.34 43.18	1775.5	1982.4	1926.4	9.05	8.843	0.83	2.691
Qādisiyyah	31.97 44.90	1981.6	2195.9	2136.3	9.74	9.518	0.80	3.364
Saladin	34.60 43.66	1904.1	2133.8	2075.1	9.66	9.438	0.82	3.283
Wasit	32.50 45.86	1947	2158.8	2100	9.59	9.372	0.80	3.217
Mean		1944.1	2162.7	2103.9	9.72	9.51	0.81	3.353

The life-cycle cost (LCC) of a solar PV system is the sum of initial capital cost, operation & maintenance cost and replacement cost [15].

Table 5 lists the prices of the system components and the cost of structure and hand work and the total capital cost is about \$4,865. Such small system for a specific building requires very little maintenance and the cost for this purpose like periodic cleaning of the PV array or replacing some cables or connectors can be ignored. While Operation and maintenance cannot be ignored for single large mega scale PV power plant.

The inverter is the component of second highest cost after the PV modules and it is may be damage especially with working at high ambient temperature [49]. According to Reference [11] replacement cost of the inverter will be 577 \$. Therefore, LCC is 5,442 \$. Levelized cost of energy (LCOE) is the ratio of the total life cycle cost to the life time energy produced in \$/kWh [48]. If the system works for 10 years,  $E_{LT}$  will be 92.63MWh, LCOE is 0.058\$/kWh while when the system works for 25 years,  $E_{LT}$  will be 218.6MWh, LCOE is 0.025\$/kWh. The payback period is the time

(usually in years) for the investor to recover the initial cost or what is called breakeven point. If the cost of electricity \$0.1/kWh and 9,817 kWh/y and LCC is \$5,442 then the payback period will be 5.5 years.

**TABLE 5.** Five kW PV-GTS initial capital cost

Item	Qty	\$Unit price	\$Total price	% of total cost
PV modules	20	122	2,440	50.15
Grid tied inverter	1	855	855	17.57
Mounting structure	1	940	940	19.32
Cables and connectors	1	130	130	2.67
Installation work	1	500	500	10.28
Total cost \$			4,865	

## CONCLUSION

Meeting the electrical energy demand has now become a major challenge for a country like Iraq with the growth in population and same old thermal/gas power plants which already have their operational problems. Electricity generation using solar PV systems is a potential solution to support the national grid. In this study, PVSYS software has been used to analyze a proposed 5 kW PV system, output electricity and system losses installed in a typical governmental primary school. It is found that 5 kW system covers the schools load completely and exports the excess to the national grid. The project has tempting advantages economically and environmentally which may encourage the government and the investors for similar projects in the future.

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#### Persian Abstract

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#### چکیده

در این مطالعه، نرم افزار شبیه سازی PVSyst برای تجزیه و تحلیل یک شبکه متصل شده به شبکه PV در یک مدرسه ابتدایی معمول در عراق مورد استفاده قرار می گیرد. سیستم پیشنهادی ۵ کیلو وات است که به ترتیب مقرون به صرفه و قابل استفاده از هزینه ها و نقاط منطقه مورد نیاز است. متوسط بار الکتریکی ماهانه برای مدرسه معمولی تقریباً محاسبه شده است. شبیه سازی سیستم در سیزده استان عراق انجام شده است، در حالی که آن را شرح داده است و عملکرد آن به صورت نمونه ای برای شهر بغداد مورد تجزیه و تحلیل قرار گرفته است. نسبت عملکرد سیستم در بغداد ۰.۸۲۵ است و در حدود ۹.۸۲ مگاوات ساعت در سال تولید می شود، ۶۲.۷٪ از طریق بار مصرف می شود و باقیمانده به شبکه ملی تزریق می شود. نتایج نشان می دهد که هزینه اولیه سرمایه ۵۴۴۲ دلار است که بعد از پنج سال و نیم بازپرداخت می شود. هزینه ۱ کیلو وات ساعت، اگر سیستم برای ۱۰ سال کار می کند، ۰.۰۵۸ دلار است. این مطالعه به وضوح نشان می دهد که سیستم قدرت فتوولتائیک می تواند به طور موثر به بار پیک بر روی شبکه کمک کند. علاوه بر این، این سیستم ها پروژه بسیار با ارزش / بدون تعمیر و نگهداری می باشد و می تواند به هر بار بار حداکثر زمان برسد.

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