DESIGN OF SOLAR ENERGY SYSTEM TO SUPPLY A MARSH VILLAGE, SOUTHERN IRAQ WITH ELECTRICAL ENERGY

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ABSTRACT

This research describe a simple design of photovoltaic solar system to supply a village at marshes with independent electrical energy nodules, taking into account all meteorological conditions of this region. Different types of solar panels have been studied, and suitable choice is done for better performance of the system due to this region. This approach is suitable for any other region with an elastic variation depend upon the meteorological conditions and loads.

INTRODUCTION

Iraq is known n to be rich in fuels namely oil and gas which are the main source of revenues. In addition to these fuels, other energy resources are available such as water falls in the north of the country, Iraq is also considered to be rich in renewable energy resources such as wind and solar energy.

Recently attention has been focused on the exploitation and use of solar energy in different aspects of life especially in the remote areas (Hassan, 1995).

The Arab world and Iraq among it receives solar energy equivalent to an average of 275 Watts per square meter. With a land area of over 1 1.5 million square kilometers and assuming that only one percent of this could be utilized for solar energy collection, a total of over 30 million megawatts is potentially available. Even with existing solar technology, this could be converted to useable electricity at an efficiency of at least 10 percent, producing over 3 million megawatts or the equivalent of the output of 3000 large power stations generating 1000 megawatts each (Perera, 1980).

In this work a simple methodology has been describe to design a remote area power supply s]stem to meet the electrical energy requirements of a small village consist of 100 house at the marsh-southern Iraq using the roof's of these houses to fix the solar panels.

In order to install t conventional roof- mounted PV system in the KW power range three groups usually have to co-ordinate their work: the electrician, the roofer and the PV system specialist. The SOLAR ROOF WINDOW, however, can be installed by the roofer alone (Baunmgartner and Sutter, 1997).

2- The Proposed Scheme

(A) Geographical Data:

Location of System:	Marshes - Southern Iraq
Latitude	: 30^0, 34' N
Longitude	: 47^0, 47' E
Elevation	: 2 meters

(B) Illumination Data:

The availability of bright sunshine without interruption for long periods determines to r very great extent the possibility of utilizing of solar energy for many applications. The annual sunshine duration (hours) of 12 month at southern Iraq shown in (Fig.1).

Taking into account the number of days per each month, Figure (2) shows the mean sunshine hours per day in each month. Another data required in the system design is the mean per month occurrence of sunless days at this region. This is show n in Figure (3) (Akrawi *et al.*, 1986).

The extreme per month occurrences of sunless days in this location shown that the worst case in winter which is 5 days in continuous rainy days (Akrawi *et al.*, 1986).

Illumination and temperature arc the most significant environmental factors in solar system design. There are, however, other less obvious Points which do not feature in many design packages but can make a significant impact on system design. These include humility, wind velocity, ground condition (reflected) and the effect of sand, dirt or snow build-up on the surface of solar module. The illumination at horizontal surface and temperature in the proposed location with the optimum selections of day per month is shown in Figure (4) (Lucas, 1981).

(C) Electrical Loads:

The proposed scheme of solar village consist of 100 (one hundred) home each consist of three rooms requires an electrical energy to supply the following electrical appliances. Tables (1,2, and 3) shows the electrical load required in winter, summer, spring, and autumn.

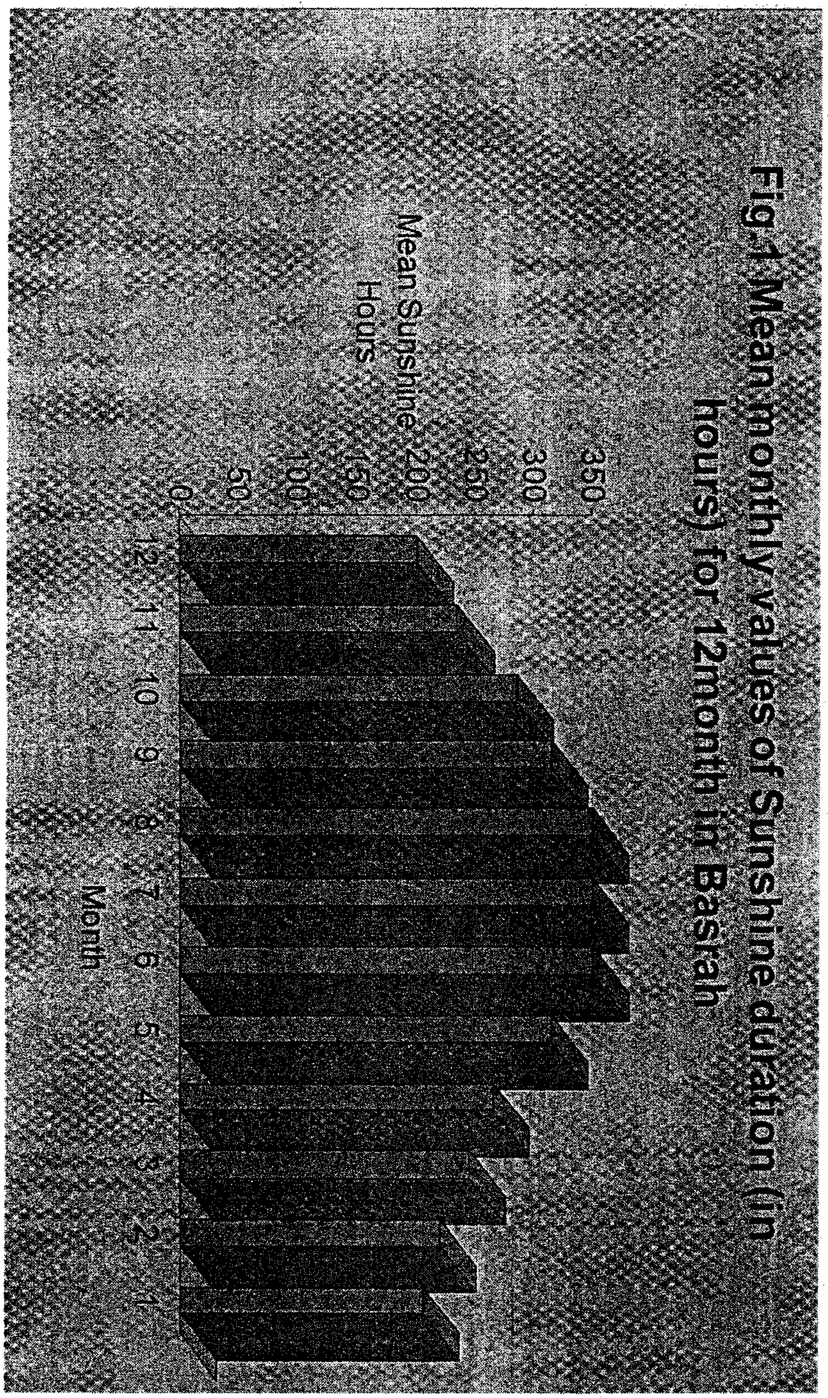

Fig.1 Mean monthly values of Sunshine duration (in hours) for 12month in Basrah

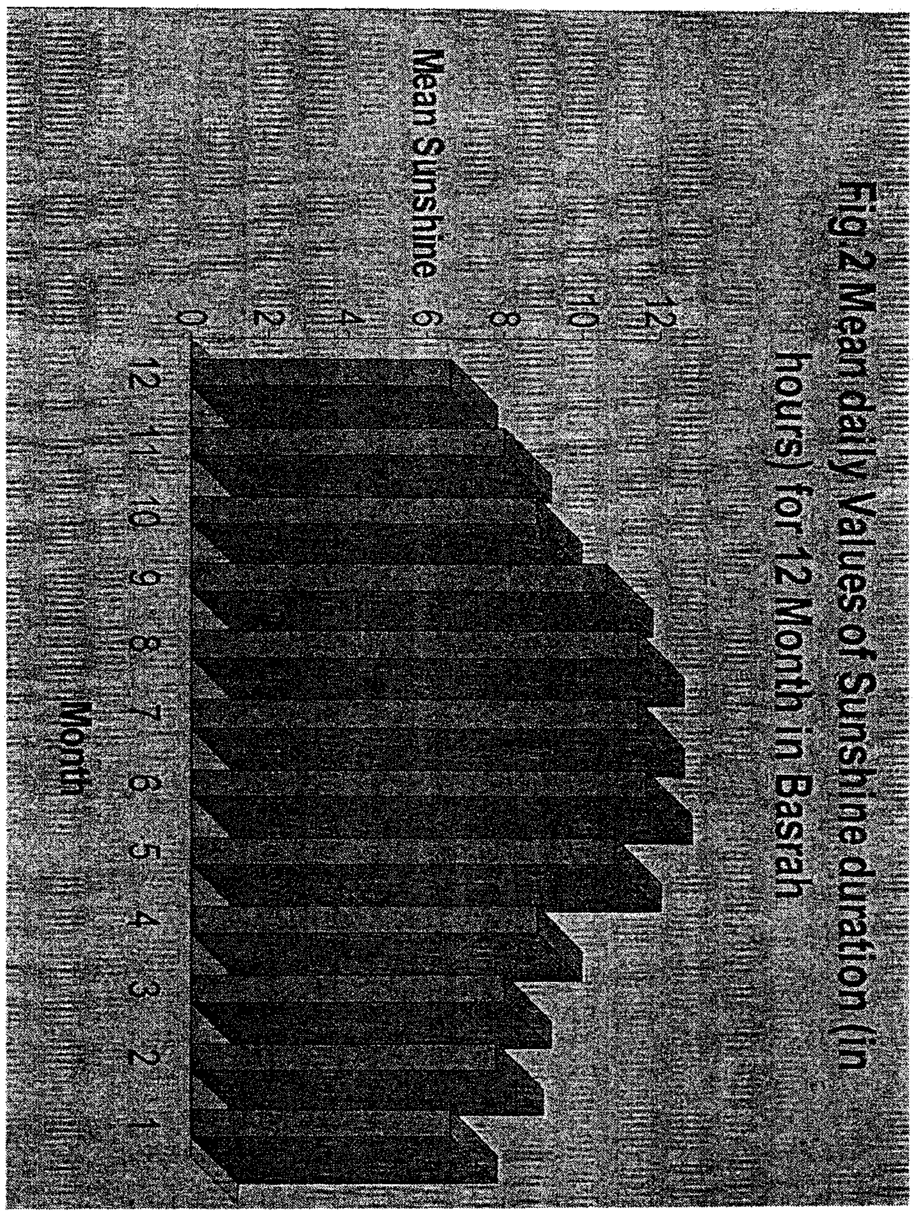

Fig 2 Mean daily Values of Sunshine duration (in hours) for 12 Month in Basrah

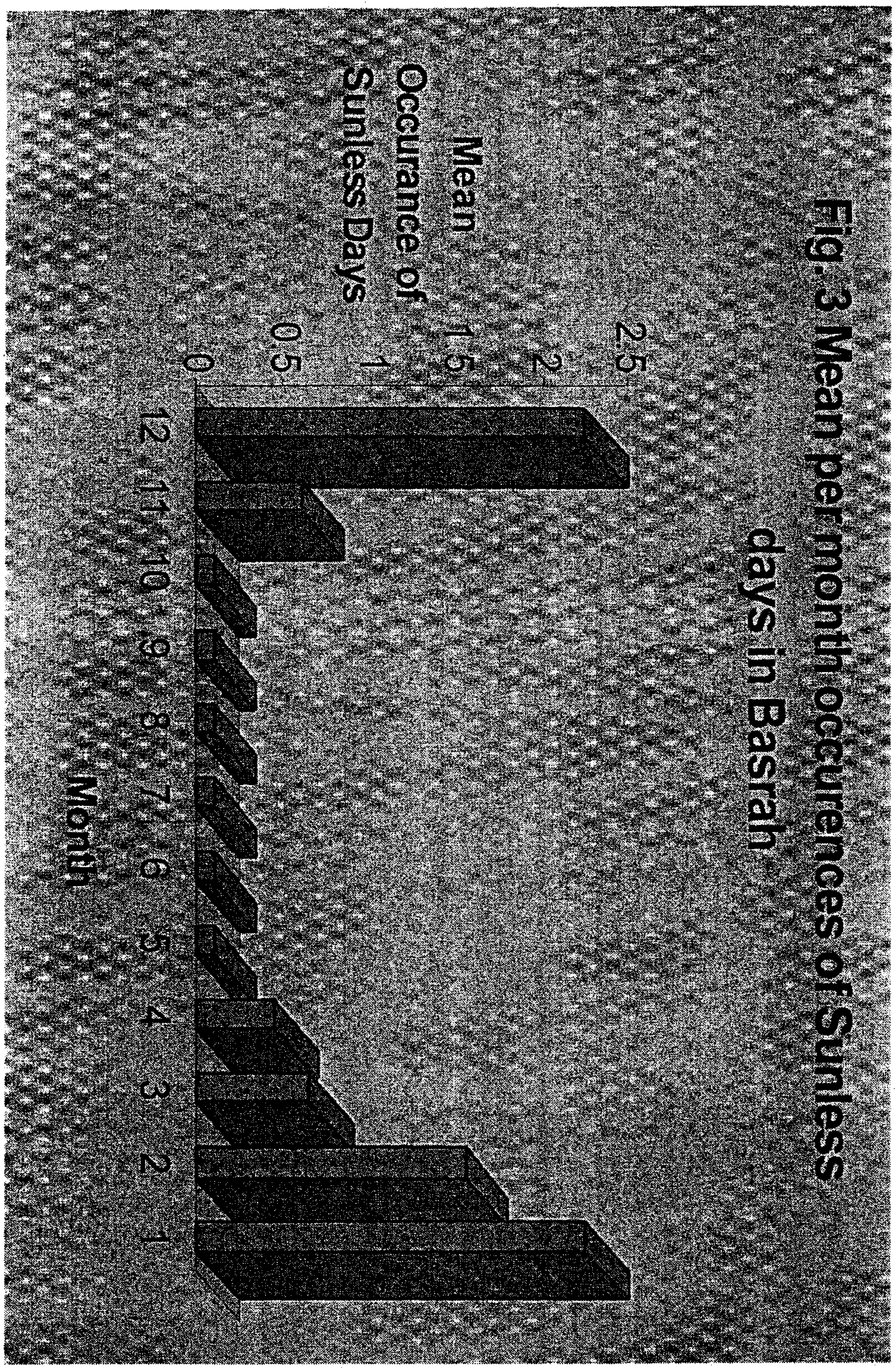

Fig. 3 Mean per month occurences of Sunless days in Basrah

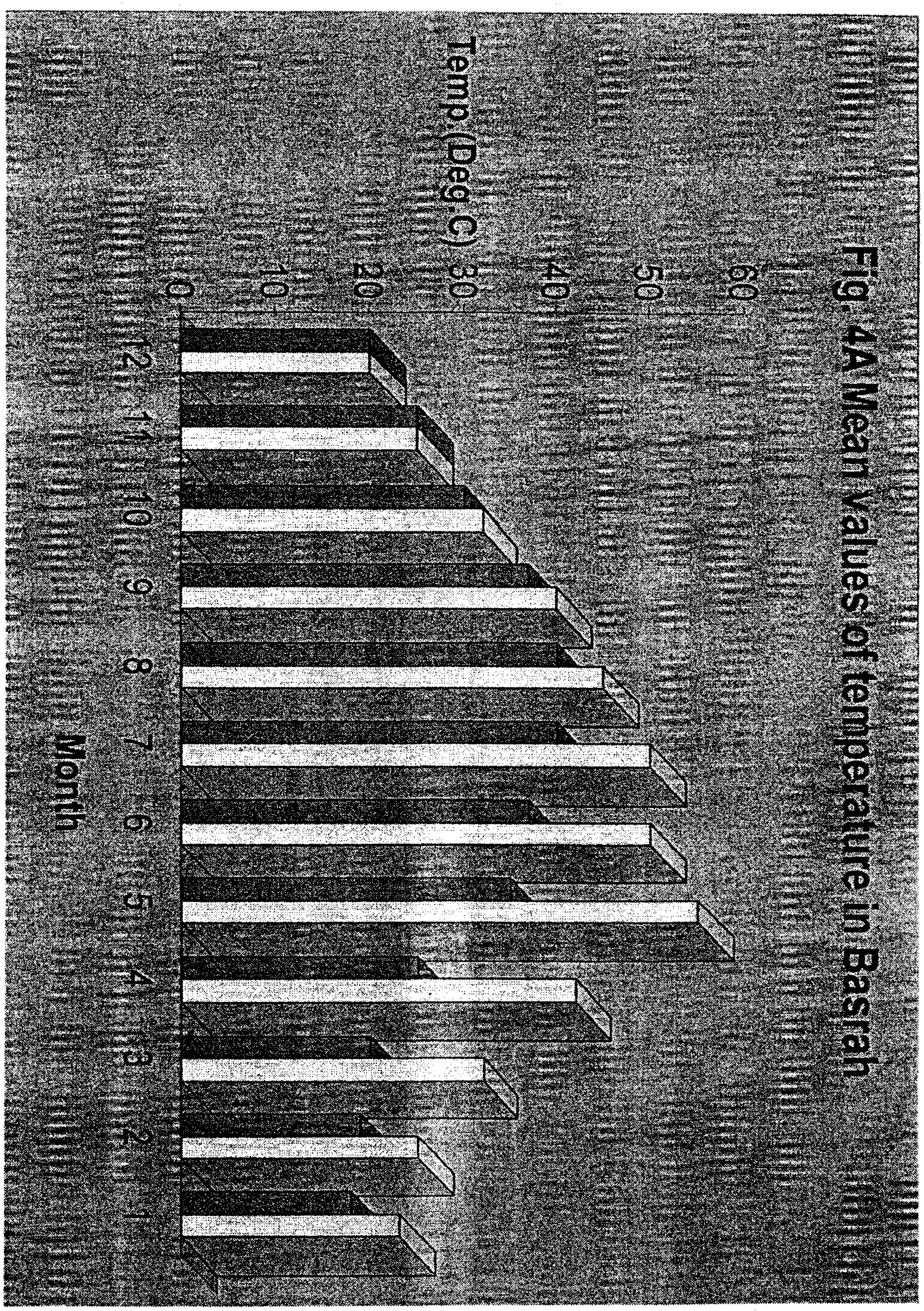

Fig. 4A Mean values of temperature in Basrah

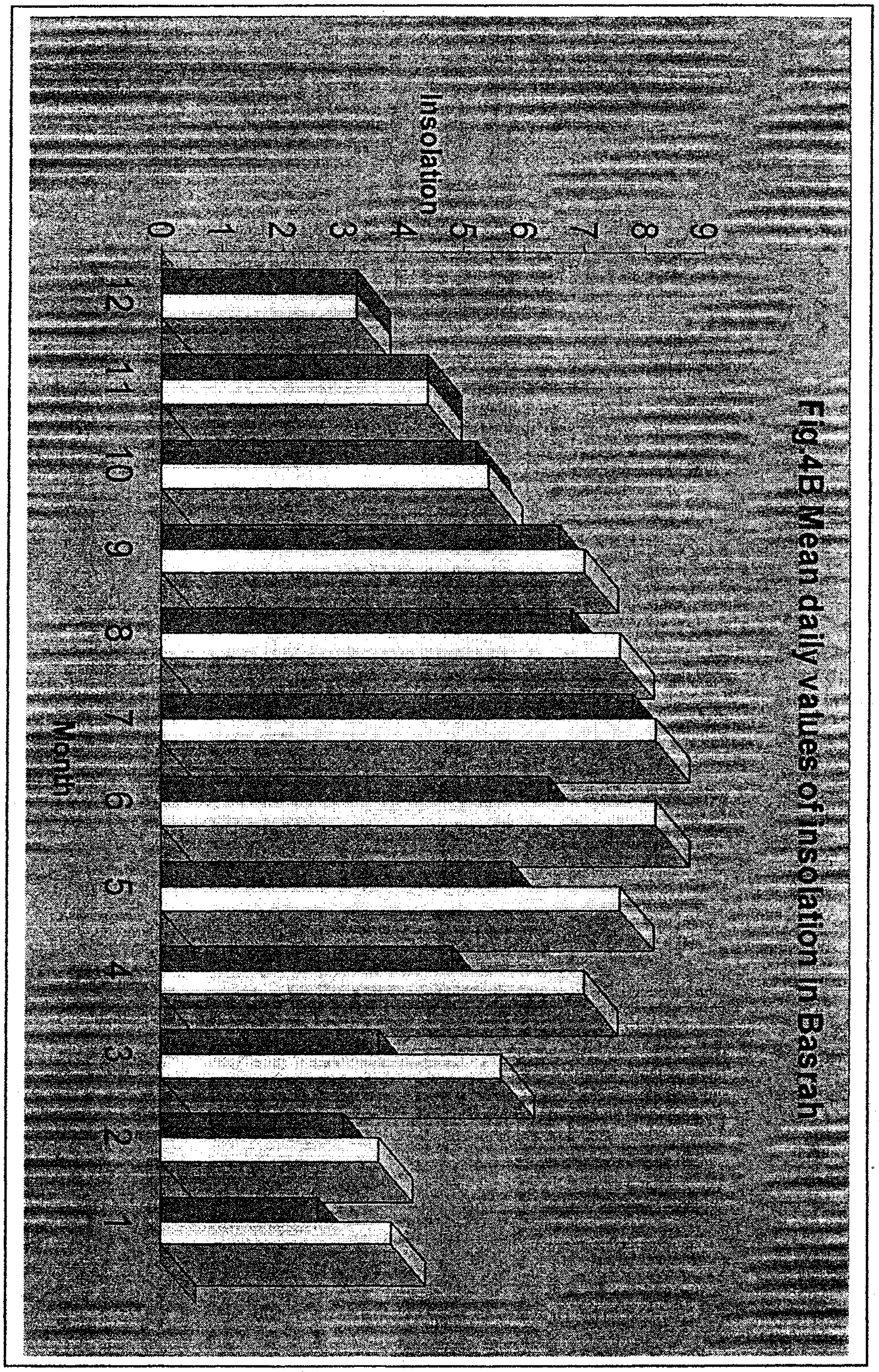

Fig.4B Mean daily values of insolation in Basrah

Table (1)- Load Consumption in winter

Load Condition				Peak Load (W)	PL (kwh/day)
Equipment	Power(w)	No's	Hrs./day		
40W Fluorescent Lamp	50	5	6	250	1500
20W Fluorescent Lamp	27	3	6	81	486
100 Incandescent Lamp	100	6	6	600	3600
Electric Hearts	1500	2	4	3000	12000
Water Hearts	1500	1	2	1500	3000
Cooking Range	1000	1	3	1000	3000
Color TV	100	1	8	100	800
Refrigerator	200	1	12	200	2400
Freezer	230	1	12	230	2760
Satellite Receiver	65	1	8	65	520
Electric Iron	800	1	1	800	800
Total					30866

Table (2)- Load Consumption in summer

Load Condition				Peak Load (W)	PL (kwh/day)
Equipment	Power(w)	No's	Hrs./day		
40W Fluorescent Lamp	50	5	6	250	1500
20W Fluorescent Lamp	27	3	6	81	486
100 Incandescent Lamp	100	6	6	600	3600
Air Conditioner	3300	1	6	3300	19800
Air Cooler	400	1	6	400	2400
Cooking Range	1000	1	3	1000	3000
Color TV	100	1	8	100	800
Refrigerator	200	1	14	200	3220
Freezer	230	1	14	230	2760
Satellite Receiver	65	1	8	65	520
Electric Iron	800	1	1	800	800
Total					38886

Table (3)- Load Consumption in spring and autumn

Load Condition				Peak Load (W)	PL (kwh/day)
Equipment	Power(w)	No's	Hrs./day		
40W Fluorescent Lamp	50	5	6	250	1500
20W Fluorescent Lamp	27	3	6	81	486
100 Incandescent Lamp	100	6	6	600	3600
Cooking Range	1000	1	3	1000	3000
Color TV	100	1	8	100	800
Refrigerator	200	1	12	200	2400
Freezer	230	1	12	230	2760
Satellite Receiver	65	1	8	65	520
Electric Iron	800	1	1	800	800
Total					15866

(3) Photovoltaic System calculations
(A) In winter [Months: Nov., Dec., Jan., and Feb.]
(1) Mean daily sunshine duration: 7.85 Hrs.
(2) Worst case of sunshine duration:6.61 Hrs.
- Load: Electrical Applications: 220Vrms A.C., 50Hz

Average daily load for each house=30866W

-inverter specifications: Stepped-sine wave dc/ac inverter in order to obtainhigh efficiency even if it works at light loads (Al-Rawi *et al.*, 1989).

Average daily load= 30866/ The nominated efficiency of the inverter

= 30866/0.85= 36 313 Wh/day

D.C. system voltage= 312V

- Array Size:

Battery loss factor * Average daily load = Adjusted total load (wh. per day)

1.2 * 36313 = 43575 wh/day

Adjusted total load / DC system voltage= Amper -Hour per day load

43575 / 312 = 139.665 Ah/ day

Amper-Hour per day / Peak sun hours per day = Array peak Amps

139.665 / 6.61 = 21.13 A

Now decision should taken about the best selection of photovoltaic panels which is suitable to the climatic conditions of marshes region-southern Iraq

(Humidity and temperature), then the selection is done for maximum power that can be obtained.
Looking among various types has been done in this project (Sahel/France; Arco solar/USA; Aeg-Telefunken/Germany; and Lucas Bp/England), then Arco solar has been taken to be the sample used in calculations for their advantages among the others.

Array Peak Amps. / Peak Amps, Per Module= Modules in Parallel
21,13 / 4.2 = 5 (rounded)

DC System Voltage / Peak Output Voltage per Module= Module in Series
312 / 8.1 = 39 (rounded)

Modules in Parallel * Modules in Series=Total Modules Required
5 * 39 = 195

- Battery Size:

In solar systems, a certain backup system is required during night periods and raining days. For this purpose, many backup systems are required, such as wind energy, diesel generators, and batteries. Among all of them, batteries have many advantages for remote areas.

Amper Hour per day load * Days of autonomy / Discharge Limit = adjusted Battery load (Amp-Hr)
139.665 * 5 / 0.50 = 1396.65

Adjusted Battery Load (Amp-Hr) / Amp.-Hr Battery rating = Batteries in Parallel
1396.65 I / 120 = 12 (rounded)

DC System Voltage / Battery Voltage rating = Batteries in Series
312 / 12 = 26

Batteries in Parallel * Batteries in Series =Total Batteries Required
12 * 26 = 312

- Controller Specification:

Short Circuit Amps per Module * Number of Modules in Parallel = Maximum Array Amps
5 * 5 = 2 5

Maximum Array Amps / Controller Array Amps = Controllers in Parallel
25 / 10 = 3 (rounded)

Total Concerted Load Watts / System voltage= Load Peak Amps
308866 / 220 = 140.3

Load Peak Amps / Controller Load Amps = Controllers in Parallel
140 / 15 = 10 (rounded)

(B) In Summer [Months , June, July, and Aug.]

- Mean daily sunshine duration = 11 Hrs
- Worst case in May= 10.07 Hrs

From Table (2): Daily load required = 38886wh/day

Repeating the same steps as in winter season:

No. of modules in parallel = 5
No. of modules in series = 39
Total modules required = 195
Total batteries required = 416
Controllers in parallel = l2 (rounded)

(C) In Autumn and Spring [Months, Mar., Apr.. Sept., and Oct.]

- Mean daily sunshine duration = 9.07 Hrs
- Worst case in May= 7,89 Hrs

From Table (3): Daily load required= 15866wh/day
No. of modules in parallel = 3
No. of modules in series = 39
Total modules required = 117
Total batteries required = 156
Controllers in parallel = 5 (rounded)

RESULTS AND DISCUSSION

No. of modules in parallel = 5 * 100 = 500
No. of modules in series = 39 * 100 = 3900
Total modules required = 1950000
Total batteries required = 416*100 = 416000
Controllers in parallel = I2 * 100 = 1200

Easy and quick technique has beer investigated to design a small village at the marsh-southern area of Iraq. This region has a lot of insolation but it suffers heavily from humidity and high temperature, so it is very important to select the suitable solar modules.

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تصميم منظومة طاقة شمسية
لتغذية قرية في أهوار جنوب العراق بالطاقة الكهربائية

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الخلاصة

هذا البحث يتضمن تصميم مبسط لمنظومة شمسية فوتوفولتائية لتغذية قرية في منطقة الاهوار بطاقة كهربائية مستقلة عن الشبكة الوطنية ومع الأخذ بنظر الاعتبار الظروف البيئية لهذه المنطقة. تم دراسة عدة أنواع من الألواح الشمسية وتم اختيار النموذج المناسب لأفضل أداء للمنظومة تبعا لظروف هذه المنطقة من حيث الحرارة والرطوبة والإشعاع الشمسي. هذه الطريقة تعتبر مناسبة لأي منطقة مع تغيرات مرنة اعتمادا على الظروف البيئية والأحمال الكهربائية.