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The Use of Photovoltaic Cell System in Lighting the Parking Lots in AL-Zahra Co-operative Society

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ABSTRACT

This research explores the implementation of photovoltaic (PV) cells in the purpose of lighting parking lots within Al-Zahraa co-op's premises, the aim of this project was to reduce the environmental impact of carbon emission and to enhance energy sustainability. Traditional lighting methods often rely on fossil fuel-based electricity, contributing to carbon emissions and escalating operational costs. Leveraging PV technology offers a renewable alternative by harnessing solar energy to power lighting fixtures efficiently. Through strategic placement of PV panels and integration with energy-efficient LED lighting, the Al-Zahraa Association can achieve reliable illumination while minimizing energy consumption. Battery storage systems ensure uninterrupted lighting during periods of low sunlight or high demand. This initiative showcases a commitment to environmental stewardship, reducing carbon emissions, and inspiring sustainable practices within the community.

Key Words: Energy efficiency, Energy storage, Environmental impact, LED lighting, Photovoltaic cells, Renewable energy, Solar energy, Sustainability.

1. INTRODUCTION

The experimental work initiated by the largest Kuwaiti scientific institution , which was completed in two phases, demonstrating the practical use of renewable energy for the prestigious Emirates Energy Award. This project was initiated and funded by KFAS in response to the directives of H.H. Sheikh Sabah Al-Ahmad Al-Jaber Al-Sabah, the Amir of Kuwait and Chairman of KFAS' Board of Directors, to advocate the use of renewable energy sources in Kuwait so that it can deliver 15% of peak electricity demand by the year 2030.

The first phase of the project aimed at installing photovoltaic (PV) systems in the carport of alzahraa (co-ops) with a total capacity of 1,038 kW_p. It also investigated improving the energy efficiency of major energy consumers such as lighting.

Hence, the objectives & Targets can be defined as follow: -

1.1 Objectives

- Establishing the use of solar energy.
- Promoting a culture of a technology use
- To improve energy efficiency in the co-operative societies.
- To demonstrate solar energy technologies in the State of Kuwait and exhibit its application first-hand to the public.

1.2 Targets

- Promote the utilization of solar energy at large-scale application.
- Reduce the electrical load during the peak period. Figure1

- Encourage implementing similar projects in the country, so that other stakeholders can take steps to follow this practice.
- Save fuel consumption and reduce CO2 emissions.
- Diversify the sources of power generation so that 15% of peak demand would be generated from renewable energy by 2030.

2. METHODOLOGY

The Development in the production and consumption of electricity in the states of Kuwait is as follow;

The total installed capacity of electric power stations reached 10189 MW in 2005 while it reached 6898 MW in 1995, 5086 MW in 1985 , and 1364 MW in 1975 it reached 300 MW in 1965 .

The development of the per-capita consumption rate of electrical energy per year amounted to 3991 kW/hr in 1975 and rise to 5686 kW/hr 1980 and increased to 7476 kW/hr in 1985 and 9858 kW/hr in 1992 and increased to 11769 kW/hr in 1995 until it increased 12305 kW/hr in the year 2000 and 12673 kW/hr in year 2005.

2.1. Utilization of Solar Energy.

The government envisaged projects to increase electricity production, (KFAS) is started a pilot major work, which was completed in two phases, demonstrating the practical use of renewable energy for the prestigious Emirates Energy Award. This project was initiated and funded by KFAS in response to the directives of Kuwaiti Amir Sabah Al-Ahmad Al-Jaber Al-Sabah, the Amir of Kuwait and Chairman of KFAS' Board of Directors, to advocate the use of renewable energy sources in Kuwait so that it can deliver 15% of peak electricity demand by the year 2030.

The first phase of the project aimed at installing photovoltaic (PV) systems in the carport of two selected co-operative societies (co-ops) with a total capacity of 1,038 kW_p. It also investigated improving the energy efficiency of major energy consumers such as lighting and air-conditioning. The total annual electrical energy produced by PV is about 1,350 MWh, while the total annual energy saved from lighting and air conditioning retrofits is about 1,730 MWh.

The second phase involved installing rooftop grid-connected PV systems for a total of 150 Kuwaiti homes over the course of three years with a total installed capacity of 1,158 kW_p. It also investigated the feasibility of widespread deployment of PV systems in the residential sector and could act as a test bed for future installations of residential PV systems. The total annual energy produced by this phase is around 1475 MWhr.

The findings of the pilot project was used to support the development of policies for the dissemination of distributed generation in Kuwait combined with realistic incentives for for owners of private buildings to encourage them to actively participate in the plan through sharing the returns from the savings especially with the expected continued decline in the cost of solar energy systems as a result of technical developments in this area , finally the decision of the Kuwaiti council of ministers to purchase renewable energy produced by others , in light of the controls and procedures determined by the ministry in accordance with the legislation in force within the state of Crete .

The Amiri Decree No. 207/2023, which amended the Decree No. 57/2022, allows the purchase of electricity and water from others, as the decree stipulates in its first article that Clause No. 11 of Article Two of Decree No. 57/2022 referred to be replaced with the following clause: Purchasing energy and water from others, in light of the controls and procedures determined by the Ministry, in accordance with the legislation in force inside Kuwait. Having regulations in place will encourage citizens, namely small investors, to establish companies working on installing solar energy systems and related equipment, The MEW ministry is seeking to produce no less than 15 percent of the country's electrical consumption from renewable energy sources by 2030.

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Figure 1 Photoelectric Car sunshades for the Alzahra association

3. EXPERIMENTAL APPLICATIONS OF ENERGY EFFICIENCY AND PHOTO VOLTAIC SYSTEMS FOR THE ALZAHRA ASSOCIATION

This is the first leading flagship project in Renewable Energy of national relevance in Kuwait. It involved the application of state-of-the-art technologies at such a large-scale to demonstrate their potential as distributive generation and benefits to the State of Kuwait.

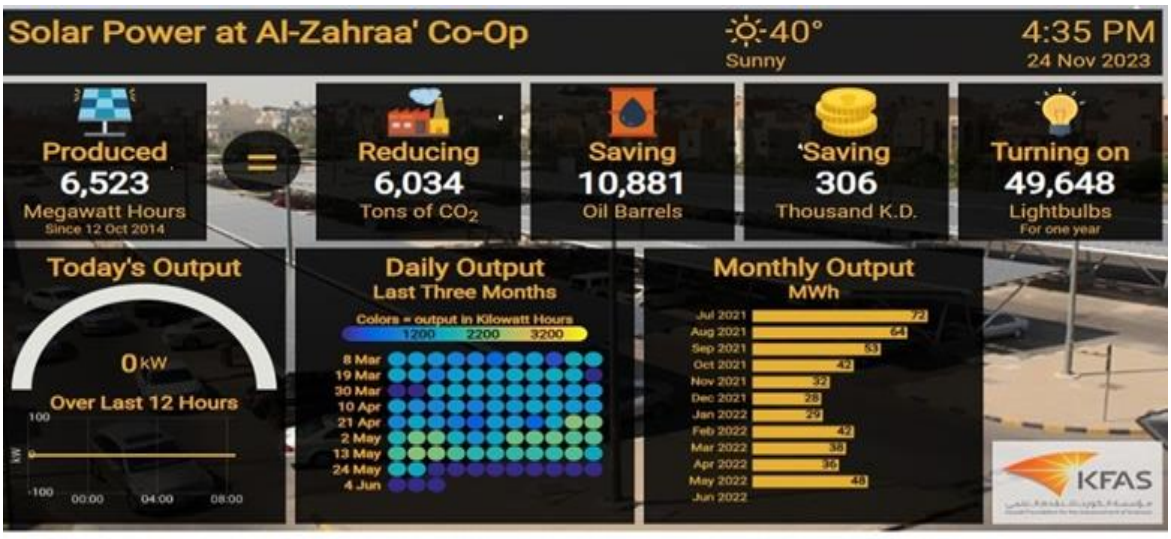

Fig.2. Savings in the production of photovoltaic energy in alzahra association.

Central markets are used by region residents , they are excellent platforms for a high-profile demonstration of sustainable energy systems and their benefits. The PV systems were designed in an optimal way to reach the highest levels of electrical power production for carport areas in co-operative societies (Al-Zahra) with a total capacity of 752kW_p, in addition to energy auditing and improving the efficiency of air-conditioning and lighting systems, which are deemed to be high energy consuming systems.

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Table.1: Type of photovoltaic units annual production of alzahra association.

Projest Type	Energy Photovoltaic type	Annual production (MWh)	instulation Area (m²)
Al-Zahra COOP	Thin Film	484	6300

The Alzahra carport project since it was established in 12 Oct 2014 it produced 6523 MW/hr which reducing 6034 tons of CO_2 saving 10881 oil barrels and saving 306 thousands K.D turning on 49648 light bulbs for one year.

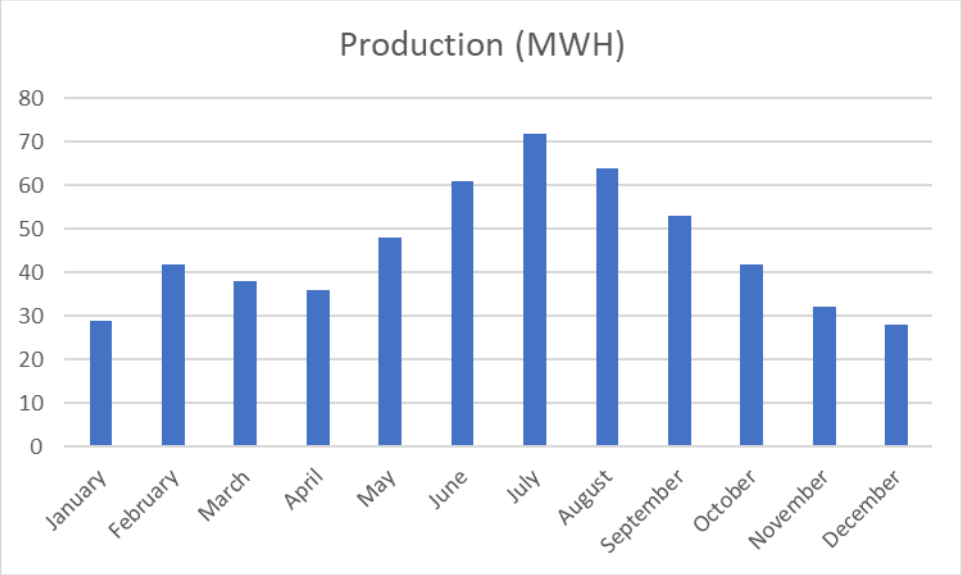

Fig.3. Monthly productivity (MWh) of electricity in Al-Zahra association parking lots shaded.

The technical specifications of the PV systems were designed by KISR, and commissioning was supervised by KISR as well. MEW took any important role of assuring that integrating the photovoltaic energy center with the association main electricity source. in accordance of international standards. The Association of Co-operative Societies played a big role in facilitating communications within the Coops.

Calculation reduced the carbon emissions by the equation below: -

$$C_t = E_t * C_f \qquad (1)$$

C_t = *the amont of Carbon mass*

E_t = *Energy productivity*

C_f = *productivity of Carbon mass from fuel*

While, the C_f for 1 kWh of electricity with petroleum gasoline is 0.924 kg/kWh.

referring to (Table.1) we must calculate (C.F. %) taking into account the average productivity output 545 MWh-per year. Like to the following:

$$C.F.\% = [\, E_a / (P*24*365)] * 100 \qquad (2)$$

E_a = *energy produced (kWh-year)*

P = *System panel power (kW)*

24,365 = *hours per year*

$$C.F.\% = [545\ M.\ Wh*1000\ /(365*24*752\ kW)]*100$$

$$= 8.27\ \%$$

, while the global average C.F.% is 20%!

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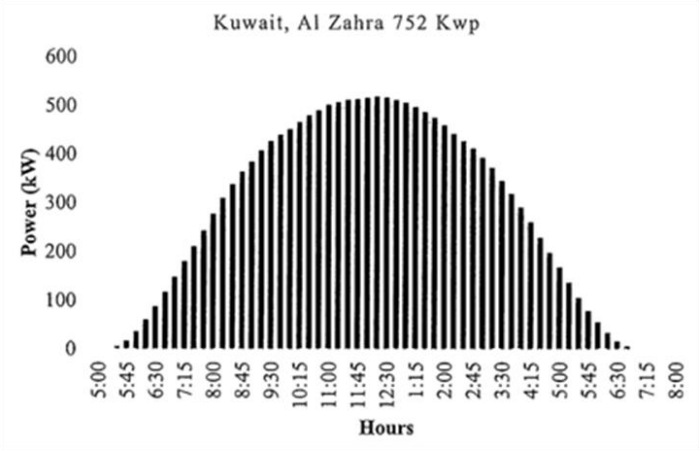

Figure 4. Output power for Al-Zahra Cooperative society solar project.

Figure 5. Transparent glass built-in photoelectric panel.

3.1 P.V. details of thin films

The evolution of the second generation of c-si moudels made by applying more than one layers of thin films materials over different elements such as glass, metal, plastics fewer semiconductors used in thin film in production. Changing the semiconductor elements position creates flux that make the electricity useful in the external circuit.

4. CONCLUSION

The integration of photovoltaic cells in lighting the parking lots of the Al-Zahraa Association represents a forward-thinking approach to immediate energy management and sustainability. By harnessing solar energy, the Association can illuminate its facilities responsibly, reduce its environmental footprint, and inspire positive change within the community. This initiative exemplifies the potential of renewable energy technologies to drive meaningful progress towards a more sustainable future.

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