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RESEARCH ARTICLE

IMPROVING A ROADMAP TO EASE CLIMATE CHANGE VIA PHOTOVOLTAIC SOLAR ENERGY EXPLOITATION ENERGY SYSTEMS: A SOURCE SUSTAINABLE ALTERNATIVE TO FOSSIL FUEL

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ABSTRACT

Most countries in the world are moving towards enhancing solar energy in the current era, given the anticipated perspective of the role of photovoltaic energy in green hydrogen energy, as it is the considerable prominent energy source capable of employing green hydrogen energy and achieving sustainability in the next three decades. Hence, in this work, we have emphasized the capabilities of Middle Eastern countries, with stress on furnishing solutions such as proposing a photovoltaic system grid-connected (Produced Energy 1997(MWh/year), Used Energy (44 MWh/year), Specific production (1681 kWh/kWp/year), Performance. Ratio PR(80.37%) Solar Fraction SF (63.27 %))that can be adapted to meet the need in Iraq, in addition to testing the system's lifetime in Yemen, Iran, Saudi Arabia, Syria, and Lebanon from 5 to 60, where changes in the system's lifetime show that photovoltaic energy contributes effectively to reducing carbon dioxide emissions as well as the system's ability to reduce the phenomenon of global warming. Furthermore, grid-connecting the solar system to the central grid can minimize dependency on fossil fuels, consequently enhancing the energy sector in several Arab nations such as Palestine and Syria.

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INTRODUCTION

The efforts to mitigate carbon emissions have gained decisive momentum in establishing a safe and sustainable environment, as the effects of carbon dioxide greatly affect global warming. Hence the emphasis must be on diminishing (1). In light of the challenges encountered by the world regarding climate change, which is one of the myriad prominent environmental issues meeting the entire world, and its consequences on biodiversity and society, etc. (2),(3)(4),(5),(6),(7),(8),(9)(10).Hence. The world's compass is shifting towards renewable energy sources to enhance the environment and reduce the effects of fossil energy sources. The Paris Agreement reached at the Conference of the Parties in December 2015 enabled the direction of global cooperation in addressing climate change (11). However, reliance on fossil fuels must be diminished, and usage must be mitigated or eliminated. Nevertheless, utilizing diverse energy sources such as solar PV, hydropower, biomass, wind, solar, etc. (12). As well as the increasing demand for fossil energy sources has led to an exacerbation of greenhouse gas emissions, which contribute to climate change and drive it as a global concern, The Intergovernmental Panel on Climate Change foresees that in 2023, greenhouse gas emissions will increase by 130% due to a 70% growth in energy demand by 2050, Integrating renewable resources as an alternative energy source into the energy mix has the potential to deliver eco-benefits and economically simultaneously(13),(14)
Furthermore, the usage of renewable energy sources for electricity generation has grown increasingly vital in recent years (15). Renewable energy can become significantly affordable with improved technology and modernized infrastructure. However, the principal sources of renewable energy are as showing in Figure (1) (16).

Solar energy is one of the most stand-out renewable energy sources and an alternative to fossil fuels in this era and the next three decades. Consequently, a promising and freely available energy source to manage long-term issues in energy crises (17),(18),(19),(20),(21). Plus, the eminent feature that distinguishes solar is that they are inexhaustible (22). According to the International Energy Agency's report from 2023, solar energy is among the rapidly expanding segments of the global renewable energy market, in 2022, the installed capacity surged to a record of 243 gigawatts, enabling the cumulative capacity of solar power plants to exceed 1 terawatt. Consequently, its proportion of electricity produced by 2023 rose from 5 to 6.2%, emphasizing the

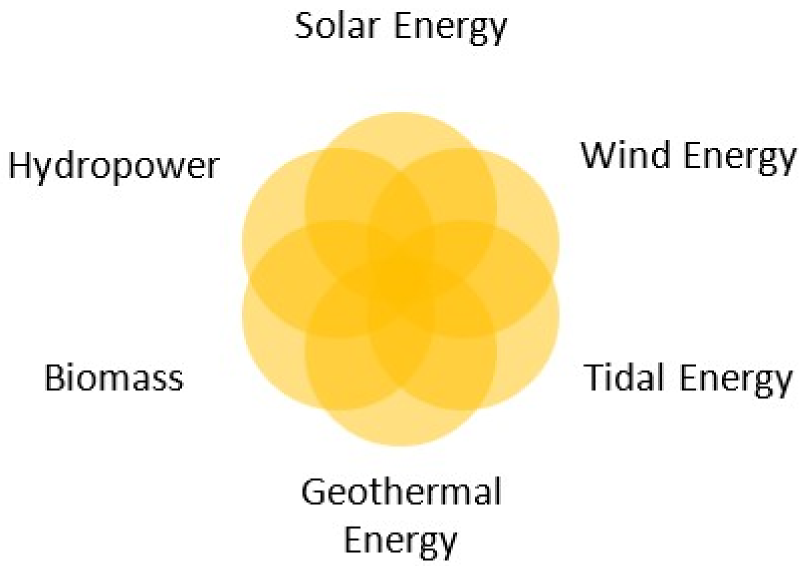


Fig .1. Illustrates the main energy sources of renewable energy.

significant impact of solar energy and its usage in power generation (23),(24). Besides, Solar energy is anticipated to generate nearly 25% of the world's total electricity needs by 2050(25).

A Foresight Thematic of Photovoltaic to Enhance Climate Change: Photovoltaic energy is the future hope that shapes environmental sustainability all over the world. Hence, as it continues to make significant and extensive progress in the field of energy, the "Redrawn Map" (IRENA) and "Sustainable Development Scenario" (WEO) project significant PV growth, with terawatts of capacity anticipated by 2040 and 2050 due to updated projections (26). In addition, energy that relies on renewable sources such as solar photovoltaic energy is the only solution to reduce the levels of greenhouse gas emissions (27). It is characterized by easy to implement, PV is the most advanced technology and system in usage (28),(29). As well as Solar PV is a clean and eco-friendly source (30). And PV is now cheaper, more efficient, and easy to deploy, with lower installation costs (31),(32). The promotion of strategies for enhancing solar photovoltaic energy systems in countries that focus on their net dependence on fossil energy sources must change and chart the path to improve alternative green energy sources represented by green hydrogen energy, as sectors must be enriched sustainable solar energy sources in preparation for the year 2040 and 2050 to use green fuels that depend on solar photovoltaic energy sources and wind energy, etc., as solar photovoltaic energy sources can be the active factor in enhancing environmental and energy sustainability. Moreover, a sustainable future requires analyzing and understanding the impact of climate change on energy production and enhancement, as solar photovoltaic energy sources are prominent sources in addressing climate change (33),(34),(35). One of the global goals for reducing emissions requires an increase in solar photovoltaic energy production in order to achieve the main goals of enhancing the reduction of carbon emissions in 2050(36),(37),(38).

The span of PV systems in the future: Global energy demand has risen due to population growth, economic advances, industrial production, and technology (39). The dependability and lifetime of solar systems are receiving increasing attention (40),(41),(42). Enhancing grid-connected photovoltaic systems enhances the reduction of harmful emissions, via knowing the lifetime through the PVSyst program, we provide a complete understanding of how solar photovoltaic systems can be the future energy era through which the increased installation of photovoltaic systems will accelerate the space in fossil fuel sources Solar photovoltaic systems have achieved grid parity targets in many countries and several targets have been set to achieve 100% renewable energy systems by 2050(43). integration of photovoltaic systems with the grid enables solving the problem of energy blackouts enhancing the energy sector(44)

Identify hurdles in PV solar system: We will elucidate the hurdles facing solar energy according to the vision we relied on for researchers. However, we stress that researchers should develop it in future studies to enhance solar energy in future

Evaluate Middle East avenues for solar energy opportunities: There is considerable potential in the Middle East region for electricity generation through the use of renewable energy, notably solar (78). Expanding renewable energy technology further reduces reliance on fossil fuels, assists climate targets enhances energy security, and promotes economic growth and job creation, according to the World Bank and As well as efficient storage is critical for the dependability of solar and wind energy, Green hydrogen provides a possible large-scale solution through the electrolysis of water using renewable energy(79),(80),(81),(82),(83),(84).However, Solar PV systems are the cornerstone for the future of renewable energy since they are significantly less costly(85). Meanwhile, the ongoing efforts to solve the challenges of photovoltaic energy have solved about

60% of the troubles. According to the insights, the public sees PV infrastructure more positively than fossil fuel infrastructure. Furthermore, solar energy has a higher level of social and political acceptance, as well as public preference, than other sources of renewable energy, and we discovered that people consistently identify solar energy with positive imagery (86),(87),(88),(89).

Table .1. The hurdles in solar PV

The hurdles	Ref
High investment costs hinder the profitability of solar projects, making investors hesitant to invest, and negatively impacting clean energy production.	(45)(46)
Fluctuations in weather conditions create concerns about the reliability of photovoltaic energy sources.	(47)(48)
ongoing Issues of low efficiency in solar PV cells	(49)
PV solar power facilities have considerable environmental implications, involving land usage, greenhouse gas emissions (GHG), water use, toxic materials, visual impact.	(50)(51)
Numerous elements have a favorable influence on a PV system, (solar panel temperature, humidity, wind speed, amount of light, altitude, and barometric pressure).	(52)
The solar photovoltaic sector relies greatly on sun radiation dispersion and intensity. plus, a trouble in maintaining a balance between intermittent energy output and dynamic power demand.	(53)(54)(55)
The consequences on biodiversity and ecosystems, climate change, resource consumption, and disposal of huge, end-of-life PV panels.	(56)
Financial restrictions with fees for solar panels, inverters, and energy storage devices, etc.,	(57)(58)
Relying on sources of conventional fuels such coal, oil, and natural gas.	(59)(60)
The role of energy security	(61)
Geopolitical Situation The worldwide transition to renewable energy is expected to result in geopolitical and strategic rearrangement, with new winners and losers arising.	(62)(63)(64)(65)(66)
Problems due to photovoltaic waste, transportation damage, manufacturing defects, deterioration of some components, and new replacement of old ones by users	(67)(68)(69)(70)(71)(72)(73)
The need for energy storage systems due to Balancing the energy supply and demand and Enhance the overall efficiency of a power plant consequently reducing the operating cost in the long run, the flexibility of ESSs provides the convenience and suitability to cover remote areas which generally suffer from a lack of electricity.	(74)(75)(76)(77)

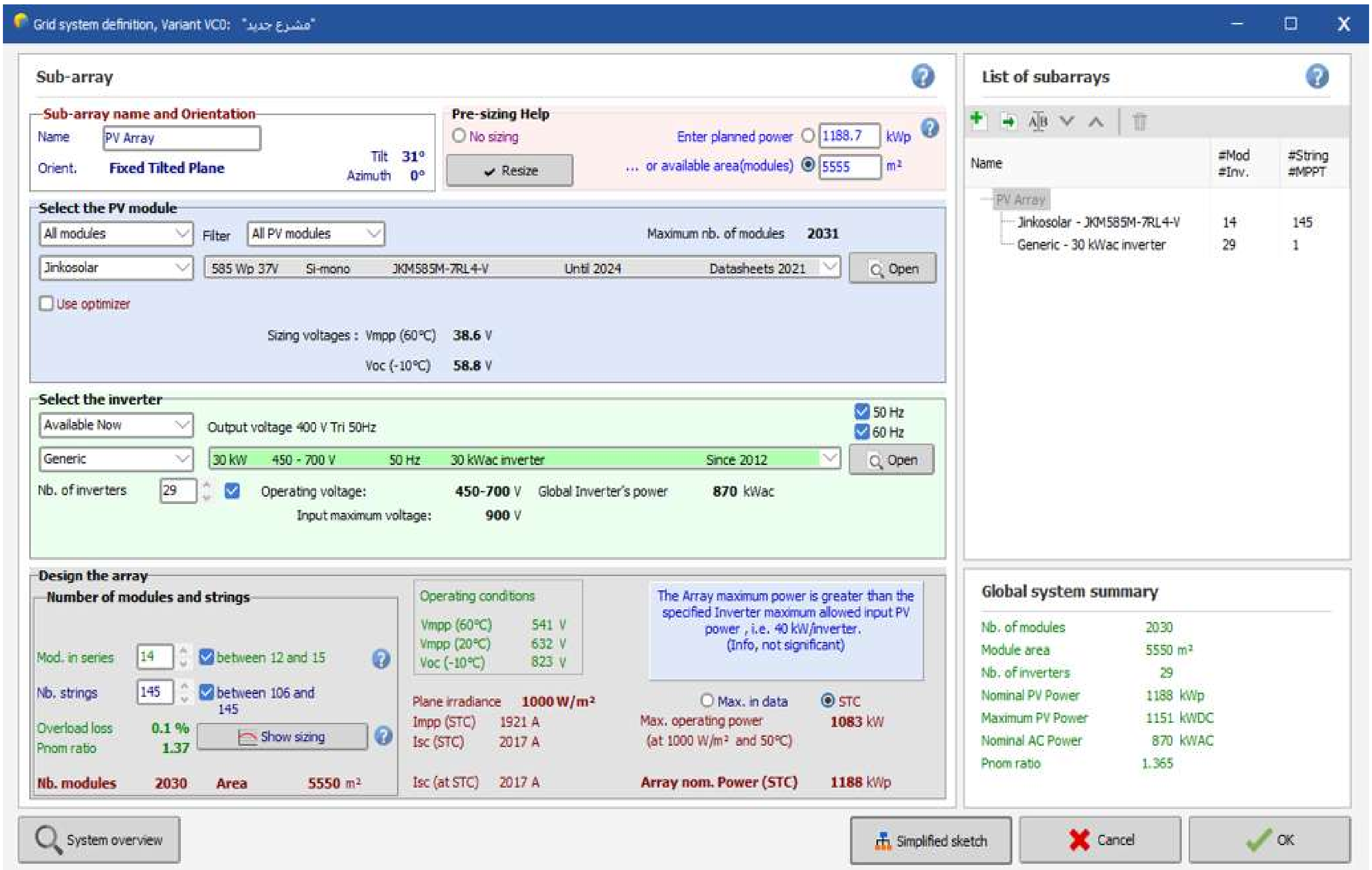
Nowadays this is one of the continuing solutions to enhance energy security and geopolitical importance. On the other hand, solar photovoltaic and other renewable energy sources assist in diminishing dependence on fossil fuels and emissions (90),(91). With the requirements in the energy sector, solar energy is the sustainable path towards the future (92) Regardless of its specifications and features, as mentioned by researchers, it is the bridge to future energy sources, such as green hydrogen energy (93) which depends largely on solar energy sources in production. Solar energy is an effective option in Iran due to the abundance (94) Saudi Arabia is moving towards solar energy in a big way(95)Iraq's move towards sustainable energy(96) In Syria, solar energy has proven its effective role in the energy sector despite the challenges it faces(97).In addition to providing innovative energy solutions and enhancing sustainability(98) in Lebanon, solar photovoltaic panels have arisen as an attractive solution. Besides, utilizing, Suitable for smart grid networks, Tailored for small-scale applications, and Ideal for standalone rooftop PV power systems. (99),(100),(101). In Yemen has a significant potential for solar energy sources (102) And has grown its capacity by 50 times and has lately become the principal source of power for the majority of Yemenis (103) solar energy provides solutions to enhance sustainability in Yemen (104),(105). In the United Arab Emirates, there is a broad horizon in solar energy (106). plus, it aspires to reduce climate change by switching to sustainable energy sources, mitigating the environmental impacts of energy production from unsustainable sources, and diminishing its carbon footprint (107),(108). Jordan was one of the first Middle Eastern countries to adopt PV solar as a potential energy source, and it is particularly important in the renewable energy industry (109),(110),(111). statistics about solar radiation reveal that Jordan's potential for generating renewable energy may be economically viable renewable energy sources play a useful role in providing safe, clean, and sustainable energy levels for Jordan in the twenty-first century (112).(113),(114). Oman has abundant solar energy due to its advantageous location along the Arabian Peninsula's coast (114)as well as government launched Sahim to encourage solar energy use via rooftop systems and financial incentives (116),(117),(118). Furthermore, it has the potential to be an enormous producer of solar energy and has 320 sunny days per year with great intensity (119),(120),(121). Kuwait possesses a substantial potential for solar energy (122). Finding a sustainable route to decarbonization via clean energy is crucial in Qatar, where the potential of solar energy has been the subject of several studies since the 1980s (123),(124),(125). Bahrain plans to reduce emissions by 30% by 2035 and achieve net zero emissions by 2060, due to its availability of solar and other renewable energy sources (126),(127). In the bargain, the renewable energy sector has witnessed 74% adoption of solar technology in the bargain (128). Palestine has potential solar energy, receiving around 3,000 sunshine hours and high radiation levels, Solar panels can help solve energy problems in Palestinian Bedouin communities under complete Israeli control. (129),(130).(131). As well Palestine's annual average solar energy ranges from 5.4 to 6 kWh/m2, peaking at 8.4 kWh/m2 in June and dropping to 2.6 kWh/m2 in December (132), (133), (134). In September 2020, At the 75th session of the United Nations General Assembly, Xi Jinping pledged to peak China's CO_2 emissions by 2030 and achieve carbon neutrality by 2060, This indicates China's strong commitment to addressing climate change, According to The Special Report on Global Warming of 1.5°C (135),(136). Egypt has set a target of achieving 20% of total capacity from renewable energy by 2022 and 42% by 2035(137). Too-too, sunlight's potential makes it ideal for solar energy generation (138) Besides, is located in the world's solar belt (139) Egypt's inspiration for sustainable development could be a key catalyst in boosting the energy sector in sustainability (140),(141). In Tunisia has promising signs in solar energy (142)and strategy of promoting solar energy is still in place in Tunisia (143). Further, Tunisia is well-endowed with significant solar and other renewable source potential, a considerable feasible alternative for green transformation (144),(145),(146). Morocco has enormous potential in sustainable solar and wind and it is positioned as the continent's African leader in renewable energy, It is even becoming a more pursued role on the global scene(147),(148).And harnesses its geography for solar energy, benefiting from an 80% decline in photovoltaic module prices(149),(150),(151). Libya seeks to reduce its reliance on oil and lean on alternatives such as solar energy (152). Due to its rich in solar energy (153). As well as asset in mitigating emissions and fossil fuel usage (154). Algeria's solar energy meets future generations' needs and has one of the highest solar potentials in the world (155),(156) And solar capacity is crucial among the Mediterranean's most significant energy resources in Algeria (157). In summary, solar energy is a one of reliable source of clean energy for the future apart from becoming the direction of energy transformation of emerging economies, Vast opportunities exist in rural areas of Asia enabling them to exploit it. (158),(159),(160). it is one of the considerable advantageous squeaky-clean energy sources, which enhances nations' economic, social, and environmental growth by substituting traditional energy sources (161),(162)(163). (i.e., considered an alternative to fossil sources for sustainable) (164).

METHODOLOGY

In this work, a proposed system was designed by PVsys software with the system lifetime analysis for 5 to 60, This work involved the prominent dimensions that photovoltaic energy sources play in the coming decades and how they can reduce the carbon footprint and achieve decarbonized reduction with the analysis of the standards of the systems.

Simulation and discussion

The proposed solar photovoltaic system represents one of the solutions in Iraq to enhance the energy sector and reduce reliance on fossil fuel sources, as it was designed according to the PVsys software and is (Max. operating power 1083kw at 1000w/m2 and 50c°) in addition to (module area 5500m2) Number of inverter 29 and number of module (2030) as well as to overload loss 0.1% where PV module 585 was estimated to another Figure (2) shows the segments of the system according to the parameters of the fixed standards.



Figures (4,5)showing the mechanism of PV Module model optimization for each curves irradiance(V) I, I(v) curves temperature, PV/curves and Efficiency vs irradiance, where type of module is Jinko solar consequently, a detailed analysis of the PV module is shown in the four cases according to the criteria of the PVsyst software, where the criteria clearly show the performance nature of the module based on the basic parameters that were specified for the system. Figure (6) illustrates the external environmental conditions that may affect the nature of the photovoltaic system, where the rate is (800W/m2 Irradiation), Beam/Global ratio(80%), Ambient Temperature (20C°) , wind Velocity (1.0m/s) , includence Angle(40°) the standards shown in the curves show the nature of the performance of the connected photovoltaic system and its effectiveness with the external climatic conditions according to the parameters of the PVsys program.

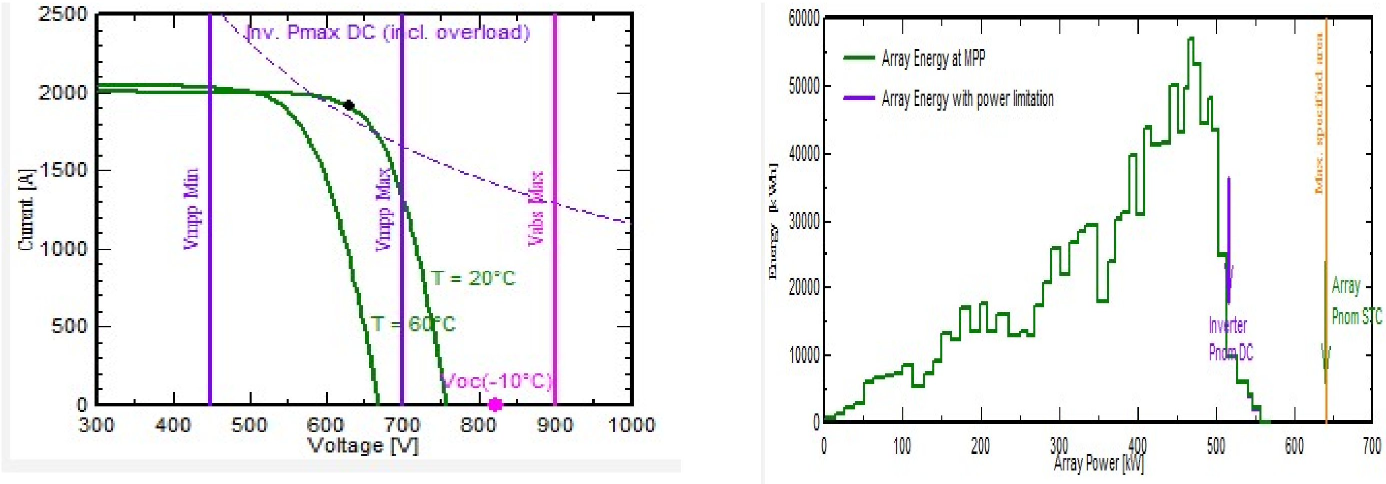


Fig. 3. Array voltage sizing and Power sizing: Inverter output distribution

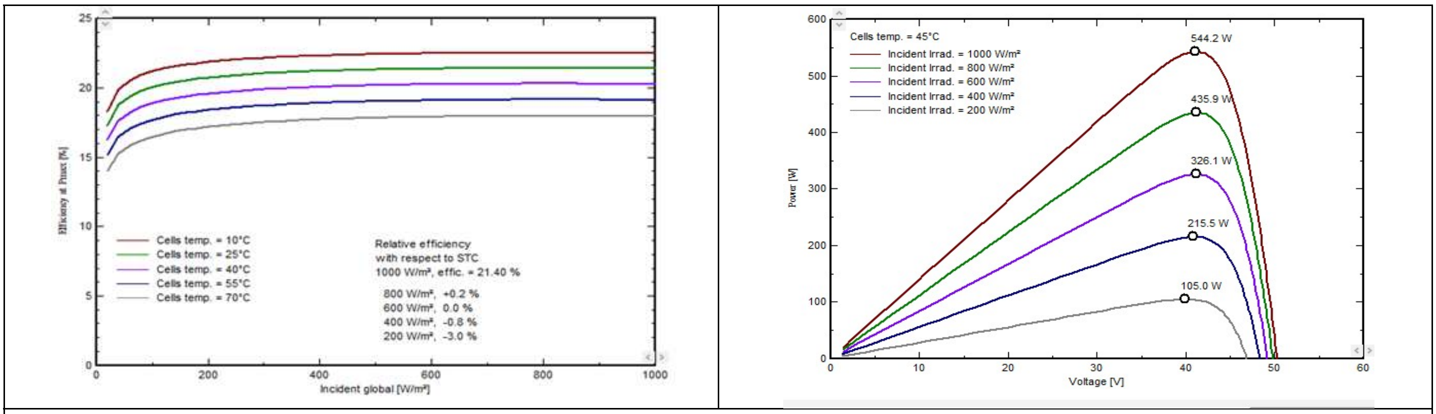


Fig. 4. Efficiently vs irradiance and PV/curves

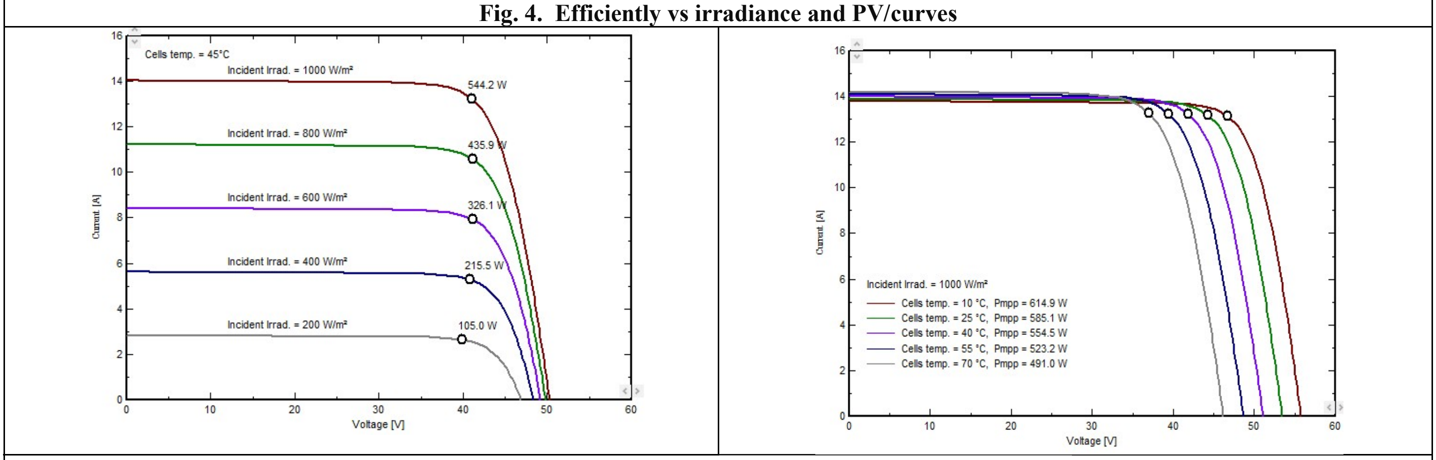


Fig.5. I(V) curves irradiance and I(V) curves temperature and

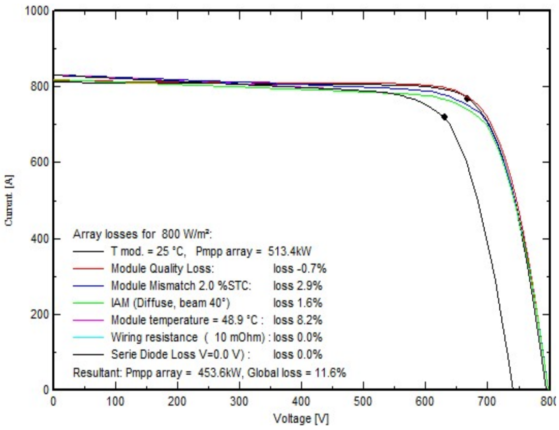


Fig.6.PV array behavior for each loss effect

Table.2. The main general parameters for the system

Geographical Site	
Kaţbīyah	Iraq
Situation	
Latitude	33.90∘N
Longitude	42.83∘E
Altitude	125m
Time zone	UTC+
Tilt /Azimuth	31/∘0

In Table (2)The grid-connected photovoltaic system standards are illustrated, as the project was set in Iraq for the main purpose of enhancing the energy sector, where an inclination angle was relied upon according to the orientation of the Fixed titled plane type), where the inclination angle of 31and azimuth 0(plane tilt) was adopted because it provides me with low loss rates.

Table .3. Array losses

Thermal Loss factor							
Module temperature according to irradiance							
Uc (const)	20.0 0.0 W/m²K						
Uv (wind)	0.0 W/m²K/m/s						
Module mismatch losses							
Loss Fraction	2.0 % at MPP						
Strings Mismatch loss	Loss Fraction 0.1 %						
Module Quality Loss							
Loss Fraction	-0.80%						
IAM loss factor							
0°	30°	50°	60°	70°	80°	85°	90°
1000	0.999	0.987	0.962	0.816	0.681	0.44	0

In Figure (7) we designed a grid-integrated system where a lifetime rate of 5 to 60 was tested, and it became clear that the higher the lifetime, the higher the carbon dioxide conservation rate, this indicates that photovoltaic energy systems contribute clearly to reducing carbon emissions in Iran and Saudi Arabia. Consequently, enhancing photovoltaic energy systems in Iran and Saudi Arabia will provide a rich, largescale sustainable environment in the next three decades.

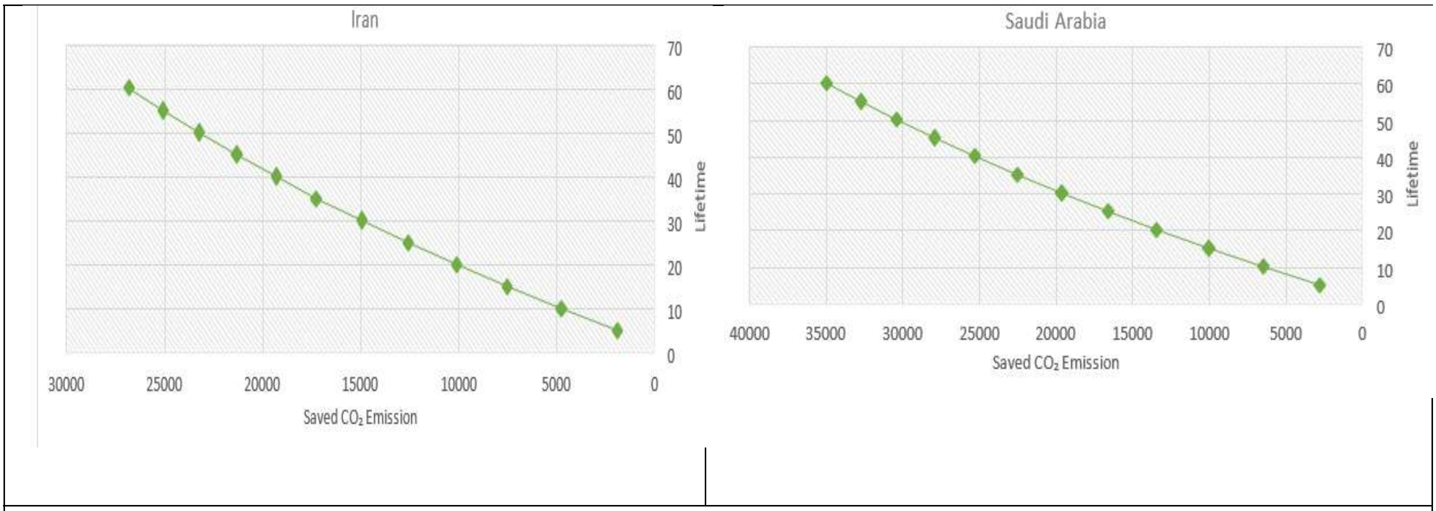


Fig.7. Balance rate Saved CO_2 Emission vs. Lifetime in Saudi Arabia and Iran

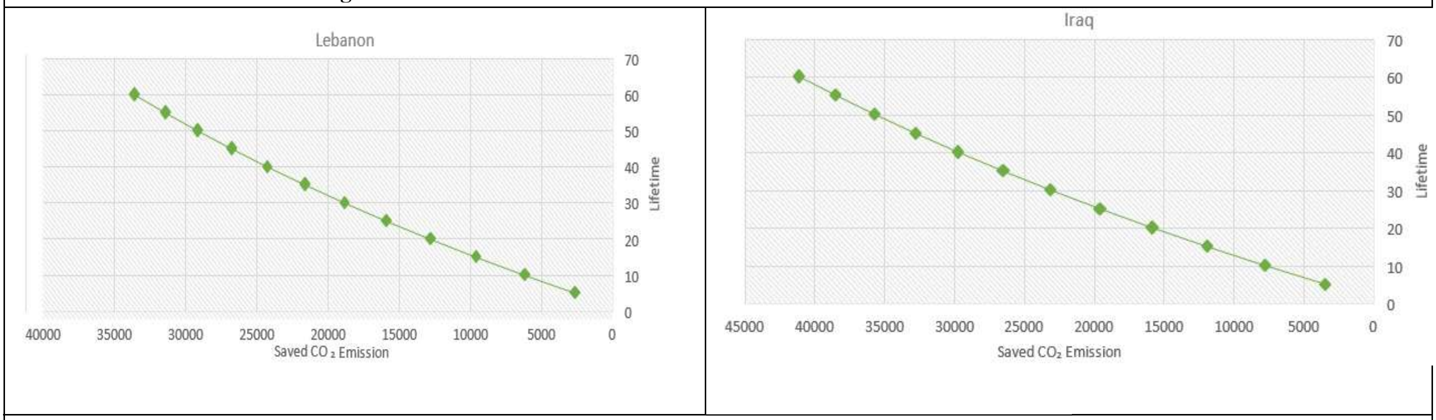


Fig.8. Fig.8. Balance rate Saved CO_2 Emission vs. Lifetime in Lebanon and Iraq

In Figure (18) we designed a grid-integrated system where a lifetime rate of 5 to 60 was tested, and it became clear that the higher the lifetime, the higher the carbon dioxide conservation rate. This indicates that photovoltaic energy systems contribute clearly to reducing carbon emissions in Iraq and Lebanon. Consequently, enhancing photovoltaic energy systems in Iraq and Lebanon will provide a rich, large-scale sustainable environment in the next three decades. In Figure (9) we designed a grid-integrated system where a lifetime rate of 5 to 60 was tested, and it became clear that the higher the lifetime, the higher the carbon dioxide conservation rate. This indicates that photovoltaic energy systems contribute clearly to reducing carbon emissions in Syria and Yemen. Consequently, enhancing photovoltaic energy systems in Syria and Yemen will provide a rich, large-scale sustainable environment in the next three decades.

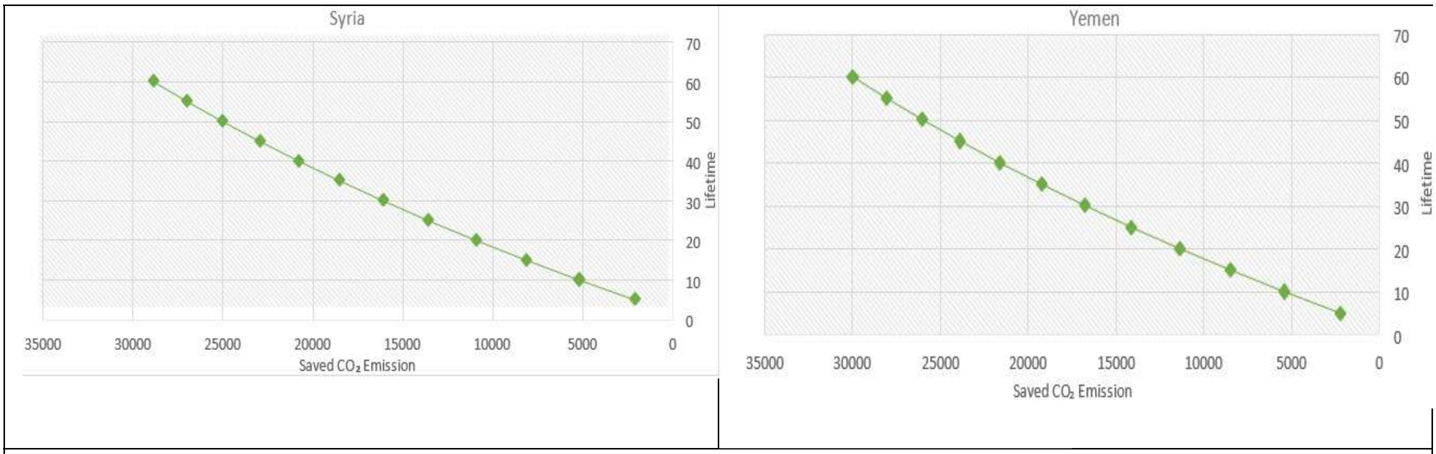


Fig.9. Balance rate Saved CO_2 Emission vs. Lifetime in Syria and Yemen

CONCLUSION

The significance of solar energy is countless and its widespread exploitation may contribute to creating a bright world, This study shows the potential of Arab countries and some Asian countries such as China, and Iran as it shows that the potential of Arab countries in achieving sustainability plans and ease reliance on fossil energy sources, I.e. (oil, gas, etc.) has eminent and promising prospects in numerous countries to evolve pioneers in achieving the Paris Agreement in addition to achieving environmental sustainability in 2050 and 2060. Despite the potential of most Arab countries and their orientation towards solar energy in the coming decades, some aspects must be focused on this study too showed that despite the potential of countries, there are countries that are lagging in employing solar photovoltaic energy such as Palestine, Iraq, Syria, and Lebanon, and that the appropriate and effective solutions in these countries are to use connected photovoltaic energy systems, as we illustrated in this work. Eventually among the keys that he showed in this work is that enhancing solar energy via solar photovoltaic systems can assist in identifying the main impediments facing solar energy.

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