

Performance Evaluation of PV Solar Energy Systems using Mono and Polycrystalline Metal Structures,- Geographic Region Climate Model

Mahmood A. Mohammed, Mohammed Z. Hasan, Mohammed Salam Taha



Abstract: This paper presents a comparison study between two different PV system technologies. The first PV system is based on single crystalline silicon (Hemo 06) and (with 12 bus bars). The second system is based on multi-crystalline silicon, which is installed and oriented in the same direction and fixed at the same angle as single-crystalline silicon. The study was conducted in Iraq, specifically in the city of Kirkuk. All seasons were taken into consideration, and data were recorded over a full year (from March 2024 to March 2025). In addition to the orientation of the solar panels, ambient temperature measurements were also considered, reaching approximately 48°C. The results show that the monocrystalline silicon system outperforms the polycrystalline system in terms of performance and reliability, with a performance improvement of up to 12.3%, especially in the spring and fall seasons. This is due to the superior material quality and the influence of temperature and lighting hours.

Keywords: PV Modelling, PV Parameter, Parameter Extraction, PV Tracking System, PV System Performance.

Abbreviations:

PV: Solar photovoltaic
FWA: Fireworks Algorithm
ABC: Artificial Honeybee Algorithm
NMS: Nelder-Mead Method
BIPV: Building-Integrated Photo Voltaics

I. INTRODUCTION

Solar photovoltaic (PV) is the fastest-growing renewable energy technology in terms of installed capacity globally. Given the diverse availability of PV technologies, a reliable and long-term evaluation of these technologies under actual operating conditions will be critical to their continued development and deployment [1]. These reasons motivated researchers to develop methods for accurately harvesting the power extracted from PV systems. PV parameter estimation is a vital link to the accuracy of the power collected from the

PV system. Additionally, the internal PV parameter was directly related to PV system performance [2]. Among these efforts was a study in which a three-parameter photovoltaic model was developed for operating under tropical climatic conditions, using the Malaysian climate as a test case. The global model demonstrated variability among Pacific islands and accuracy based on real data. The medium wave effects were reduced to 65.8%, while the inverter effect reached 97.58%. The model was validated with original models and previous models, making it a valuable reference for grid-based solar model applications in geopolitics [3]. As a result, these parameters are immensely affected by the surrounding weather conditions. Recently, several researchers have focused on extracting PV parameters, which are based on the number of PV parameters [4]. Among recent approaches, the Fireworks Algorithm (FWA) has demonstrated high efficiency in processing the dual diode model, which is less common due to the difficulty in extracting its parameters. FWA has proven its effectiveness with accurate results when tested on three different panel types, leaving behind traditional algorithms such as PSO and GA, making it a promising option in this field [5]. In this context, a new hybrid algorithm, known as EHA-NMS, was developed to improve the speed and accuracy of parameterising solar cell models by combining the artificial honeybee algorithm (ABC) and the Nelder-Mead method (NMS). Test results proved its superior efficiency and reliability, making it suitable for emergency applications in embedded systems. [6]. In another study, researchers examined various types of silicon solar cells with efficiencies exceeding 25%. They investigated integration methods, such as building-integrated photovoltaics (BIPV) and floating panels, to optimise space use and increase energy production. They also provided a comprehensive review of cell structures and methods for maintaining their efficiency in real-world environments, and discussed challenges related to system integration and future development prospects [7]. Additionally, [8] they studied the effect of the Dakar coast's sun on the tilt of two panels (mono- and polycrystalline) after ten years of operation. The energy reductions were -5.35% and -2.92%, respectively. They also considered climate damage, excluding defects in the mono- and polycrystalline panels, which had no significant impact on performance. In the current study, a mathematical model of PV parameters based on two different PV metal structures were proposed and tested. A

Manuscript received on 04 June 2025 | First Revised Manuscript received on 26 June 2025 | Second Revised Manuscript received on 17 October 2025 | Manuscript Accepted on 15 November 2025 | Manuscript published on 30 November 2025.

* Correspondence Author(s)

Mahmood A. Mohammed*, Department of Mechanical Techniques, Northern Technical University, Technical Institute, Kirkuk, Iraq. Email ID: mahmoodaif88@ntu.edu.iq, ORCID ID: 0000-0002-7070-9432

Mohammed Z. Hasan, Northern Technical University, College of Oil & Gas Techniques Engineering, Kirkuk, Iraq. Email ID: mohamop49@ntu.edu.iq

Mohammed Salam Taha, Department of Mechanical Techniques, Northern Technical University, Technical Institute, Kirkuk, Iraq. Email ID: mohammedsalam@ntu.edu.iq

© The Authors. Published by Lattice Science Publication (LSP). This is an open access article under the CC-BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>)

Performance Evaluation of PV Solar Energy Systems using Mono and Polycrystalline Metal Structures,- Geographic Region Climate Model

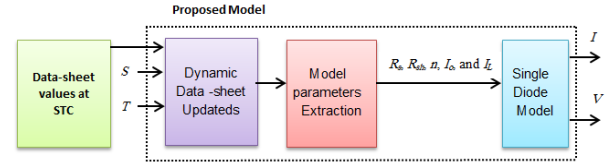
performance model based on irradiance and temperature levels, and their effects on PV parameters for both single-crystalline and multi-crystalline silicon, is presented. Then, a scheduled comparison of PV parameters was performed for Kirkuk city, Iraq.

II. PROPOSED MODEL

The accuracy of the PV model is the primary objective of any study, particularly those related to PV system modelling and characterisation. Furthermore, any model should be implemented and experienced based on a specific real case. Likewise, the current study presents a fair comparison of the implemented model's performance based on two different PV fabricated metals: single-crystalline and multi-crystalline silicon. Then, a scheduled comparison of PV parameters was performed for Kirkuk city, Iraq.

In the design of the external shape of solar collectors, using different geometric forms, such as rhombuses, may be a new idea. Additionally, studies can be conducted in March and May to achieve a performance efficiency of up to 59% [9]. One method of increasing performance is to concentrate the solar radiation reaching the system and collect it by focusing it at a specific point. In this method, the part that collects the rays is fixed at a distance of 3 meters, and the system's performance increases significantly at solar radiation values of 700 W/m² and above [10]. On the other hand, the solar collector can be improved by adding intermediate heat exchangers using different fluids to the system. In this case, when the flow rate of the auxiliary systems is adjusted to 1 litre per minute and for a 15-hour operating period, the performance efficiency of the system can increase by up to 64% [11]. Mathematical modelling is an effective method for examining the performance of double-surface photovoltaic thermal collectors equipped with mirrored reflectors, where a fluid such as air can be used for cooling purposes. Such collectors feature a V-shaped channel structure to capture solar rays more effectively. The performance of the collector is analysed using the first and second laws of thermodynamics [12]. Studies have shown that photovoltaic thermal collectors can operate with an efficiency of up to 57% at mass flow rates between 0.02 and 0.08 kg/s and under solar radiation of 863 W/m² [13]. Double-sided collectors offer an efficiency of up to 70% higher compared to single-sided collectors, which have an efficiency of 50% [14]. Today, it is possible to use hybrid solar collectors that generate both heat and electricity. In these systems, specialised models have been developed for cooling photovoltaic cells, and heat transfer fluids are utilised. Using nanofluids, the efficiency of photovoltaic cells can be increased while simultaneously generating heat energy [15]. Integrating photovoltaic and thermal energy technologies provides a significant increase in overall efficiency compared to using these two systems separately. This study presents a modern and innovative approach to the increasing importance of solar energy and its role as a clean, renewable energy source. It also highlights key factors, such as cell temperature and heat transfer mechanisms, to increase the efficiency and thermal performance of systems [16]. To avoid such difficulties, the proposed model presents a vibrant data sheet that can be

updated at each set of weather condition values. The block diagram of the proposed model is presented in Figure 1. Furthermore, the proposed model offers an offline parameter estimation, which steps beyond the conventional structure to enhance feasibility and parameter accuracy.



[Fig.1. The Block Diagram of the Proposed Model and Process]

Based on the information mentioned above, continuously updating the data sheet provides a fast and accurate method for extracting the exact values of PV parameters. Both proposed PV systems, Monocrystalline silicon and Multicrystalline silicon, are presented in Figures 2a and 3 b, below, respectively.



[Fig.2. a. Monocrystalline Silicon PV System]



[Fig.2. b. Multi-Crystalline Silicon PV System]

III. RESULTS AND DISCUSSION

The implemented study employed two types of PV modules as a case study: KC85GT and SQ165PC, both of which were used to confirm the feasibility of the used model and its accuracy. The selected two PV modules have been chosen due to their manufacturer providing many tested I - V curves with different temperatures and irradiation levels. Additionally, it is utilised in numerous other research studies addressing the PV modelling issue, which contributes to increasing its reliability. Extracted PV parameters based on the PV module datasheet parameters presented in Table 1. The proposed model exhibits several features compared to the conventional one. In the



traditional method, specifically at the open-circuit voltage (V_{oc}) point, determining the tangential line is challenging, depending on the values provided in the datasheet. Therefore, extracted PV parameters will not be exact, and the range of error will be wider. At the same time, the proposed model recorded better values and a lower error percentage, as presented in the Figures. (4-6). On the other hand, the diode ideality factor cannot be determined exactly using the conventional method, as it ranges between 1 and 2. In the case of implementing the proposed model, it will provide the exact value or, at the very least, a close approximation to the actual value. The remaining PV parameters, R_s , R_{sh} , I_L , and I_o , can be estimated using both the conventional and proposed methods. However, the proposed method provided lower error levels, as recorded and shown in the Figures. (4,5), respectively. This applied to the I-V and P-V curves, as they

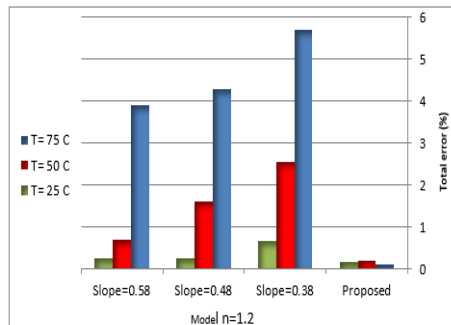
were plotted at different levels of irradiance and temperature profiles. For a realistic comparison, the curves produced in both cases — conventional and proposed models — should be compared based on the error in the P-V curve, as defined by the following equation (IEC EN 50530).

$$\text{Total Err}_p = \frac{1}{V_{oc}} \int \left| \frac{P_{model}(v) - P_{datasheet}(v)}{P_{datasheet}(v)} \right| dv \quad \dots (1)$$

Equation (1) is used to evaluate the global accuracy of the proposed PV parameters and the presented model, comparing it to data collected by the manufacturer (as per the datasheet) for the selected PV modules. The results of the compared accuracy (error value) for both monocrystalline silicon and multicrystalline silicon are presented in the Figures. (4-6), respectively.

Table-I. Data Sheet Value of PV Modules

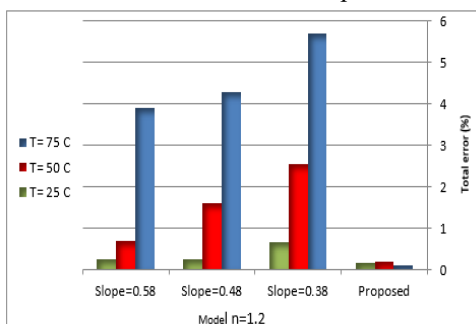
	I_{sc}	V_{oc}	I_{mp}	V_{mp}	P_{mp}	N_{ss}	$K_i(A/^{\circ}C)$	$K_v(mV/^{\circ}C)$
Jinko Solar Mono crystalline	9.98	43.71	8.76	37.41	340	72	$1.57 * 10^{-3}$	-82.3
Longi Multi crystalline	10.22	42	8.89	36	320	72	$2.58 * 10^{-3}$	-124



[Fig.3. a. Accuracy of Proposed Model Solar Monocrystalline Modules (a) Effect on Diode Ideality Factor]

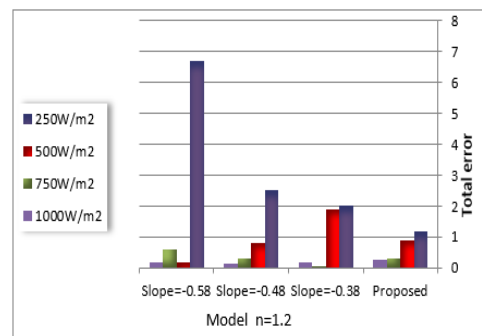
Results presented in Figure 3a above indicate that the value of the n-factor is a significant factor, as it directly impacts the performance of the PV model. Moreover, increasing the ambient temperature value directly affects the total error. Since the total error

percent increases as the n-factor decreases, with the same temperature value. On the other hand, when dealing with the same n-factor value and increasing the temperature value, the total error also increases, albeit with different values. Despite these differences in the range of n-factor, the proposed model keeps the nearest differences in the total error percentage, even with the vast differences in the temperature values.



[Fig.3. b. Accuracy of Proposed Model Under Different Temperature Values of Jinko Solar Monocrystalline Modules (b) Critical Points]

Results presented in Figure 3(b) above show that the value of the slope also directly affects the total percentage error of the PV model, as it impacts the model's performance. Since the increase in ambient temperature also increases the total error, albeit with a specific slope, it is essential to consider this relationship. Whereas, the total error percent increases as the slope decreases, with the same temperature value. On the other hand, when dealing with the same slope value and increasing the temperature value, the total error also increases, albeit with different values. Despite these differences in the range of slopes, the proposed model exhibits the closest differences in total error percentage, even with significant differences in the temperature values.

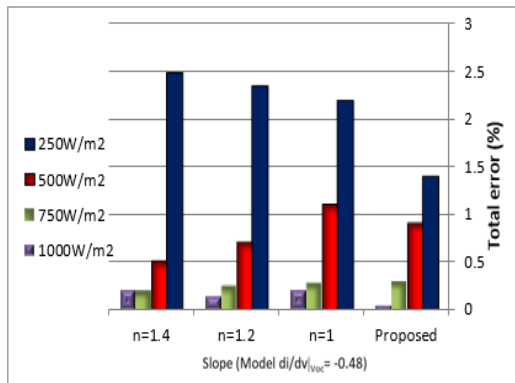


[Fig.4. a. Accuracy of the Proposed Model Under Different Irradiance Levels of Jinko Solar Monocrystalline Modules (a) Critical Points]

Results presented in Figure 4(a) above show that the value of the slope also directly affects the total percentage error of the PV model, as it impacts the model's performance. Since the increase in ambient temperature also increases the total error, albeit with a specific slope, it is essential to consider this relationship. Whereas, the total error percentage increases as the slope decreases, with the same temperature value. On the other hand, when dealing with the same slope value and increasing the

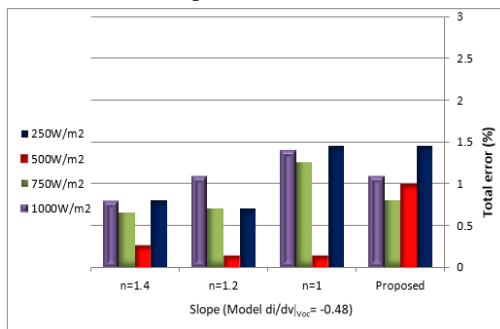
Performance Evaluation of PV Solar Energy Systems using Mono and Polycrystalline Metal Structures,- Geographic Region Climate Model

temperature value, the total error also increases, albeit with different values. Despite these differences in the range of slopes, the proposed model exhibits the closest differences in total error percentage, even with significant differences in the temperature values.



[Fig. 4. b. Accuracy of the Proposed Model Under Different Irradiation Levels of Jinko Solar Monocrystalline Modules (a) Effect on Diode Ideality Factor]

Results presented in Figure 4(b) above show that the change in the value of the n-factor and irradiation directly affects the total percentage error of the PV model, as it impacts the model's performance. Whereas, as the irradiation value increases, the total error increases, especially when the value of the n-factor equals 1 and 1.2, albeit at varying levels, and is significantly lower at the low irradiation level of 250 W/m². Although the total error percentage is affected by the irradiation level, when the slope was 1.4, it remained constant at irradiation levels of 750 W/m² and 1000 W/m². This indicates that the high irradiation level with a high n-factor level results in the same percentage error. Despite these differences in the range of percentage error for most irradiation values, it can be seen that the low level recorded the most significant percentage error. On the other hand, in the proposed model, the total percentage error increases at the equated level. It registers a very low value at high irradiation levels, as well as an acceptable value at low irradiation levels.

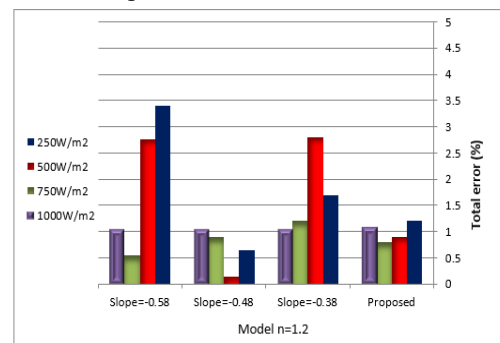


[Fig.5. a. Accuracy of the Proposed Model Under Different Temperature Values of Longi]

Multi-crystalline modules (a) effect on diode ideality factor. Results presented in Figure 5(a) above show that changes in both n-factor and temperature affect the total percentage error of the PV model, but in different ways, through their impact on the model's performance. Despite an apparent change in the value of the n-factor, the high temperature level did not result in a significant change in the total error percentage. Whereas, in general, the total error percentage increases as the n-factor and temperature are

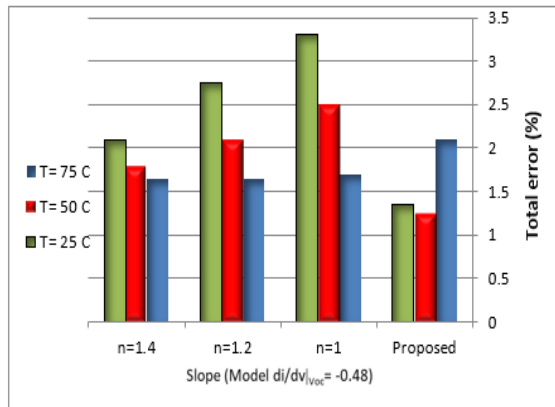
increased. Additionally, it can be observed that the effect of low temperatures is greater than that of the highest temperatures on the total percentage error of the PV model. Although the total error percentage is affected by a low level of temperature, it remains unaffected by the highest temperatures. However, in the proposed model, it is not significantly affected at a low temperature level, but it increases when the temperature is high.

Figure 5. b. Accuracy of proposed model under different temperature values of Longi Multi-crystalline modules (b) critical points. Figure 5(b) above shows that the change in the slope value and temperature directly affects the total percentage error of the PV model, as it impacts the model's performance. Whereas, as the slope value increases, the total error decreases, especially when the slope value is low; however, at high levels of slope, the total error percentage remains low. Although the total error percentage is affected by the temperature level, when the slope was 0.38, the effect of high temperature dissipated, and the percentage error showed the same effect. This indicates that the high temperature level with a low slope level has a high percentage error. Despite these differences in the range of percentage error for most temperature values, it can be seen that the lowest level recorded the most significant percentage error. On the other hand, in the proposed model, the total percentage error is higher at 25°C than at 50°C, while it increases again at 75 °C. This means that the proposed model has more reliability than the literature, since the difference is not as significant as compared to the literature.



[Fig.6. a. Accuracy of Proposed Model Under Different Irradiation Levels of Longi Multi-Crystalline Modules (a) Effect on Diode Ideality Factor]

Results presented in Figure 6(a) above show that changes in both slope and irradiation affect the total percentage error of the PV model, but in different ways, through their impact on the model's performance. Since the high level of slope effect of irradiation is so clear and prominent, despite its small effect at high irradiation levels, the impact of high irradiation levels (1000 W/m²) on the percentage error is equal for all slope levels, as observed in both the literature and the proposed model. At 750 W/m², it is shown that as the slope increases, the level of error decreases, maintaining the same irradiation level of 750 W/m². On the other hand, at a low level of irradiation, 250 and 500 W/m², the value of total percentage error is more affected than at a high level of irradiation.



[Fig.6. b. Accuracy of the Proposed Model Under Different Irradiation Levels of Longi Multi-Crystalline Modules (b) Critical Points]

Figure 6(b) above shows that the change in the n-factor value and irradiation levels also affect the total percentage error of the PV model, but in different ways, as they impact the performance of the PV model. Whereas, at the highest irradiation values of 1000 W/m² and 750 W/m², as the n-factor value increases, the total error decreases, particularly when the n-factor value is observed to reduce the error. On the other hand, at 500 W/m², the percentage error is very low but slightly increases with the rise in the n-factor.

Meanwhile, in the proposed model, the total percentage error is higher at a low level of irradiation and decreases as the irradiation level increases. This means that the proposed model has minimised the total percentage error level across all irradiation levels, indicating that it is more reliable than the literature, as the difference is less pronounced compared to others.

IV. CONCLUSION

The current study presents a developed and improved five-parameter model of PV solar modules under various operating conditions, accounting for changes in temperature and irradiation levels. Furthermore, a comprehensive assessment of the presented PV model accuracy is based on two different PV modules, fabricated from two different materials: monocrystalline silicon and multicrystalline silicon. All available PV parameters were thoroughly presented and assessed. The primary concern is the accuracy and reducing the error level based on the critical points, as well as the characteristics of PV modules themselves. The proposed model has demonstrated merit in terms of accuracy, owing to its lower error percentage, particularly with monocrystalline silicon. Therefore, it could be considered to have better performance than the other presented conventional parameter values. The accuracy of the proposed model was verified through a low error percentage using single-crystalline silicon; therefore, its effects on the performance of the PV module were also assessed, especially with changes in irradiation levels and temperature values. Lastly, it's shown, in the current study, that the performance of the PV cell parameters is influenced at high temperature values in the multi-crystalline silicon more than in the other metal (mono-crystalline silicon), as compared within the exact value of temperature, in the region of study.

DECLARATION STATEMENT

After aggregating input from all authors, I must verify the accuracy of the following information as the article's author.

- **Conflicts of Interest/ Competing Interests:** Based on my understanding, this article has no conflicts of interest.
- **Funding Support:** This article has not been funded by any organizations or agencies. This independence ensures that the research is conducted with objectivity and without any external influence.
- **Ethical Approval and Consent to Participate:** The content of this article does not necessitate ethical approval or consent to participate with supporting documentation.
- **Data Access Statement and Material Availability:** The adequate resources of this article are publicly accessible.
- **Author's Contributions:** The authorship of this article is contributed equally to all participating individuals.

REFERENCES

1. O. Ayadi, R. Shadid, A. Bani-Abdullah, M. Alrbai, M. Abu-Mualla, and N. Balah, "Experimental comparison between Monocrystalline, Polycrystalline, and Thin-film solar systems under sunny climatic conditions," *Energy Reports*, vol. 8, pp. 218–230, 2022, doi: <https://doi.org/10.1016/j.egyr.2022.06.121>
2. A. M. Humada, M. Hojabri, S. Mekhilef, and H. M. Hamada, "Solar cell parameters extraction based on single and double-diode models: A review," *Renew. Sustain. Energy Rev.*, vol. 56, pp. 494–509, 2016, doi: <https://doi.org/10.1016/j.rser.2015.11.051>
3. A. M. Humada, A. M. Aaref, H. M. Hamada, M. H. Sulaiman, N. Amin, and S. Mekhilef, "Modeling and characterization of a grid-connected photovoltaic system under tropical climate conditions," *Renew. Sustain. Energy Rev.*, vol. 82, pp. 2094–2105, 2018, doi: <https://doi.org/10.1016/j.rser.2017.08.053>
4. E. E. Ali, M. A. El-Hameed, A. A. El-Fergany, and M. M. El-Arini, "Parameter extraction of photovoltaic generating units using multi-verse optimizer," *Sustain. Energy Technol. Assessments*, vol. 17, pp. 68–76, 2016, doi: <https://doi.org/10.1016/j.seta.2016.08.004>
5. T. S. Babu, J. P. Ram, K. Sangeetha, A. Laudani, and N. Rajasekar, "Parameter extraction of two diode solar PV model using Fireworks algorithm," *Sol. energy*, vol. 140, pp. 265–276, 2016, doi: <https://doi.org/10.1016/j.solener.2016.10.044>
6. Z. Chen, L. Wu, P. Lin, Y. Wu, and S. Cheng, "Parameters identification of photovoltaic models using hybrid adaptive Nelder-Mead simplex algorithm based on eagle strategy," *Appl. Energy*, vol. 182, pp. 47–57, 2016, doi: <https://doi.org/10.1016/j.apenergy.2016.08.083>
7. S. N. Vodapally and M. H. Ali, "A comprehensive review of solar photovoltaic (PV) technologies, architecture, and its applications to improved efficiency," *Energies*, vol. 16, no. 1, p. 319, 2022, doi: <https://doi.org/10.3390/en16010319>
8. S. Sow, "Evaluation And Analysis Of Crystalline Pv Modules Performance Characteristics Degradation In A Sub-Saharan Environment After Ten Years Of Exposure: Case Study Of Senegalese Environment," 2017. [Online]. Available: <http://repository.pauwes-cop.net/handle/1/125>
9. A. S. Al-jerjery and O. K. Ahmed, "Experimental Investigation of Thermal Performance for Novel Integrated Collector Storage," *NTU J. Renew. Energy*, vol. 7, no. 1, pp. 22–33, 2024, doi: [10.56286/k5f4mj56](https://doi.org/10.56286/k5f4mj56)
10. M. A. Sharif, K. S. Khalaf, and M. A. Omer, "A simulation model of a system-based concentrated solar power system (CSP) for maximum solar energy harvesting applications," *NTU J. Renew. Energy*, vol. 4, no. 1, pp. 26–35, 2023, doi: <https://doi.org/10.56286/ntujre.v4i1.410>
11. G. A. Baker, O. K. Ahmed, and M. A. Ahmed, "An experimental study to improve the performance of a solar still using solar collectors and heat exchanger," *NTU J. Renew. Energy*, vol. 4, no. 1, pp. 47–56, 2023, doi: <https://doi.org/10.56286/ntujre.v4i1>
12. R. Rawat, R. Lamba, and S. C. Kaushik, "Thermodynamic study of solar photovoltaic energy conversion: An overview," *Renew. Sustain.*

Performance Evaluation of PV Solar Energy Systems using Mono and Polycrystalline Metal Structures,- Geographic Region Climate Model

Energy Rev., vol. 71, pp. 630–638, 2017, doi:
<https://doi.org/10.1016/j.rser.2016.12.089>

13. N. S. B. Rukman *et al.*, “Thermal efficiencies of photovoltaic thermal (PVT) with Bi-fluid cooling system,” *J. homepage http://iijeta.org/journals/ijht*, vol. 40, no. 2, pp. 423–428, 2022, doi:
<https://doi.org/10.18280/ijht.400209>
14. A. Fudholi and M. Mustapha, “Mathematical modelling of bifacial photovoltaic-thermal (BPVT) collector with mirror reflector,” *Int. J. Renew. Energy Res.*, vol. 10, no. 2, pp. 654–662, 2020, doi:
<https://doi.org/10.20508/ijrer.v10i2.10603.g7936>
15. S. D. Prasetyo, A. R. Prabowo, and Z. Arifin, “The use of a hybrid photovoltaic/thermal (PV/T) collector system as a sustainable energy-harvest instrument in urban technology,” *Heliyon*, vol. 9, no. 2, 2023, doi: <https://doi.org/10.1016/j.heliyon.2023.e13390>
16. M. T. Ahmed, M. R. Rashel, M. Islam, A. K. M. K. Islam, and M. Tlemcani, “Classification and parametric analysis of solar hybrid PVT system: A review,” *Energies*, vol. 17, no. 3, p. 588, 2024, doi:
<https://doi.org/10.3390/en17030588>

AUTHOR'S PROFILE



Mohammed Z. Hasan. I hold a teaching title and currently work as a lecturer at the Northern Technical University, Technical College. I have 30 years of experience in teaching and research in Fuel and Energy Engineering. I have 10 joint research papers indexed in Scopus, and I am a member of the Iraqi Engineers Syndicate. I have experience in administrative work and have held administrative positions. I work on developing teaching methods and scientific research.



Mahmood. A. Mohammed. M Tech Metallurgical engineering I hold a teaching title and currently work as a lecturer in the Department of Mechanical Technology at the Northern Technical University. I have 19 years of experience in teaching and research. My strengths include accuracy and discipline in my work. I have three joint research papers published in Scopus databases, as a member of the Iraqi Engineers Syndicate. I have practical experience in welding, turning and casting operations.



Mohammed Salam Taha. I hold the academic title of Assistant Lecturer and currently serve as the Head of the Department of Studies and Planning at the North Technical University/Kirkuk Technical Institute. I also teach at the Department of Mechanical Technologies - Production Branch. I have three years of experience in teaching and scientific research, as I am one of the newly appointed academic staff members at the Ministry of Higher Education and Scientific Research. I have strong analytical skills, the ability to work under pressure, a high level of commitment to deadlines and a desire for continuous self-improvement. I also have effective teamwork and academic communication skills. I have co-authored scientific articles published in international journals indexed in Scopus. I am a member of the Iraqi Engineers Union.

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of the Lattice Science Publication (LSP)/ journal and/ or the editor(s). The Lattice Science Publication (LSP)/ journal and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions, or products referred to in the content.