PHOTOVOLTAIC PANEL COOLING : CFD SIMULATION

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CAPSTONE PROJECT 2024-25

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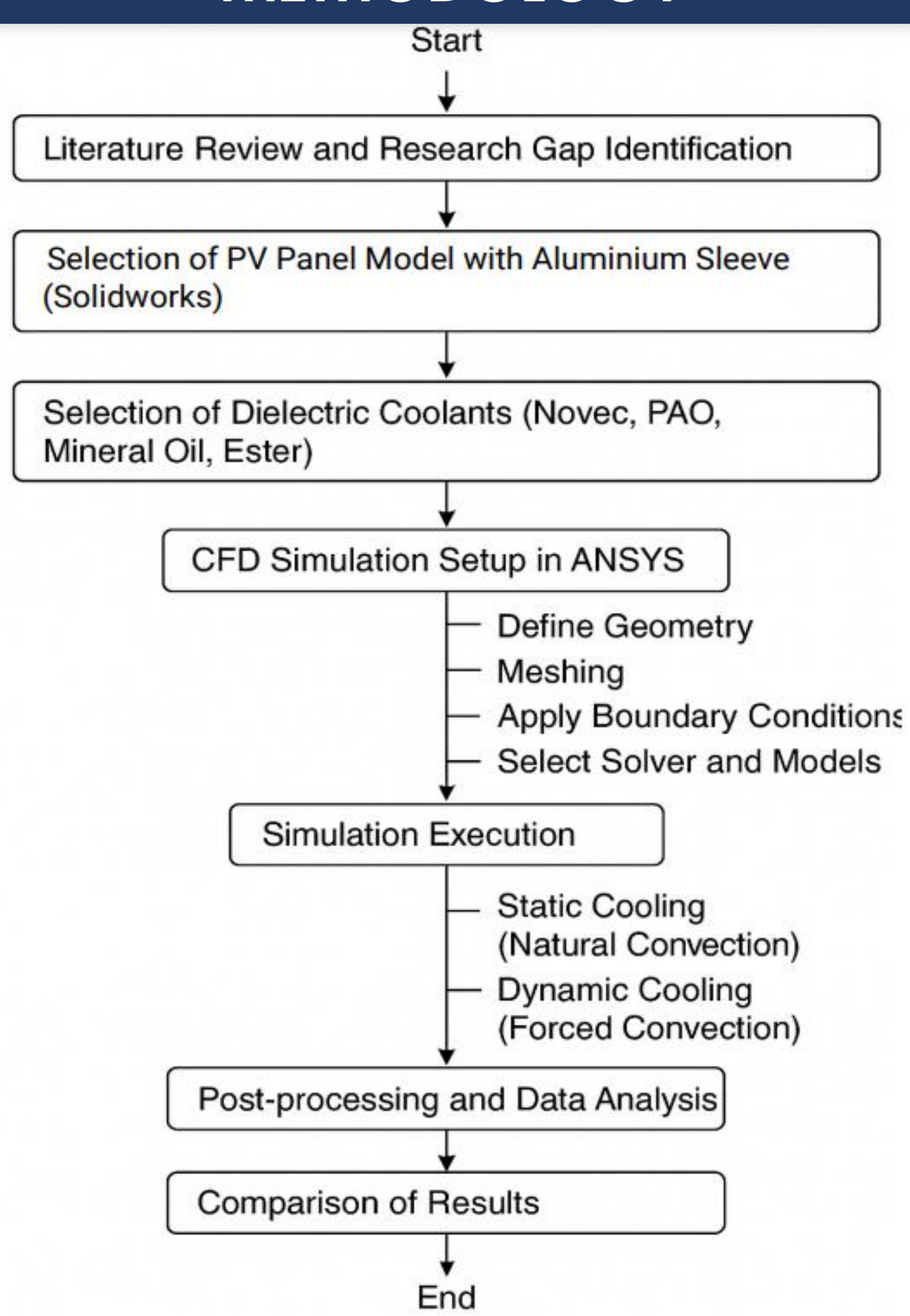
OBJECTIVES

The major objectives of the project are:

- To design a indirect cooling system for a PV Panel with dielectric fluid and aluminium sleeve using CFD.
- To perform comparative analysis of static vs. dynamic dielectric liquid cooling techniques.
- To identify the most efficient dielectric coolant based on thermal performance and material properties.
- To optimize the cooling system design based on thermal efficiency, cost-effectiveness, and implementation feasibility.

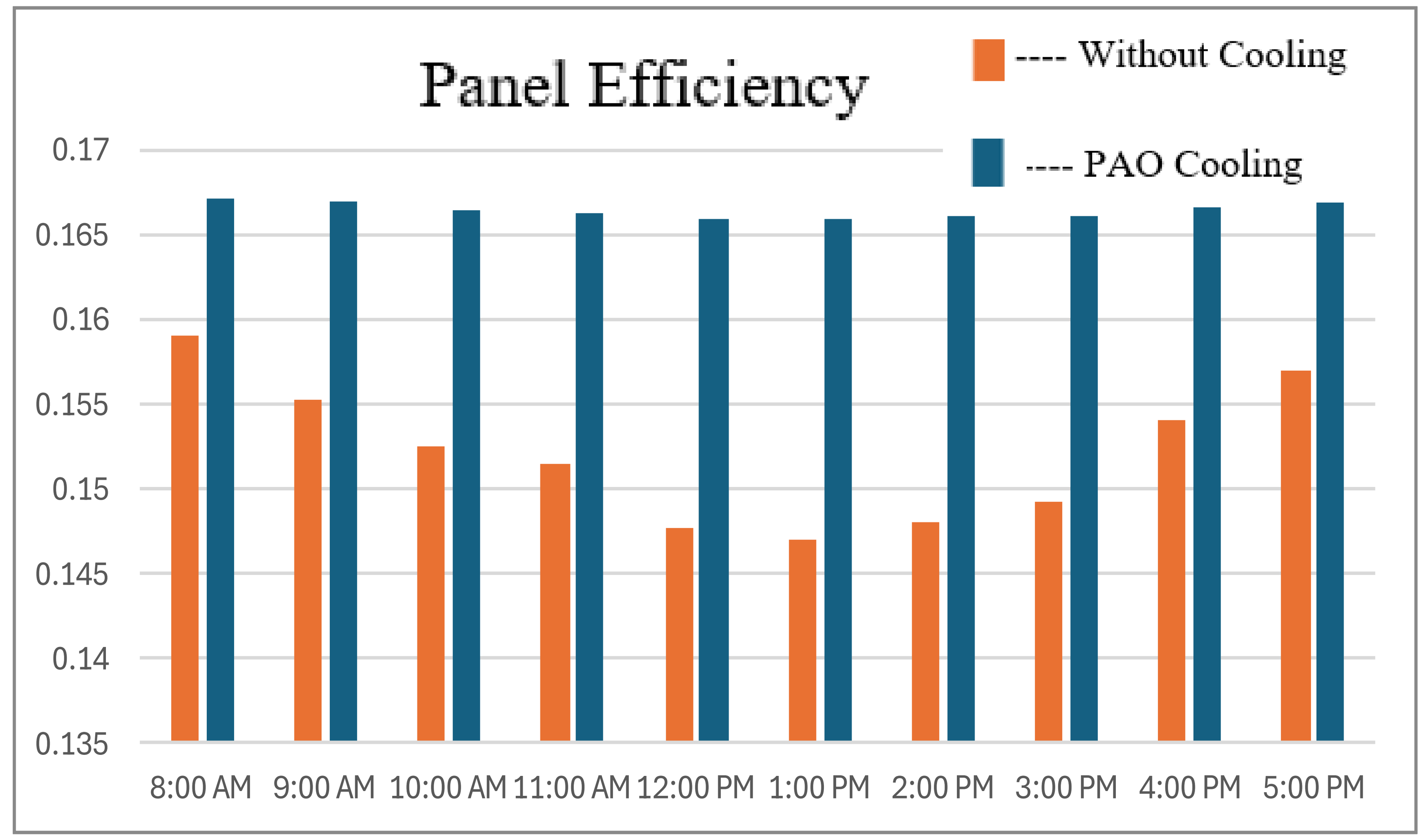
METHODOLOGY

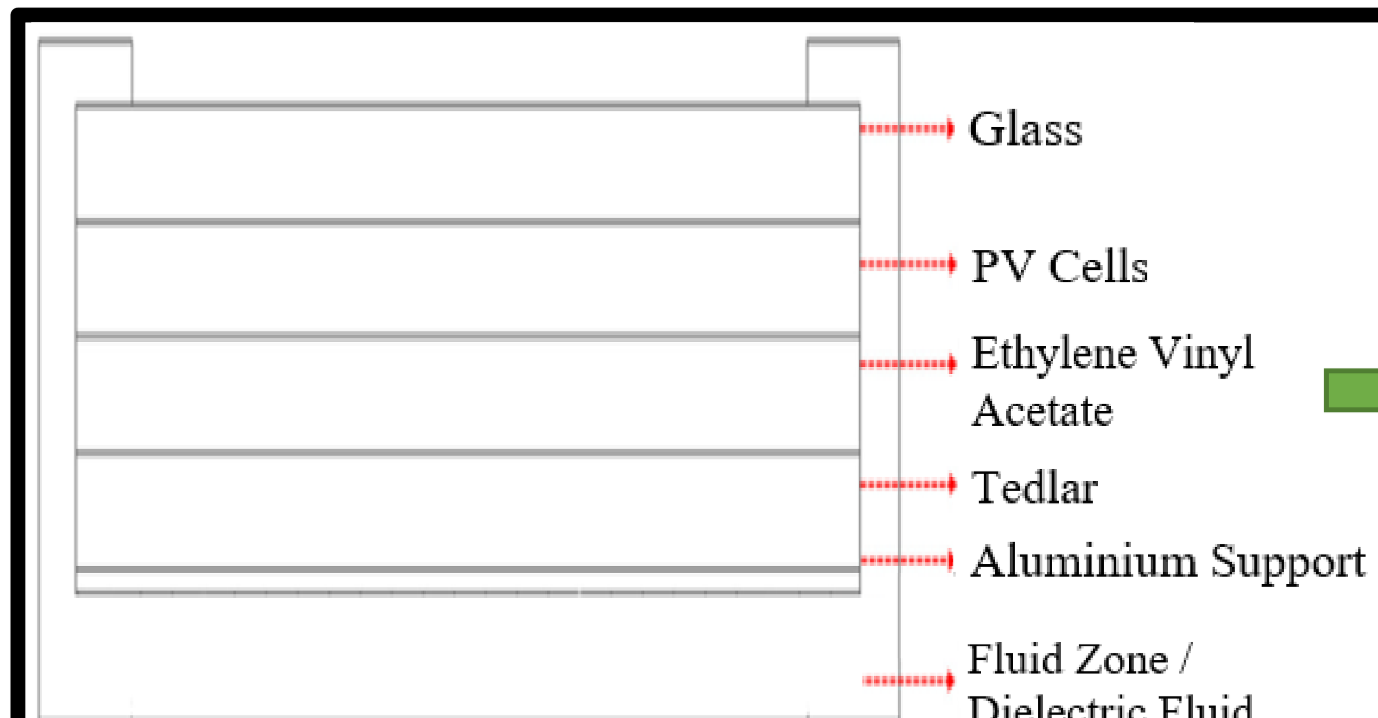


RESULTS AND DISCUSSIONS

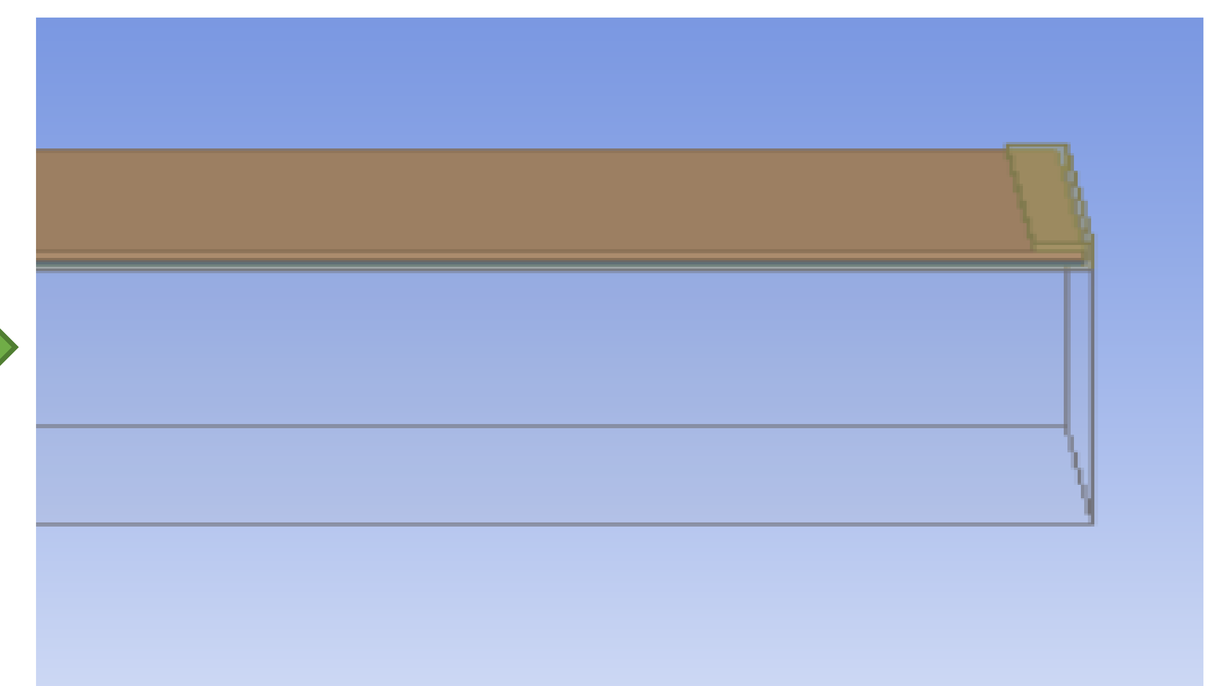
The outcomes of the project:

- Highest efficiency using PAO for cooling is 16.71 %.
- PAO out of other dielectric fluid showed best thermal efficiency for both static dynamic cooling methods.
- At a PAO flow rate of 0.05m/s, PV Panel efficiency with cooling is 5.1% higher that without cooling.

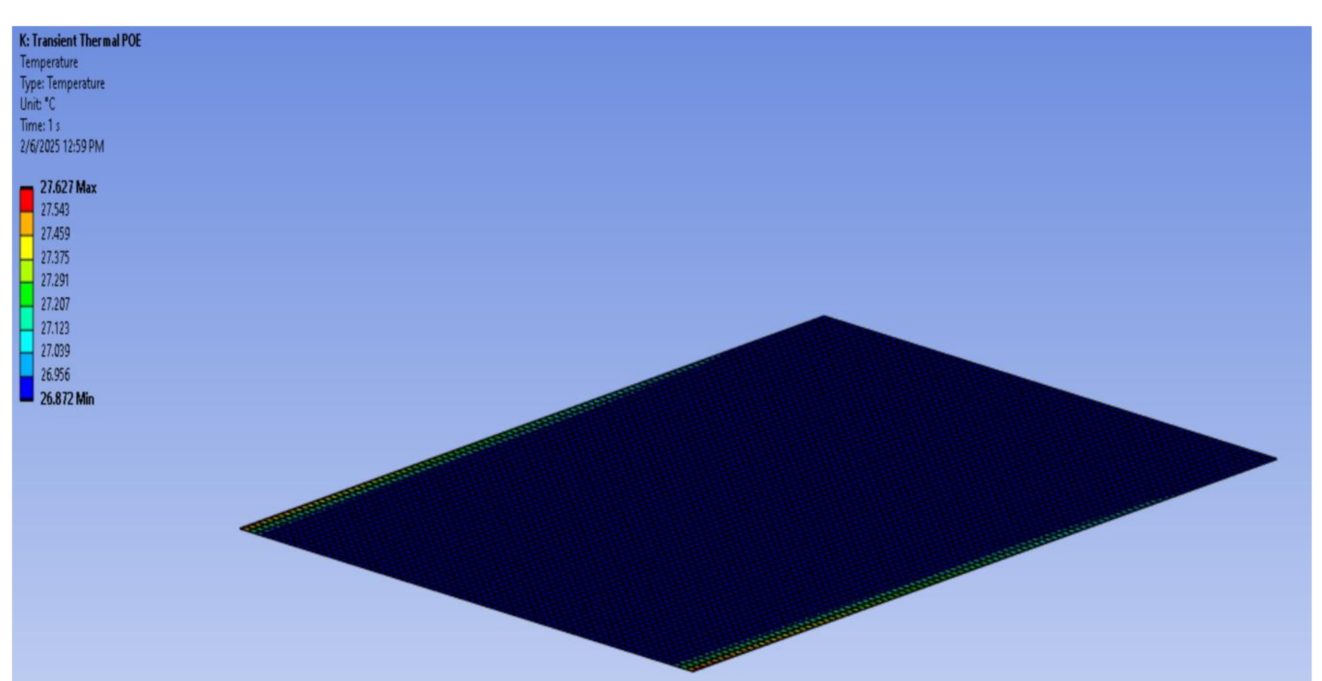




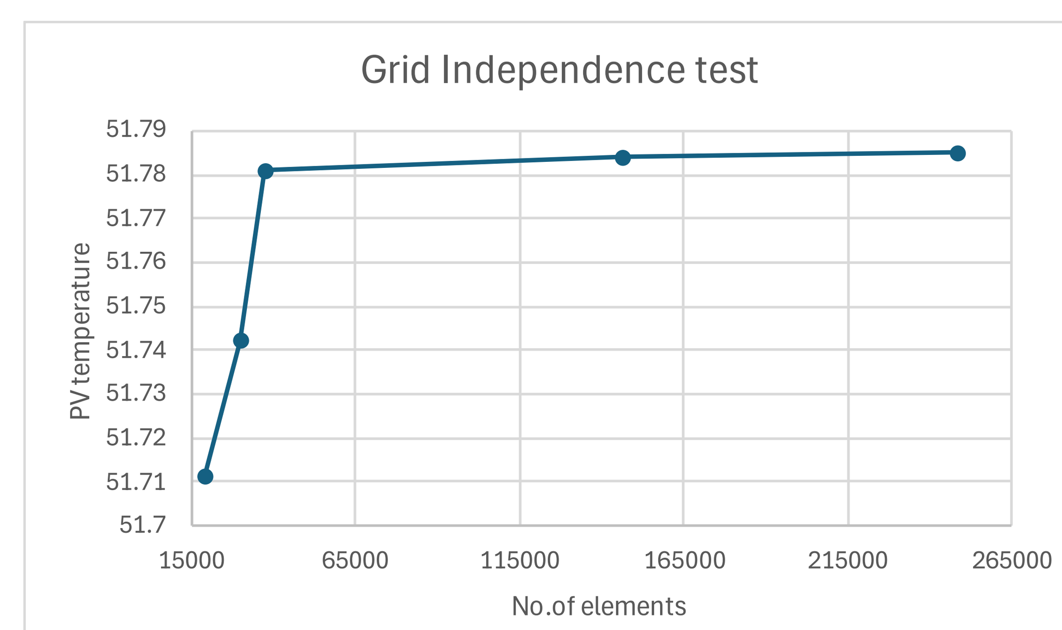
SCHEMATIC DIAGRAM



CAD MODEL



DYNAMIC COOLING USING PAO



GRID INDEPENDENCE TEST

CONCLUSIONS

The project outcomes and findings:

- The integration of aluminium sleeves with dielectric fluid significantly improved heat dissipation in PV systems.
- Dynamic cooling using Poly Alpha Olefins (PAO) outperformed other fluids in both effectiveness and stability.
- The simulation-based approach confirms the feasibility of the design for scaling up and real-world use.

REFERENCES

[1] **Emad Jaleel Mahdi, Sameer Algburi, Nasser Al-Abadi, Omer K. Ahmed, Amer K. Ahmed**, Photovoltaic panel cooling using ground source energy: CFD simulation.

[2] **Noor Muhammad Abd Rahman, Lim Chin Haw, Khairul Azmy Kamaluddin, Muhammad Syukri Imran Abdullah**, Investigating photovoltaic module performance using aluminium heat sink and forced cold-air circulation method in tropical climate conditions.

[3] **A.A. Abdullah, F.S. Atallah, S. Algburi, O.K. Ahmed**, Impact of a reflective mirrors on photovoltaic/trombe wall performance: experimental assessment, Results Eng 16 (2022) 100706..

[4] **S. Bhattacharyya, N. Jain, T. Bhatt, H. Yasmin, M. Sharifpur**, Mini-channel cooling system for solar PV Panels with hybrid magnetic nanofluid and magnetic field, Results Eng 20 (2023) 101473.

[5] **D.M.N. Mahmood, I.M.A. Aljubury**, Experimental investigation of a hybrid photovoltaic evaporative cooling (PV/EC) system performance under arid conditions, Results Eng 15 (2022) 100618.

[6] **Z. Liu, X. Yang, H.M. Ali, R. Liu, J. Yan**, Multi-objective optimizations and multi-criteria assessments for a nanofluid-aided geothermal PV hybrid system, Energy Rep. 9 (2023) 96–113.

[7] **M.T. Hussain, E.J. Mahdi**, Assessment of solar photovoltaic potential in Iraq, J. Phys. Conf. Ser. 1032 (1) (2018).

[8] **S.H. Majeed, et al.**, Cooling of a PVT system using an underground heat exchanger: an experimental study, ACS Omega 8 (33) (2023) 29926–29938.

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