UNIVERSITAS
GADJAH MADA
Optimization of Photovoltaic (PV) Hosting Capacity in 20 kV Distribution System Using Grey Wolf Optimizer (GWO) Algorithm
Syah Ridho Natiqoh, Dr. Ir. Atikah Surriani, S.T., M.Eng.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

REFERENCES

[1] United Nations, "Climate Action Fast Facts," 2022, accessed: February 21, 2026. [Online]. Available: https://www.un.org/en/climatechange/science/key-findings

[2] M. Ge, J. Friedrich, and L. Vigna, "4 Charts Explain Greenhouse Gas Emissions by Countries and Sectors," December 2024, accessed: February 21, 2026. [Online]. Available: https://www.wri.org/insights/4-charts-explain-greenhouse-gas-emissions-countries-and-sectors

[3] International Renewable Energy Agency (IRENA), "Fast-Track Energy Transitions to Win the Race to Zero," 2021, accessed: February 21, 2026. [Online]. Available: https://www.irena.org/news/pressreleases/2021/mar/fast-track-energy-transitions--to-win-the-race-to-zero

[4] Kementerian Energi dan Sumber Daya Mineral (KESDM), "Rencana Umum Ketenagalistrikan Nasional 2019–2038," p. vi, 2019. [Online]. Available: https://gatrik.esdm.go.id/assets/uploads/download_index/files/0e997-rukn-2019-2038.pdf

[5] Kementerian Energi dan Sumber Daya Mineral (ESDM), "Laporan Kinerja Ditjen EBTKE Tahun 2025," 2025, accessed: May 11, 2026. [Online]. Available: https://www.esdm.go.id/assets/media/content/content-laporan-kinerja-ditjen-ebtke-tahun-2025.pdf

[6] M. Shakboua and R. Aljarrah, "Enhancement of Photovoltaic Hosting Capacity in Distribution Networks through Genetic Algorithm," in *2023 2nd International Engineering Conference on Electrical, Energy, and Artificial Intelligence (EICEEAI)*, December 2023, pp. 1–6. [Online]. Available: https://doi.org/10.1109/EICEEAI60672.2023.10590545

[7] F. T. Wardana and T. Riady, "Hosting Capacity Analysis for Rooftop PV in Indonesia: A Case Study in Gayo Lues District, Aceh," in *2020 International Conference on Technology and Policy in Energy and Electric Power (ICT-PEP)*, 2020, pp. 12–15. [Online]. Available: https://doi.org/10.1109/ICT-PEP50916.2020.9249821

[8] M. Zain ul Abideen, O. Ellabban, and L. Al-Fagih, "A Review of the Tools and Methods for Distribution Networks' Hosting Capacity Calculation," *Energies*, vol. 13, no. 11, 2020. [Online]. Available: https://doi.org/10.3390/en13112758

Optimization of Photovoltaic (PV) Hosting Capacity in 20 kV Distribution System Using Grey Wolf Optimizer (GWO) Algorithm
Syah Ridho Natiqoh, Dr. Ir. Atikah Surriani, S.T., M.Eng.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

[9] Y. Alghamdi, A. A. Al-Mehizia, and F. Al-Ismail, "PV Hosting Capacity Calculation Using Particle Swarm Optimization," in *2021 North American Power Symposium (NAPS)*, 2021, pp. 1–6. [Online]. Available: https://doi.org/10.1109/NAPS52732.2021.9654749

[10] K. Gholami and M. H. Parvaneh, "A Mutated Salp Swarm Algorithm for Optimum Allocation of Active and Reactive Power Sources in Radial Distribution Systems," *Applied Soft Computing*, vol. 85, p. 105833, 2019. [Online]. Available: https://doi.org/10.1016/j.asoc.2019.105833

[11] V. Janamala and K. R. Rani, "Optimal Allocation of Solar Photovoltaic Distributed Generation in Electrical Distribution Networks using Archimedes Optimization Algorithm," *Clean Energy*, vol. 6, no. 2, pp. 271–287, April 2022. [Online]. Available: https://doi.org/10.1093/ce/zkac010

[12] M. D. Hraiz, J. A. M. García, R. Jiménez Castañeda, and H. Muhsen, "Optimal PV Size and Location to Reduce Active Power Losses While Achieving Very High Penetration Level With Improvement in Voltage Profile Using Modified Jaya Algorithm," *IEEE Journal of Photovoltaics*, vol. 10, no. 4, pp. 1166–1174, 2020. [Online]. Available: https://doi.org/10.1109/JPHOTOV.2020.2995580

[13] E.-G. Talbi, *Metaheuristics: From Design to Implementation*. Hoboken, NJ: John Wiley & Sons, 2009.

[14] A. E. Tio, I. Cruz, B. Malquisto, and R. Mundo, "A Binary Programming Model for Reliability Optimization Considering Fuse-blow and Fuse-save Schemes, isbn = 978-1-4673-4823-2, journal = IEEE Region 10 Annual International Conference, Proceedings/TENCON, doi = https://doi.org/10.1109/TENCON.2012.6412247," 11 2012, pp. 1–6.

[15] Asrori, A. M. Zainuri, and E. Yudiyanto, *Teknologi Panel Surya*. Pasuruan, Indonesia: UNU Pasuruan Press, 2025.

[16] D. Dahliya, S. Samsurizal, and N. Pasra, "Efisiensi Panel Surya Kapasitas 100 Wp Akibat Pengaruh Suhu Dan Kecepatan Angin," *SUTET*, vol. 11, pp. 71–80, 12 2021. [Online]. Available: https://doi.org/10.33322/sutet.v11i2.1551

[17] A. S. Al-Ezzi and M. N. M. Ansari, "Photovoltaic Solar Cells: A Review," *Applied System Innovation*, vol. 5, no. 4, 2022. [Online]. Available: https://doi.org/10.3390/asi5040067

Optimization of Photovoltaic (PV) Hosting Capacity in 20 kV Distribution System Using Grey Wolf Optimizer (GWO) Algorithm
Syah Ridho Natiqoh, Dr. Ir. Atikah Surriani, S.T., M.Eng.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

[18] M. Sofyan, I. Sara, and S. Suriadi, "The Effect of Bypass Diode Installation on Partially Covered Solar Panel Output Power," in *IOP Conference Series: Materials Science and Engineering*, vol. 1087, 02 2021, p. 012077. [Online]. Available: https://doi.org/10.1088/1757-899X/1087/1/012077

[19] S. Mirjalili, S. Mohammad, and A. Lewis, "Grey Wolf Optimizer," *Advances in Engineering Software*, vol. 69, pp. 46–61, 2014. [Online]. Available: https://doi.org/10.1016/j.advengsoft.2013.12.007

[20] C. Muro, R. Escobedo, L. Spector, and R. Coppinger, "Wolf-pack (Canis lupus) hunting strategies emerge from simple rules in computational simulations," *Behavioural Processes*, vol. 88, no. 3, pp. 192–197, 2011. [Online]. Available: https://doi.org/10.1016/j.beproc.2011.09.006

[21] O. Afolabi, W. Ali, P. Cofie, J. Fuller, P. Obiomon, and E. Kolawole, "Analysis of the Load Flow Problem in Power System Planning Studies," *Energy and Power Engineering*, vol. 07, pp. 509–523, 01 2015. [Online]. Available: https://doi.org/10.4236/epe.2015.710048

[22] S. Hadi, *Power System Analysis*, 3rd ed. North York: PSA Publishing, 2010.

[23] *Modern Electronics Devices and Communication Systems: Select Proceedings of MEDCOM 2021*. Germany: Springer Nature Singapore, 2023.

[24] M. Setyonegoro, R. Irnawan, L. Putranto, E. Firmansyah, W. Atmaja, N. Triyono, Z. Arifin, R. Gusti, D. Prastianto, and S. Sarjiya, "Study of Rooftop PV Hosting Capacity in 20 kV Systems in Facing Distributed Generation Penetration," *Results in Engineering*, vol. 23, p. 102517, 09 2024. [Online]. Available: https://doi.org/10.1016/j.rineng.2024.102517

[25] B. Weedy, B. Cory, N. Jenkins, J. Ekanayake, and G. Strbac, *Electric Power Systems*. Wiley, 2012.

[26] *SPLN T6.001:2013 - Pedoman Perencanaan dan Persyaratan Umum Sistem Tenaga Listrik*, PT PLN (Persero) Std., 2013, standar PLN T6.001:2013.

[27] D. Khatod, V. Pant, and J. Sharma, "A Novel Approach for Sensitivity Calculations in the Radial Distribution System," *Power Delivery, IEEE Transactions on*, vol. 21, pp. 2048 – 2057, 11 2006. [Online]. Available: https://doi.org/10.1109/TPWRD.2006.874651

Optimization of Photovoltaic (PV) Hosting Capacity in 20 kV Distribution System Using Grey Wolf Optimizer (GWO) Algorithm
Syah Ridho Natiqoh, Dr. Ir. Atikah Surriani, S.T., M.Eng.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

[28] V. Murthy and A. Kumar, "Comparison of Optimal DG Allocation Methods in Radial Distribution Systems based on Sensitivity Approaches," *International Journal of Electrical Power and Energy Systems*, vol. 53, pp. 450–467, 2013. [Online]. Available: https://doi.org/10.1016/j.ijepes.2013.05.018

[29] O. D. Montoya, W. Gil-González, and C. Orozco-Henao, "Vortex Search and Chu-Beasley Genetic Algorithms for Optimal Location and Sizing of Distributed Generators in Distribution Networks: A Novel Hybrid Approach," *Engineering Science and Technology, an International Journal*, vol. 23, no. 6, pp. 1351–1363, 2020. [Online]. Available: https://doi.org/10.1016/j.jestch.2020.08.002

[30] V. Chandran and Chittesh, "GA Based Optimal Control for Maximizing PV Penetration at Transmission," *Student Journal of Energy Research*, vol. 1, no. 1, p. Article 3, 2016. [Online]. Available: https://doi.org/10.21427/D7WM9W

[31] M. Tarigan and D. Silaban, "Statistika Deskriptif," *JINTAN: Jurnal Ilmu Keperawatan*, vol. 4, pp. 187–195, 07 2024. [Online]. Available: https://doi.org/10.51771/jintan.v4i2.859

[32] V. Sharma, S. M. Aziz, M. H. Haque, and T. Kauschke, "Effects of High Solar Photovoltaic Penetration on Distribution Feeders and the Economic Impact," *Renewable and Sustainable Energy Reviews*, vol. 131, p. 110021, 2020. [Online]. Available: https://doi.org/10.1016/j.rser.2020.110021

[33] S. Kaur, G. Kumbhar, and J. Sharma, "A MINLP Technique for Optimal Placement of Multiple DG Units in Distribution Systems," *International Journal of Electrical Power and Energy Systems*, vol. 63, pp. 609–617, 2014. [Online]. Available: https://doi.org/10.1016/j.ijepes.2014.06.023

[34] S. Fatima, V. Püvi, and M. Lehtonen, "Review on the PV Hosting Capacity in Distribution Networks," *Energies*, vol. 13, no. 18, 2020. [Online]. Available: https://doi.org/10.3390/en13184756

[35] United Nations Environment Programme (UNEP), "Renewable Energy," 2022, accessed: February 21, 2026. [Online]. Available: https://www.unep.org/explore-topics/energy/what-we-do/renewable-energy

[36] M. Baran and F. Wu, "Network Reconfiguration in Distribution Systems for Loss Reduction and Load Balancing," *IEEE Transactions on Power Delivery*, vol. 4, no. 2, pp. 1401–1407, 1989. [Online]. Available: https://doi.org/10.1109/61.25627

Optimization of Photovoltaic (PV) Hosting Capacity in 20 kV Distribution System Using Grey Wolf Optimizer (GWO) Algorithm
Syah Ridho Natiqoh, Dr. Ir. Atikah Surriani, S.T., M.Eng.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

[37] S. M. Ismael, S. H. Abdel Aleem, A. Y. Abdelaziz, and A. F. Zobaa, "State-of-the-art of Hosting Capacity in Modern Power Systems with Distributed Generation," *Renewable Energy*, vol. 130, pp. 1002–1020, 2019. [Online]. Available: https://doi.org/10.1016/j.renene.2018.07.008

[38] R. Khomarudin, J. Putra, R. Syahputra, and A. P. A. Chamim, "Hosting Capacity Distribution System Yogyakarta with Ant Lion Optimization: A Case Multiobjective," *Jurnal Ilmiah Teknik Elektro Komputer dan Informatika*, vol. 7, p. 88, 04 2021. [Online]. Available: https://doi.org/10.26555/jiteki.v7i1.20473

[39] Meera and S. Hemamalini, "Optimal Siting of Distributed Generators in a Distribution Network using Artificial Immune System," *International Journal of Electrical and Computer Engineering*, vol. 7, pp. 641–649, 04 2017. [Online]. Available: https://doi.org/10.11591/ijece.v7i2.pp641-649