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Design and control of Energy Storage Management and PV Power Control with performance improvement for Microgrids Applications

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***Abstract*: A microgrid having sun based PV exhibits and a battery energy storage framework (BESS). The vast majority of the energy the board system utilized for business photovoltaic (PV) inverters and battery inverters don't think about the future burden conduct and can't guarantee the energy versatility for a PV and battery storage based microgrid. This paper proposed design and control of energy storage management and PV power control with performance improvement for microgrids applications. The simulation is done using MATLAB software.**

***Keywords:* PV, Energy, Power, System, MATLAB, DG, Microgrid, .**

I. INTRODUCTION

The expanded entrance of sustainable power sources (RESs, for example, photovoltaic (PV) clusters, energy components, wind turbines, and miniature turbines to customary power frameworks supports the development of microgrids. RESs that produce dc and viable burdens make dc microgrid a reality. Cost investment funds, further developed dependability, voltage quality, and association of conveyed ages are the critical advantages of the dc appropriation organization. The dc framework that utilizations power-electronic converters improves power stream, power quality, and the size and weight of the dispersion gear.

The presence of power-electronic gadget controls the current somewhat during issue condition and assessing the area of the shortcoming becomes troublesome. In a conveyance framework, the capacity to precisely find a shortcoming prompts many benefits, like speedy support, quick rebuilding, and, consequently, decrease of power blackout span. In high-voltage dc (HVDC) transmission line, the voyaging wave and time-area issue area calculations are utilized. These voyaging wave calculations gauge the area of issue utilizing the time taken by the issue created venturing out wave to proliferate along the transmission line. In any case, the precision of the voyaging wave-put together shortcoming area technique depends with respect to the exact location of the flood appearance time and requires elite execution information obtaining gear.

The reflected wave identification and segregation are additionally issues if there should arise an occurrence of close-in shortcomings. In this framework, the utilization of the technique is viewed as troublesome because of varieties of the most brief ways to the various identifiers from the issue area point. Furthermore, a painless to the inverter, PV-plant control methodology, in light of controller of PV-strings actuators, is introduced and applied on a microgrid-based brilliant lattice geography. Both of these methodologies are related to another iterative control calculation of a microgrid.

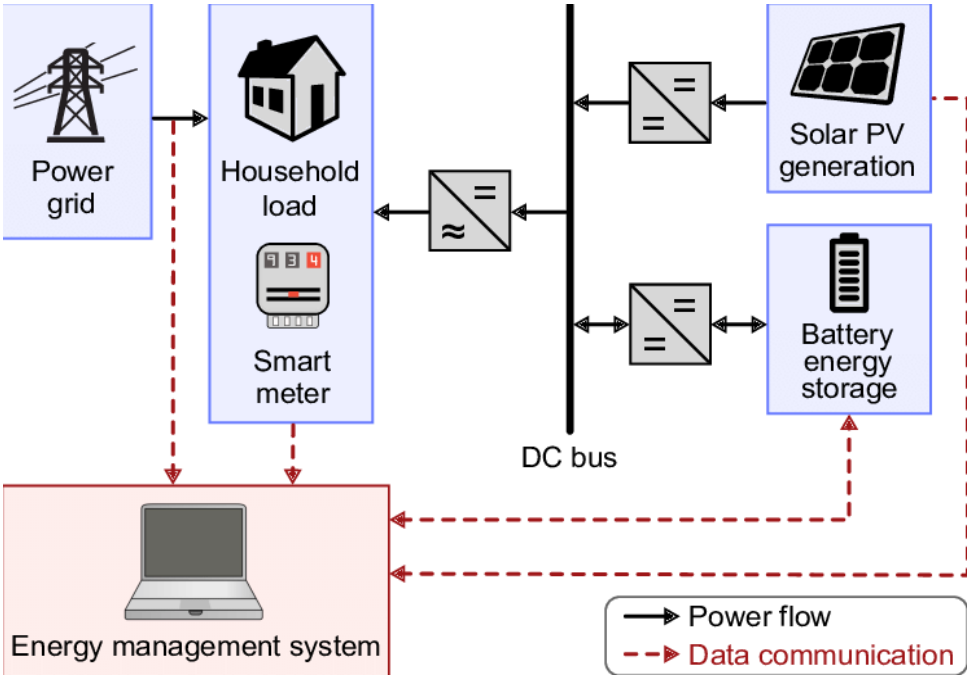

Figure 1: PV system based microgrid

To begin with, the smart appropriation lattice geography is depicted, featuring its new control framework parts that change the utility network to "shrewd matrix." Microgrids for the most part work interconnected to the utility framework, yet additionally can transform into an islanded mode, if there should arise an occurrence of outer shortcomings. According to the matrix's perspective, a microgrid can be viewed as a controllable element inside the power framework that can be worked as a solitary totaled electrical burden, giving appealing compensation, even as a little wellspring of power or auxiliary assistance supporting the organization. Late turns of events and advances in energy storage and power hardware advances are making the utilization of energy storage innovations a possibly feasible answer for the microgrid, permitting the framework to be worked in a more adaptable, monetary way.

The utilization of energy storage requires an advancement conspire that considers the time-basic piece of the heap stream. In this way the energy the board needs to perform energy planning a solitary day or several days ahead. A savvy energy the board framework is along these lines required which empowers transient energy portion planning at limited costs dependent on power age and burden interest.

II. PROPOSED SYSTEM

In a microgrid-based shrewd conveyance framework geography, each dc burden, generator, or energy storage gadget is furnished with its dc–ac inverter and associated with the air conditioner microgrid through savvy gadgets that are called exceptional control units (SCUs). All SCUs comprise of a straightforward metering module, a correspondence module, an initiation module (actuator), and a "savvy" module that is liable for the decision making of each SCU. In this proposed execution comprises two PV modules each have 6 boards, battery bank, 1kw wind age. All units are having hand-off and breaker unit. Entire unit having 5 various types of burdens. Each PV module yield is taken care of into the PV inverter, that converters DC to AC.

That changed over AC voltage is taken care of into AC network transport. And furthermore battery bank yield is changed over into AC then, at that point, took care of into AC framework transport. At last all producing units are taken care of to lattice and burdens associated with the air conditioner framework transport. The DC matrices – including storage frameworks and interconnected to the air conditioner network through AC/DC PWM controlled static converters - profoundly add to work on both quality and congruity of supply to AC and DC delicate burdens. The Air conditioner matrix is ideally controlled to play out a few framework administrations (i.e., limit power misfortunes and improve voltage profiles at essential recurrence and at consonant frequencies). Time area reenactments on a 30-hub low voltage crossover SG are introduced and talked about to prove the adequacy of the thought about arrangement.

Proposed Model

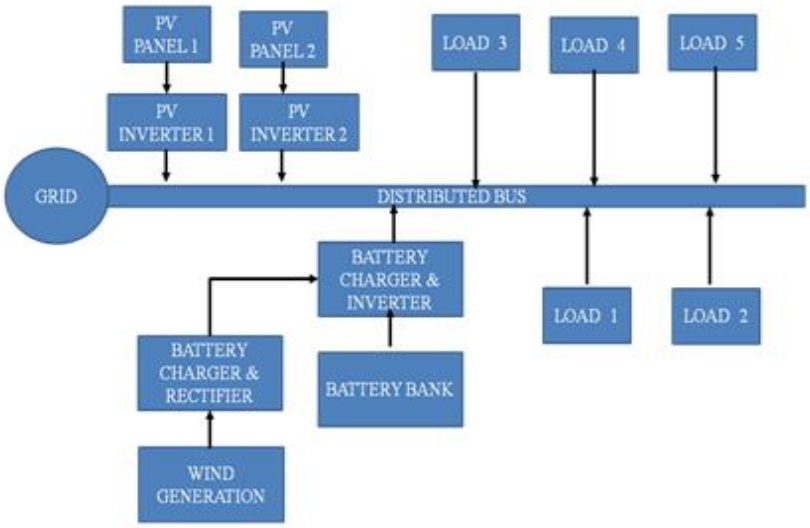

Figure 2: Model Flow Chart

The presence of numerous circulated sources that infuse flows for remuneration works with a more critical improvement of the framework pay activity.

- In addition, dividing pay activities between a specific numbers of converters can give clear benefits as far as streamlining of converter sizes.
- High framework execution
- Speedy to support
- Quick reclamation, and, consequently, decrease of blackout length.
- High precision of shortcoming identification

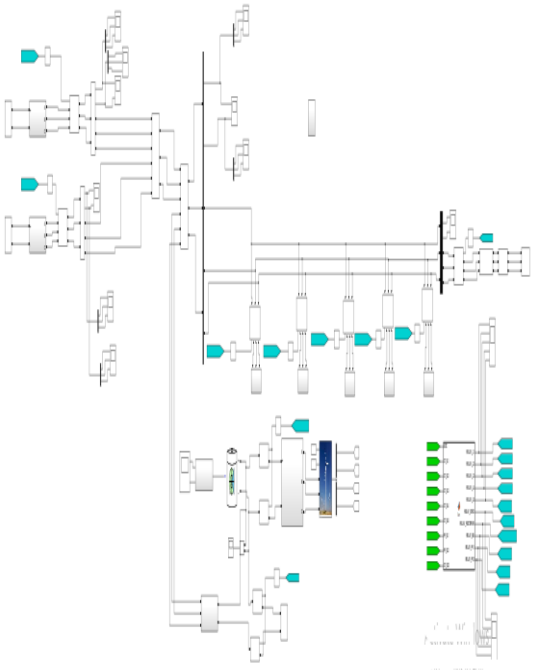

Figure 3: Proposed model

Figure 3 is showing proposed microgrid model. This model consist various sub models which is described in details.

Sub-Modules

- PV Generation
- Battery Bank
- Wind Generation
- DC To AC Converter
- AC To DC Converter
- Relay
- Circuit Breaker
- Microgrid
- Grid

III. SIMULATION RESULTS

Simulation is performed using MTALAB software. The simulation results is as followings-

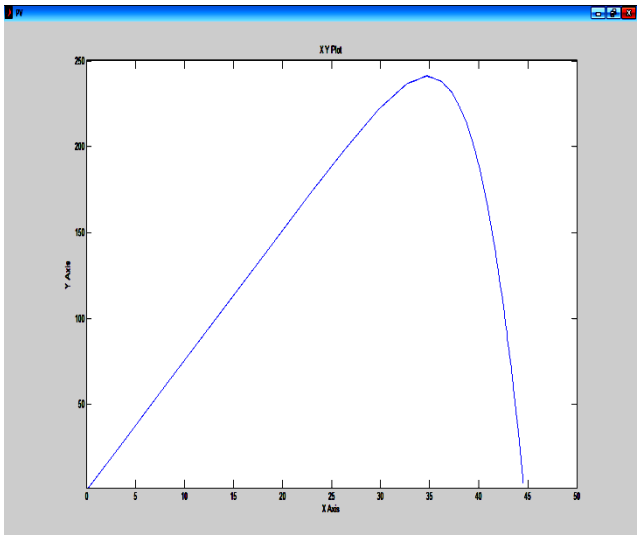

Figure 4: PV Curve

Figure 4 is showing PV curve of solar cells.

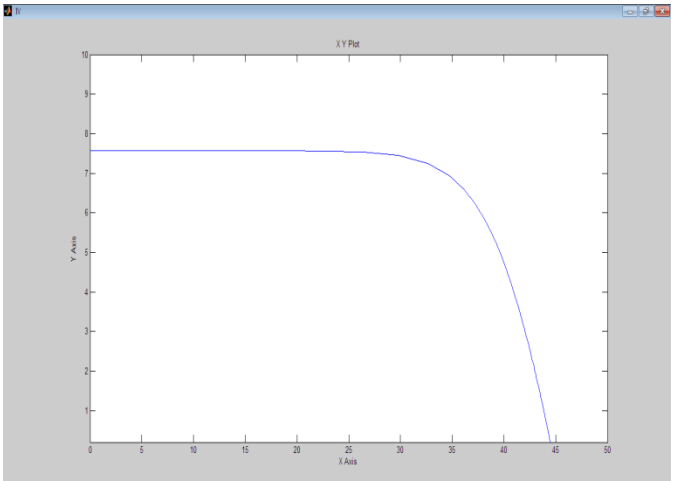

Figure 5: IV Curve

Figure 5 is showing IV Curve.

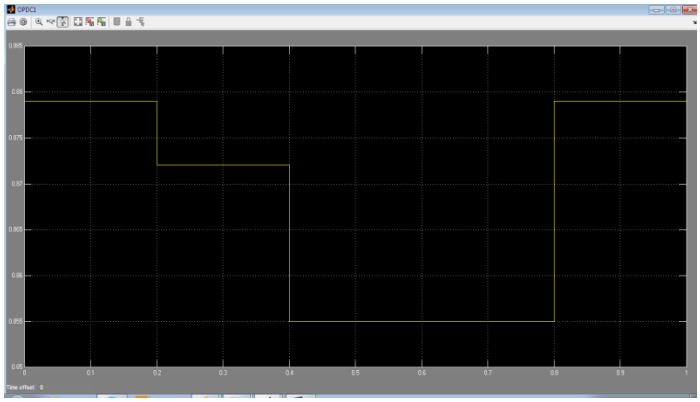

Figure 6: PV Output Current Waveform

Figure 6 is showing PV Output currentWaveform.

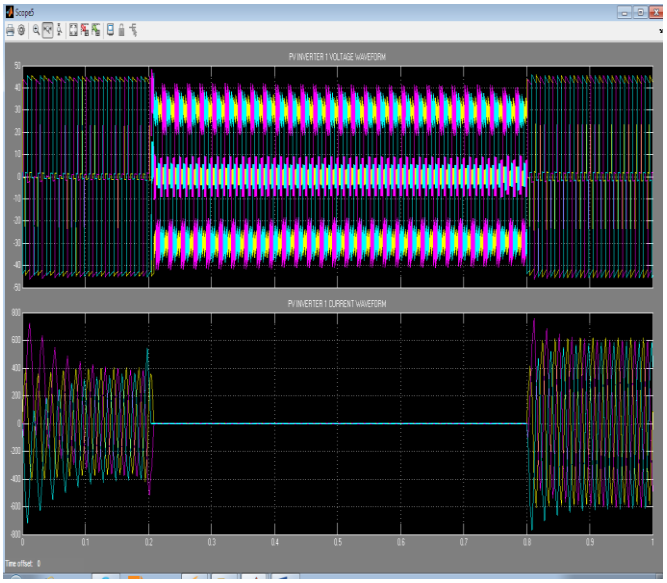

Figure 7: PV Inverter 1 Output Voltage And Current Waveform

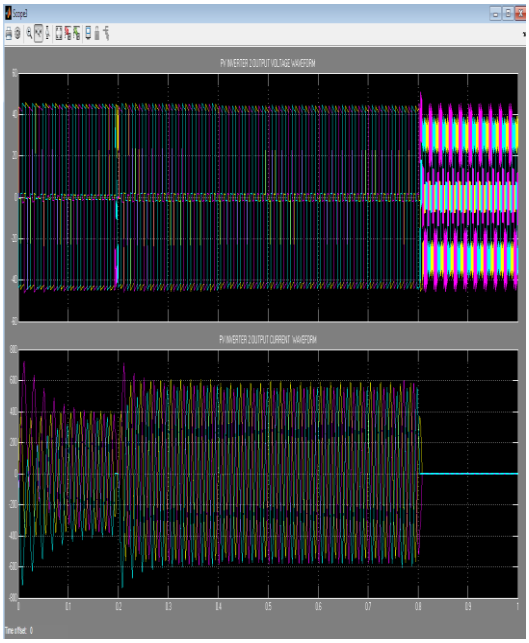

Figure 8: PV Inverter 2 Output Voltages And Current Waveform

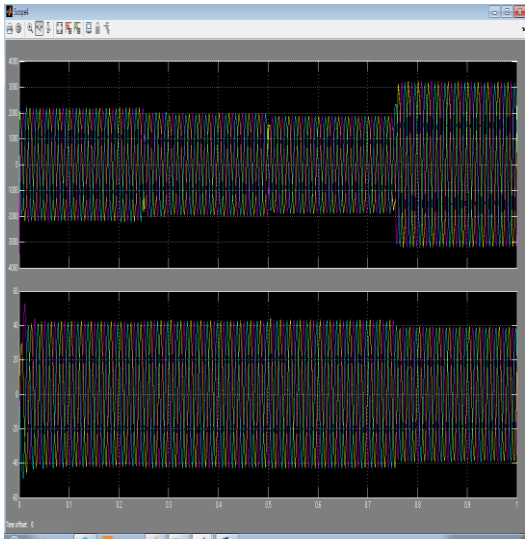

Figure 9: Load And Distributed Bus Voltage & Current Waveform

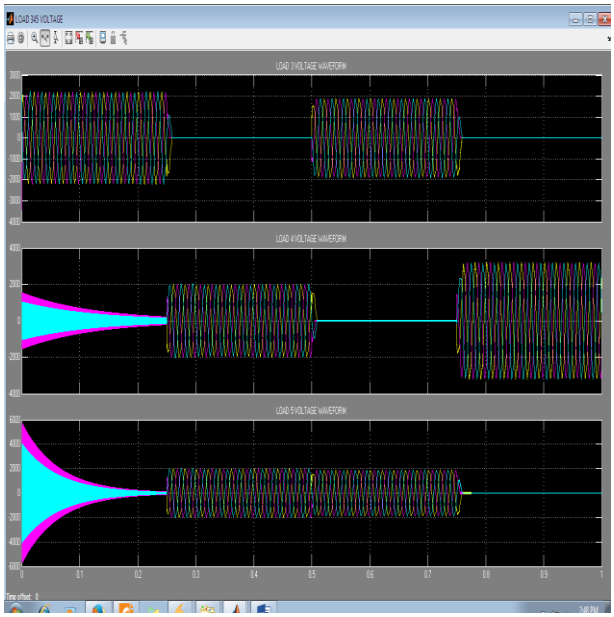

Figure 10: Load Voltage Waveform

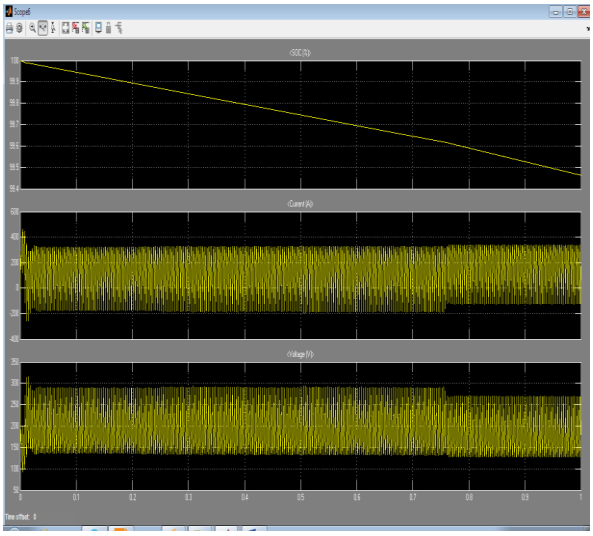

Figure 11: Battery Output Waveform

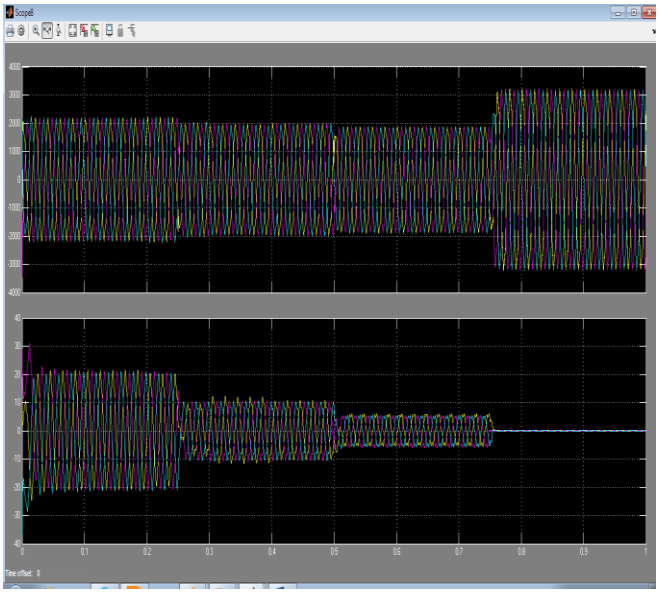

Figure 12: Grid Voltage and Current

Therefore proposed model simulation result for performance is better than previous model in terms battery, load, and solar. Proposed model gives significant improved results.

IV. CONCLUSION

In this proposed implementation, showing an improved strategy for energy storage management and PV active power control are presented and applied on a microgrid-based savvy matrix geography. The pseudo-SOC idea is acquainted with further develop energy storage the executives. Also, a painless to the inverter, PV-plant control technique, in light of controller of PV-strings actuators, is depicted and applied on a microgrid-based shrewd lattice geography. The proposed improvement considers the past SoC of batteries and joins appropriately the SoC assurance with estimations by RES and stacks and designated control activities. Hence the further developed system incorporates likewise control foundation and iterative calculations that are joined into the microgrid offices and can be applied to all RES, as PV plants and the more difficult biogas plants.

REFERENCES

[1] A. M. Mahfuz-Ur-Rahman, M. R. Islam, K. M. Muttaqi and D. Sutanto, "An Effective Energy Management With Advanced Converter and Control for a PV-Battery Storage Based Microgrid to Improve Energy Resiliency," in IEEE Transactions on Industry Applications, vol. 57, no. 6, pp. 6659-6668, Nov.-Dec. 2021, doi: 10.1109/ TIA.2021.3115085.

[2] A. Bharatee, P. K. Ray and A. Ghosh, "A Power Management Scheme for Gridconnected PV Integrated with Hybrid Energy Storage System," in Journal of Modern Power Systems and Clean Energy, doi: 10.35833/MPCE.2021. 000023.

[3] S. Gangatharan, M. Rengasamy, R. M. Elavarasan, N. Das, E. Hossain and V. M. Sundaram, "A Novel Battery Supported Energy Management System for the Effective Handling of Feeble Power in Hybrid Microgrid Environment," in IEEE Access, vol. 8, pp. 217391-217415, 2020, doi: 10.1109/ACCESS.2020.3039403.

[4] V. V. V. S. N. Murty and A. Kumar, "Optimal Energy Management and Techno-economic Analysis in Microgrid with Hybrid Renewable Energy Sources," in Journal of Modern Power Systems and Clean Energy, vol. 8, no. 5, pp. 929-940, September 2020, doi: 10.35833/MPCE.2020.000273.

[5] A. Imran et al., "Heuristic-Based Programable Controller for Efficient Energy Management Under Renewable Energy Sources and Energy Storage System in Smart Grid," in IEEE Access, vol. 8, pp. 139587-139608, 2020, doi: 10.1109/ACCESS.2020.3012735.

[6] U. R. Nair and R. Costa-Castelló, "A Model Predictive Control-Based Energy Management Scheme for Hybrid Storage System in Islanded Microgrids," in IEEE Access, vol. 8, pp. 97809-97822, 2020, doi: 10.1109/ACCESS. 2020.2996434.

[7] A. M. A. Haidar, A. Fakhar and K. M. Muttaqi, "An Effective Power Dispatch Strategy for Clustered Microgrids While Implementing Optimal Energy Management and Power Sharing Control Using Power Line Communication," in IEEE Transactions on Industry Applications, vol. 56, no. 4, pp. 4258-4271, July-Aug. 2020, doi: 10.1109/TIA. 2020.2992974.

[8] J. Ospina et al., "Sampling-Based Model Predictive Control of PV-Integrated Energy Storage System Considering Power Generation Forecast and Real-Time Price," in IEEE Power and Energy Technology Systems Journal, vol. 6, no. 4, pp. 195-207, Dec. 2019, doi: 10.1109/JPETS.2019.2935703.

[9] K. Mahmud, A. K. Sahoo, J. Ravishankar and Z. Y. Dong, "Coordinated Multilayer Control for Energy Management of Grid-Connected AC Microgrids," in IEEE Transactions on Industry Applications, vol. 55, no. 6, pp. 7071-7081, Nov.-Dec. 2019, doi: 10.1109/TIA.2019.2931490.

[10] J. Hong, J. Yin, Y. Liu, J. Peng and H. Jiang, "Energy Management and Control Strategy of Photovoltaic/Battery Hybrid Distributed Power Generation Systems With an Integrated Three-Port Power Converter," in IEEE Access, vol. 7, pp. 82838-82847, 2019, doi: 10.1109/ACCESS.2019.2923458.

[11] M. F. Zia, E. Elbouchikhi, M. Benbouzid and J. M. Guerrero, "Energy Management System for an Islanded Microgrid With Convex Relaxation," in IEEE Transactions on Industry Applications, vol. 55, no. 6, pp. 7175-7185, Nov.-Dec. 2019, doi: 10.1109/TIA.2019.2917357.

[12] S. Kumar and B. Singh, "Self-Normalized-Estimator-Based Control for Power Management in Residential Grid Synchronized PV-BES Microgrid," in IEEE Transactions on Industrial Informatics, vol. 15, no. 8, pp. 4764-4774, Aug. 2019, doi: 10.1109/TII.2019.2907750.