International Journal of Advancement in Electronics and Computer Engineering (IJAECE)
Volume 12, Issue 6, June 2023, pp.225-228, ISSN 2278 -1412

A Design and study of Solar Net Energy Metering System in Prospective of INDIA- A Review

Pappu Kumar[1], Prof. Ashish Bhargava2
[1]Mtech Scholar,BERI, Bhopal, India
[2] Prof. & HOD, BERI,ashi.sonali12@gmail.com, Bhopal, India

Abstract – *Power The rapid depletion of conventional energy sources and growing concerns about environmental sustainability have prompted a global shift towards renewable energy solutions. Solar energy, in particular, has emerged as a promising alternative due to its abundance and eco-friendly nature. In the context of India, a nation with a burgeoning energy demand and significant solar potential, the implementation of solar net energy metering systems holds great promise.*

This study focuses on the design, implementation, and analysis of a Solar Net Energy Metering System tailored to the Indian energy landscape. The system enables the seamless integration of solar energy into the existing power grid, allowing consumers to both consume solar-generated electricity and feed excess energy back into the grid. By facilitating a two-way flow of electricity, solar net energy metering incentivizes renewable energy adoption while reducing dependency on fossil fuels.

Keywords: **Power Quality, Power System, Fuzzy Logic, Fuzzy-PI Controllers Voltage Fluctuations**

I. INTRODUCTION

The global energy landscape is undergoing a profound transformation driven by the need for sustainable and environmentally friendly sources of power. Solar energy has emerged as a prominent solution to meet the growing energy demand while mitigating the adverse effects of traditional fossil fuel-based generation. In the context of India, a nation with abundant solar resources and a substantial energy appetite, harnessing solar power has become imperative to address both energy security and environmental concerns.

The concept of net energy metering has gained prominence as an innovative approach to encourage the adoption of renewable energy sources, particularly solar energy, among consumers. Net energy metering allows individuals, businesses, and institutions to generate their own electricity through solar panels and feed any excess energy into the grid, effectively becoming energy producers as well as consumers. This approach not only enables self-consumption of clean energy but also offers the opportunity to earn credits for surplus energy supplied to the grid.

This study focuses on the design, implementation, and evaluation of a Solar Net Energy Metering System tailored to the unique energy landscape of India. The system's fundamental objective is to promote the utilization of solar energy while ensuring efficient energy distribution and reducing strain on conventional power generation.

The main goals of this study are as follows:

Addressing Energy Demand: India's rapidly growing population and expanding economy have resulted in a substantial increase in energy demand. Solar net energy metering has the potential to alleviate the strain on traditional energy sources and contribute to a more balanced energy mix.

Solar Potential: With its geographical location, India receives abundant sunlight throughout the year. This study explores how harnessing this solar potential through net energy metering can play a pivotal role in meeting energy requirements.

Technical Feasibility: The study assesses the technical feasibility of integrating solar panels and bidirectional meters into the existing energy infrastructure. This includes evaluating compatibility, grid synchronization, and energy flow management.

Economic Viability: An essential aspect of solar net energy metering is its economic viability for consumers. The study conducts a comprehensive cost-benefit analysis to determine the financial attractiveness of adopting such a system.

Regulatory Framework: Understanding the policy and regulatory environment is crucial for the successful implementation of solar net energy metering. This study delves into the existing regulations, incentives, and barriers that influence the adoption of this system.

Environmental Impact: By quantifying the reduction in greenhouse gas emissions and reliance on fossil fuels, the study showcases the environmental benefits of solar net energy metering in contributing to India's sustainable development goals.

The findings of this study have far-reaching implications for India's energy future. As the nation strives to increase its renewable energy capacity and reduce its

DOI Member 22.95.156

carbon footprint, solar net energy metering emerges as a practical and empowering solution. By enabling consumers to actively participate in the energy transition, this system aligns with India's commitment to clean energy, energy security, and a greener future.

II. LITERATURE REVIEW

A. S. M. Mominul Hasan This study explores the virtual net-metering (VNM) option for enabling inclusive investment opportunities in renewable energy for self-consumption in Bangladesh. It focuses on consumers, such as households and businesses in multi-family and multi-story buildings, who cannot participate in traditional net-metering policy due to technical and space constraints. The study adopted the classical socket parity method to identify suitable consumers for VNM. Then it determined the consumer benefits of using VNM by calculating the net present cost (NPC) and discounted payback period.

Prof. S. S. Kumbar, The first Net Meter has been installed in the premises of Vardhan Industries Limited, located in Andheri (Mumbai) by €Tata Power Company•. In March, the civic body had installed 25 kilowatts Solar Net Metering at its Vartak Nagar ward office and Majiwada, Manpada, It will also introduce this new power generation technique at Mumbra and Anandibai Joshi hospital in Vartak Nagar to meet its energy requirements.

Andreas Poullikkas A feed-in tariff (FiT) scheme provides a guaranteed premium price to the green electricity producer and put an obligation on the grid operators to purchase the generated electricity output. The price is typically guaranteed for a long period in order to encourage investment in new renewable energy sources for power generation (RES-E) plants. FiT schemes are supply-side measures that push green electricity onto the market and are mostly used for the promotion of RES-E technologies in Europe.

Charalampos Ziras et al Netting the local production and consumption of prosumers is likely to remain the prevalent settlement practice, because it is essential for the economic viability of investments in the absence of generous feed-in tariffs. It is common for energy suppliers to use hourly intervals for settlement, but the exact way that netting is applied has various implications. In this paper we showed that by using hourly-reported values the yearly energy imports of a typical Danish prosumer can increase by up to 34%, depending on how exactly netting is applied.

Sylvester William Chisale et al. Globally increasing energy demand has had a significant impact on development. In Malawi, the net metering policy, which is part of the framework for independent power producers, has the potential to improve energy access. The purpose of this paper was to investigate the use of net metering policy as a means of improving reliability and access to electricity. The HOMER software was used to size solar PV systems while accounting for net metering at the household level.

Nisha R. Molke et al. Renewable power generation has become an ultimatum in recent years. In recent times many energy experts, scientists, engineers and activists actively promote a 100% renewable energy vision. The recent reports suggest that, we have already used almost 2/3 of our carbon budget and at the current projected rate; this entire budget will be used by the year 2040. So it is essential that we move rapidly towards a renewable energy.

Muhammad Nabeel Hussain et al. In this research proposal we introduce with novel approach the net metering through solar hybrid system integrated with grid. As we know the demand of electricity increases as the use of modern electronic devices has increased manifold in household. The main purpose of this research is to develop knowledge about the residential generating station from solar photovoltaic cell near to consumer site. This study has been pursuit to assure if solar energy is cost beneficial over a 25 years period for residential, commercial and agricultural sector. The results show it will be also a great business and helpful to all the consumer to earn profit and earn back their capital through net metering.

Puneeth S R et al. Indian power sector is confronting phenomenal difficulties with the developing economy; a quick increment in power demand on one hand and supply limitations and expanding expenses of fuels, for example, coal and common gas utilized for force generation combined with developing worries about environmental change and greenhouse gas emanations from the utilization of fossil fills on other. The accessibility of vitality is restricted and known assets of vitality are debilitating quick. Keeping in mind the end goal to ration the accessible assets, it is vital to concentrate on vitality preservation perspectives. With a specific end goal to ration accessible assets, there is a need to move towards renewable vitality.

III. METHOD

The Under different criteria we have recorded three design approaches of Net Energy Metering System such as the distribution system at the purchaser,s end, site placement opportunities, pre-allocation of tax benefits etc. Few approaches are explained below .

I . Community Net Energy Metering- It focuses on multiple purchasers who come to an agreement of using multiple meter systems for multiple households offsetting power among the purchasers of the community. The below given figure shows the way how community Net Energy Metering system works. The single onsite solar panel installed produces electricity from solar energy and supplies it to the households of the community. Excess energy that is not utilized by the community is sent to the grid. This record is done by the net meter system that are set up in every household. Thus purchasers enjoy the credits on electricity units which is observed in their electricity

billings and such an image is depicted in the figure below.

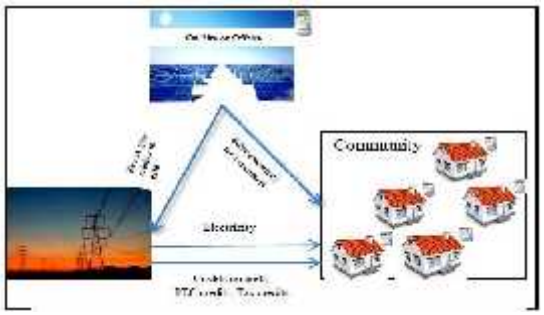

Fig. 1 Community Net Energy Metering system

II.Aggregate Net Energy Metering- It tends to have a single purchaser with a single generation system and uses multiple meters underneath the same roof to offset power from multiple meters. Eventually, accumulating all the benefits under a single purchaser. In the figure below, we can see that a single onsite generation of solar panels supplies electricity to a large area . The excess electricity is sent to the grid and this is recorded by multiple net meters under the same Area , for which credits on electricity is achieved by the participant. This flow is clearly displayed in the below given figure.

Fig. 2.2 Aggregate Net Energy Metering system

III. Virtual Net Energy Metering- It has a collective generation system though the generation facility placement is done offsite and the tax benefits are shared among all the purchasers involved. In the figure given below we can see that the solar panel is set off- site and supplies electricity produced from it to offsite households. The electricity that is sent to the grid results in credits that are obtained by the offsite purchasers. This record of net electricity consumption is done by the net meter. This scenario is clearly displayed below.

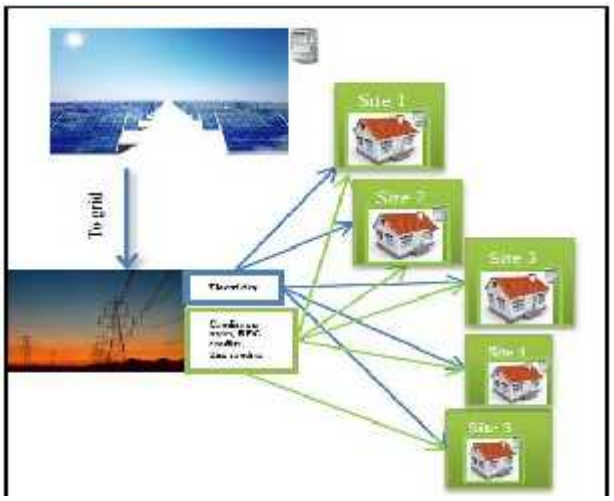

Fig. 2.3 Virtual Net Energy Metering system 5. shunt capacitor.

IV. Conclusion

In our review paper has delved into the innovative concept of Net Energy Metering (NEM) enhanced by the integration of solar energy, showcasing its potential to revolutionize the energy landscape. Our project was driven by the overarching objective of conserving natural resources, reducing dependency on non-renewable sources, and addressing the escalating energy demands of our society. Additionally, we aimed to empower households by efficiently tracking their energy consumption and offering the prospect of reducing future electricity bills.

Throughout our research journey, we unveiled various avenues for implementing NEM systems, with a particular focus on community Net Energy Metering. This approach treats an entire community as a unified entity, capitalizing on a single generating site to meet collective energy demands. By aggregating load requirements, this model optimizes the size of the generating facility, streamlining application processes, operation, and maintenance. It offers an effective solution for smaller purchasers and those without sufficient space for solar panel installation, thus promoting inclusivity and equity in energy access. innovation.

Reference

[1] R. G*f*rnowicz and R. Castro, €Optimal design and economic analysis of a PV system operating under Net Energy Meteringor Feed-In-Tariff support systems: A case study in Poland,• Sustain. Energy Technol. Assessments, vol. 42, no. 100863, p. 100863, 2020.

[2] I. A. Sajjad, M. Manganelli, L. Martirano, R. Napoli, G. Chicco and G.Parise, €Net Energy Meteringbenefits for Residential Client's,• IEEE Industry Applications Magazine, 2017.

[3] W. ur Rehman, I. A. Sajjad, T. N. Malik, L. Martirano, and M. Manganelli, €Economic analysis of Net Energy Meteringregulations for residential purchasers in Pakistan,• IEEE International Conference on Environment and Electrical Engineering and IEEE Industrial and Commercial Power Systems Europe (EEEIC / I&CPS Europe), 2017.

[4] Abolhosseini, Shahrouz & Heshmati, Almas & Altmann, Jörn, "A Review of Renewable Energy Supply and Energy Efficiency Technologies," IZA Discussion Papers 8145, Institute of Labor Economics (IZA), 2014.

[5] J. W. Stoutenborough and M. Beverlin, €Encouraging pollution-free energy: The diffusion of state Net Energy Meteringpolicies,• Soc. Sci. Q., vol. 89, no. 5, pp. 1230,,1251, 2008.

[6] €INDIA,s power crisis: Not just a national issue,• July 22, 2022, Dhaka Tribune.

[7] Haque, M. A., & Rahman, J, €Power crisis and solution in INDIA•, INDIA Journal of Scientific and Industrial Research, vol. 45(2), 155,,162, 1970.

[8] Crisis. €INDIA: Power crisis ongoing nationwide amid a supply shortage and severe heat as of July 26,• Crisis24, September 10, 2022.

[9] United Nations. (n.d.). €Achieving sustainable energy targets in INDIA,• United nations, Retrieved April 29, 2022, from https://www.un.org/en/chronicle/article/achieving-sustainable-energy-targets- INDIA

[10] Hossain, S. and Rahman, M., €Solar Energy Prospects in INDIA: Target and Current Status,• Energy and Power Engineering, 13, 322-332., 2021, doi: 10.4236/epe.2021.138022

[11] S. A. Chowdhury and M. Z. R. Khan, €The Net Energy Meteringguideline of INDIA-potential and way forward,• in 2020 11th International Conference on Electrical and Computer Engineering (ICECE), 2020

[12] A. J. Lawson, €Net Metering : In Brief,• Library of Congress, Congressional Research Service, Nov. 2019.

[13] Zahid, H., Umer, F., Rashid, Z., Raheem, A., Shakoor, R., & Hussain, G. A. €Critical Analysis and Application of Net-Metering Practice in MEPCO,• International Journal of Photoenergy, 1,,13, 2020, https://doi.org/10.1155/2020/4135860

[14] E. Doris, S. Busche, and S. Hockett, €Net Energy MeteringPolicy Development and Distributed Solar Generation in Minnesota: Overview of Trends in Nationwide Policy Development and Implications of Increasing the Eligible System Size Cap,• Tech. Rep., National Renewable Energy Lab. (NREL) Tech. Reports, Golden, CO (United States), 2009.

[15] B. Yosiana, €The Rise of the Energy POWER USERs,• The ASEAN, 2018.

[16] €INDIA,s net-metering policy: Jump starting the solar rooftop market?• (n.d.). Gov.Bd. Retrieved September 10, 2022.

[17] W. Masoud, €Net-Metering Reference Guide for Electricity Purchaser•, AEDB (Ministry of Water & Power)

[18] J. Thakur and B. Chakraborty, "Smart Net Energy Meteringmodels for smart grid in India," 2015 International Conference on Renewable Energy Research and Applications (ICRERA), 2015, pp. 333-338, DOI: 10.1109/ICRERA.2015.7418720

[19] Umar, Najib & Bora, Birinchi & Banerjee, Chandan, €Comparison of different PV power simulation softwares: case study on performance analysis of 1 MW grid-connected PV PVplant,• 2018.