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A Comprehensive Review on Renewable Energy Trading

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Abstract: ***The problem we are facing is how to efficiently use renewable energy sources like solar and wind, which are sometimes unpredictable. Current energy systems struggle to handle this unpredictability, which can lead to wasted energy and more pollution. There is also a lack of trust and transparency in the energy market. The effective tracking and management of renewable energy present complex challenges. Traditional energy tracking systems often lack transparency, security and trust among stakeholders, hindering the realization of a fully sustainable energy ecosystem. To fix these issues, we are looking at using blockchain technology. Blockchain is like a secure and transparent digital ledger. It can help automate energy trading and make it more trustworthy. By using smart contracts, we can make sure energy transactions happen quickly and with fewer costs. We will also use data analytics and devices that connect to the internet to better predict when we will have energy and how to use it efficiently. Our solution is to create a platform for renewable energy trading using blockchain. We will use technologies like Hyperledger Fabric and Ethereum to make sure everything works securely. Smart contracts will help with automatic energy trading, and AI will help us predict when we will have energy. Devices connected to the internet will give us real-time data to manage the energy grid better. With this plan, we want to make renewable energy trading easy and help the world switch to cleaner energy sources faster***

Keywords: decentralized, bug bounty, blockchain, Ethereum.

I. INTRODUCTION

Renewable energy sources are considered as a potential solution to achieve energy sustainability. They can be integrated on a large scale at the generation level or on a small scale at the distribution level of the grid. More and more countries are aiming to increase the installed capacity of these sources at the generation level. For example, India has set a target to achieve 175 GW and 450 GW of renewable energy capacity by 2022 and 2030. However, generation level integration requires a significant amount of upfront investment. That leads to the alternative option of installing renewable energy sources at the distribution level, as the localized energy generation and consumption minimize the requirement for expensive network upgrades. The integration of renewable generation at the distribution level faces challenges due to the lack of motivation in the energy users. The users receive less price for feeding excess power to the grid compared to the price paid for power consumption. Some of the feed-in-tariff schemes have been discontinued because of that reason, leading to the need for consumer-centric markets. In this scenario, decentralized energy trading can play a pivotal role as it allows the prosumers to trade surplus power at the desired rate, with the consumers willing to purchase off-grid power.

They receive benefits for investing in the generation and storage facilities. On the other side, consumers get the freedom to choose from multiple energy suppliers. They can choose based on the rate and source of energy, which leads to energy affordability and transparency. Decentralized energy trading encourages active customer participation resulting in customer empowerment in the energy sector and promotes energy self-sufficiency. A Blockchain can be defined as a dispersed log of all affairs that have taken place digitally and allocated among the engaging candidates. The system not only contains the information regarding all the events of the present but also of the past. The Blockchain will not mandate a change in the public log without the concession of most of the candidates within the system. The Blockchain can be classified into three groups, public, consortium, and private. As the name suggests, in public blockchain all the candidates can contribute and access, as for consortium, a cluster of candidates will be able to participate, whereas, for private blockchain, the access will be confined within the central organization itself. The first exploitation of Blockchain was done by Satoshi Nakamoto with the introduction of the infamous cryptocurrency Bitcoin, and up till now, it has the adequate utilization of the technology. Despite the prestige of blockchain in cryptocurrencies, it has found its exploitations in many other fields, such as digital transactions without the interpretations of any third-party agent as Bank, or in IoT (Internet of Things), Smart Contract or any general services.

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Motivated by environmental concerns related to climate change and associated financial incentives, homeowners in residential communities are shifting towards procuring locally deployed distributed energy resources (DERs) that seek to maximally utilize clean, renewable energy to accomplish their respective tasks.

Within residential communities, these DERs typically include: rooftop photovoltaic arrays (PV), plug-in electric vehicles (EV), smart thermostats (ST), as well as battery energy storage systems (BESS). These DERs offer many tangible benefits to the community, including increased energy efficiency, reduction of peak demand, increased resiliency from outages in the main grid, as well as a decreased carbon footprint.

However, these DERs can have unintended negative consequences if left uncontrolled. Previous work has investigated the negative impact of uncontrolled EV charging leading to overloading of local transformers, as well as uncontrolled PV generation leading to overvoltage violations. The addition of DERs to a home has indeed resulted in the vision of smart homes, however, there is a fundamental need for additional mechanisms that will coordinate and align the operation of smart home DERs to mitigate the aforementioned issues.

II. LITERATURE REVIEW

1) Alexandra Schneiders et al. proposed "Energy Cooperatives: A Missing Piece of the Peer-to-Peer Energy Regulation Puzzle" [2018]. Peer-to-peer (P2P) energy trading is emerging as a new mechanism for settling exchanges of energy between renewable energy generators and consumers. Often facilitated through distributed ledgers (‘blockchains’), it provides a mechanism for matching local supply and demand. Energy communities across Europe, including in the United Kingdom (UK), have realised the potential of this technology and are currently running pilots testing its applicability to P2P energy trading.

2) P. Devi Prasad et al. proposed "Energy Trading through Blockchain", [2019], Energy Trading through Blockchain is an innovative way to trade solar energy across different places. It enables the owners of solar plants to trade the solar energy that is been produced by their plants in an easy and utmost secure manner using Blockchain technology.

3) Muhammad Faizan et al. proposed "Decentralized Bottom-up Energy Trading using Ethereum as a Platform", [2019], In the past decade, there has been a significant increase of distributed energy resources. This transformation has rendered the grid more bidirectional and transformed many small consumers to prosumers.

4) Mel T. Devinea et al. proposed "Blockchain electricity trading using tokenised power delivery contracts" [2019], This paper proposes a new mechanism for forward selling renewable electricity generation. In this transactive framework, a wind or solar farm may directly sell to consumers a claim on their future power output in the form of nonfungible blockchain tokens.

5) Muhammad Usman Gurmani et al. proposed " Energy Trading Between Prosumer and Consumer in P2P Network Using Blockchain" [2020], Nowadays energy demand and energy production are increasing. Renewable energy resources will play an important role in managing future production of electricity due to an increase in the development of societies.

6) Abdul Ghaffar, et al. proposed " Energy Trading Between Prosumer and Consumer Using Blockchain" [2019], Centralized existing energy trading system totally relies on a central system or third party, because the third party has many drawbacks in the form of record tampering or record altering. The fair transaction is the main issue in the energy trading sector.

7) Rabiya khalid et al. proposed "A Blockchain-Based Load Balancing in Decentralized Hybrid P2P Energy Trading Market in Smart Grid" [2020], Local energy generation and peer to peer (P2P) energy trading in the local market can reduce the energy consumption cost, emission of harmful gases (as renewable energy sources are used to generate energy at user’s premises) and increase the smart grid resilience.

8) Adamu Sani Yahaya et al. proposed " Blockchain Based Sustainable Local Energy Trading Considering Home Energy Management and Demurrage Mechanism" [2020], t: With the increase in local energy generation from Renewable Energy Sources (RESs), the concept of decentralized peer-to-peer Local Energy Market (LEM) is becoming popular.

III.OBJECTIVES

1) To design and develop a robust and transparent blockchain-based framework for facilitating renewable energy trading.

2) To establish a reliable and scalable backend infrastructure using decentralized storage solutions, to store critical data related to energy production, consumption and trading.

3) This ensures data integrity, security and tamper resistance.

4) Implement smart contracts and consensus mechanisms that enable fair and efficient trading among participants.

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IV. LIMITATIONS

1) *Dependence on Energy Producers and Consumers:* The success of the renewable energy trading platform is reliant on the active participation of energy producers and consumers. A shortage of participants may limit the variety and availability of renewable energy resources on the platform.
2) *Blockchain Resource Requirements:* Utilizing blockchain technology can be resource-intensive, particularly in terms of computational power and energy consumption.
3) *Market Volatility:* The renewable energy market can be subject to price fluctuations and changes in supply and demand. These market dynamics may impact the stability and predictability of energy trading on the platform.
4) *Regulatory Compliance:* Compliance with regional and international regulations related to renewable energy trading may be complex and may vary from one jurisdiction to another. Ensuring legal compliance can be a significant challenge. •
5) *Interoperability:* Integrating with existing energy infrastructure and systems may be challenging due to compatibility issues.

V. CONCLUSION

In summation, these diverse studies collectively contribute to a growing body of knowledge, highlighting the versatility of blockchain in addressing the evolving challenges and opportunities within the energy sector. The findings underscore the potential for blockchain to play a pivotal role in fostering a more sustainable, efficient, and resilient future for energy trading. This body of research serves as a valuable resource for policymakers, researchers, and industry stakeholders seeking to navigate the complexities of the modern energy landscape.

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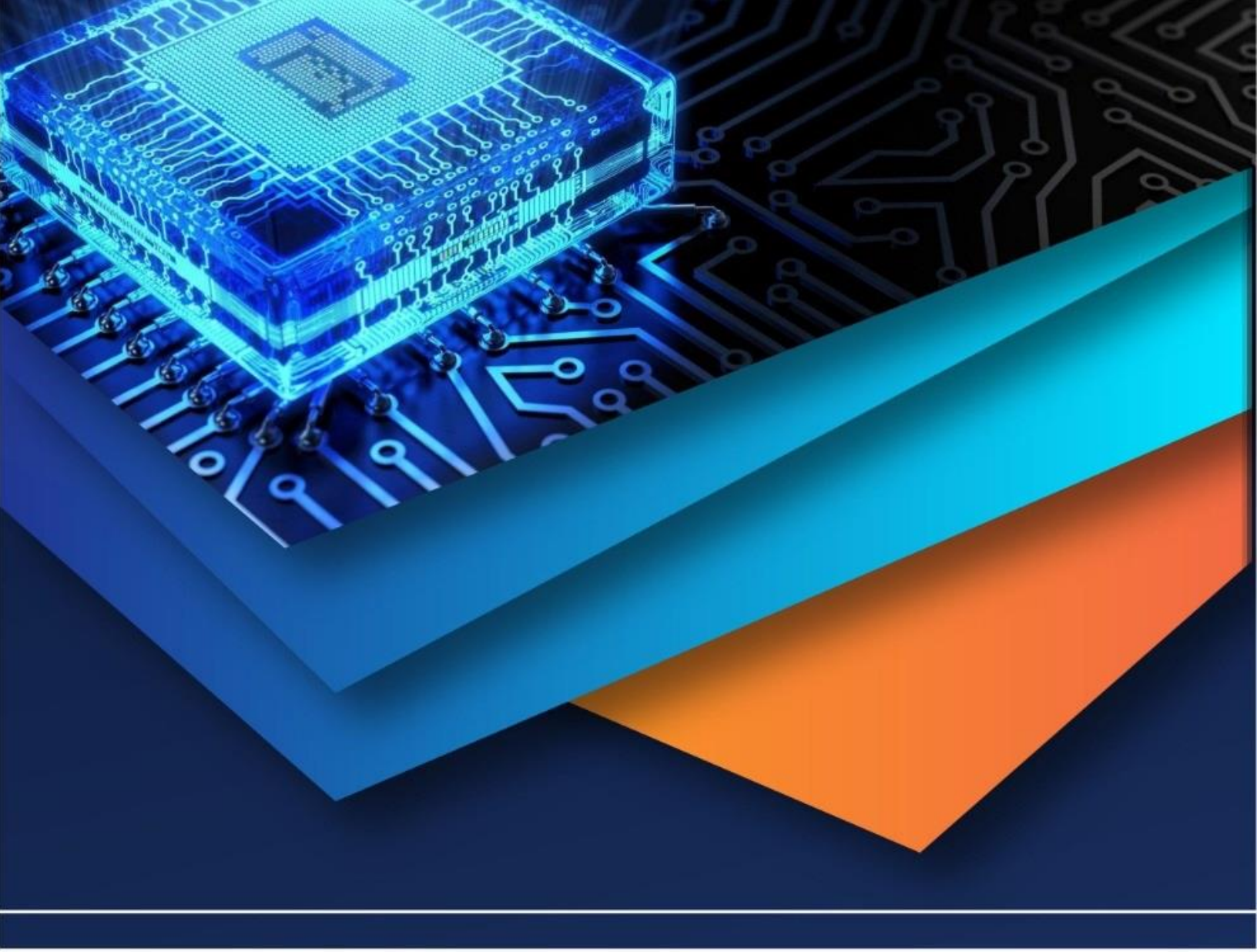

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