

APPLICATION OF BLOCKCHAIN IN ENERGY

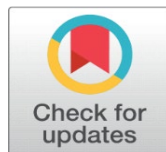
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ABSTRACT

Blockchain or distributed ledger technology has attracted great interest from companies in the energy industry. The combination of blockchain and energy is undoubtedly one of the most striking technological innovations in recent years. A typical application area of blockchain in the energy industry is trading and credit. Stakeholders use blockchain technology to promote distributed or wholesale energy transactions and create virtual grids. Consumers can trade between their own devices and resources, with their neighbors and with the grid. The whole process can be automated through smart contracts. In this article, we will discuss some use cases related to the application of blockchain in the energy field.

Keywords: Blockchain, Energy, Renewable Energy, Decentralization, Application

1. INTRODUCTION

Energy is the basic currency of the universe. As a matter of fact, the entire history of human civilization can be accurately described as the endless pursuit of meeting the increasing energy demand of mankind. Every major technological leap we have made in history is to some extent related to the discovery of new energy or the better use of existing energy. At the same time, our ability to use energy always depends on the construction, maintenance, and management of infrastructure [Yang et al. \(2021\)](#), [Xiao et al. \(2021\)](#), [Meshram et al. \(2021\)](#), [Esiner et al. \(2022\)](#), [Verma](#)

et al. (2021), Bisheh-Niasar et al. (2021), Shim (2022), Culqui-Culqui et al. (2022), Yavuz & Ozmen (2022), Li et al. (2022).

It is essential to use and accept renewable energy in order to address the increasing problem of global climate change. The exponential rise in conventional energy demand has made it difficult to utilize renewable energy on a significant scale. Hurricanes, floods, melting glaciers, forest fires, and other extreme weather events are just a few examples of how excessive use of fossil fuels and other conventional energy is having an influence on the planet's climate. The need for sustainable alternatives has grown recently as this devastating impact has worsened more than ever. Other, less obvious effects of excessive fossil fuel consumption include the melting of the polar ice caps, rising sea levels, heat waves, and depletion of the ozone layer. A few other factors come into play as well, including infrastructure, accessibility, knowledge of requirements and goals, and the initial expense of delaying the adoption of renewable energy. For instance, consumers won't be interested in purchasing electric vehicles until they are aware of their primary use. Even if some individuals comprehend, they may still run across issues like a lack of suppliers or charging stations in their neighbourhood. Finding a gas station close by and purchasing a gasoline vehicle will never be a problem. One thing to keep in mind in this situation is that difficulties in a particular area can be solved even if a charging station or supplier is built. Some additional variables also play a part in the mainstreaming of renewable energy. Suhail et al. (2021), Huang et al. (2021), Hou et al. (2021), Liu et al. (2022), Akleylek et al. (2021), Impedovo & Pirlo (2021), Li et al. (2022), Yang et al. (2021), Fouladi et al. (2022), Malekshah et al. (2021).

To tackle the difficulties, the renewable energy industry, like all other industries, has to integrate and use innovative technologies. More significantly, it appears that using blockchain in the energy industry or integrating it into the field of renewable energy would be the best way to utilize the technology. Blockchain is a distributed ledger system that uses a consensus process to function, doing away with the need for middlemen and creating a peer-to-peer network. Blockchain creates an immutable record utilizing the most advanced encryption technologies and stores it in a decentralized setting. Blockchain so makes it unnecessary for third parties to keep user data and enables the creation of a better, more transparent system. Many energy blockchain use cases are possible because various blockchain components, including nodes, smart contracts, and tokens, may be utilized to solve particular use case problems in different ways. This is the area where blockchain may have the most influence on the sector, particularly when used in conjunction with other cutting-edge technologies that have altered electricity production, distribution, and consumption. In order to establish the groundwork for the future energy network, blockchain is a very ideal technology.

2. METHODS TO SOLVE ENERGY CHALLENGES BASED ON BLOCKCHAIN

2.1. MICROGRID

The energy industry's blockchain has responded to the growth of micro-grid operated by small and medium-sized businesses by establishing peer-to-peer networks. The construction of microgrids has effectively distributed energy generation and ended reliance on the government. The microgrid can still provide all of the electricity needed in its own region even if the main grid goes down. If any microgrid fails, the main grid can still supply electricity to the region it serves. This

system does, however, have several drawbacks, including a lack of market awareness, a centralized authority, and political interference. An organization will be more interested in establishing renewable energy production facilities, such as wind turbines, to provide a sustainable supply if it can calculate the sustainable demand for energy. The energy industry's blockchain has responded to the growth of micro-grid operated by small and medium-sized businesses by establishing peer-to-peer networks. The construction of microgrids has effectively distributed energy generation and ended reliance on the government. The microgrid can still provide all of the electricity needed in its own region even if the main grid goes down. If any microgrid fails, the main grid can still supply electricity to the region it serves. This system does, however, have several drawbacks, including a lack of market awareness, a centralized authority, and political interference. An organization will be more interested in establishing renewable energy production facilities, such as wind turbines, to provide a sustainable supply if it can calculate the sustainable demand for energy.

2.2. SMART ELECTRICITY METER

A smart electricity meter is a tool for calculating energy rates and tracking energy use. These smart contracts in the blockchain ecosystem give data directly to the blockchain ledger rather than to any other entity. The prospect of data modification by other parties is therefore no longer relevant. Moreover, smart contracts may be used to operate these smart meters. Energy tariffs may be automatically calculated using smart contracts, which also offer charging transparency. The energy usage of certain houses may likewise be controlled by these smart contracts.

2.3. LACK OF MARKET VISIBILITY

The market for renewable energy is dispersed. It is difficult to connect these two entities in a decentralized market, whether the aim is to connect producers and sellers or vendors and customers. As a result, the use of blockchain as a market by the energy industry has evolved into a global platform where consumers, vendors, carriers, storage providers, and all other organizations can interact. The absence of communication between knowledgeable individuals and businesses is another perspective on market visibility. Most of the time, energy producers are unable to satisfy the needs of the finest transit or storage facilities. This is due to the absence of a market where all parties may congregate and communicate. In the past, producers of renewable energy had to set up local distribution networks, storage facilities, and transportation if they wanted to provide their services in other places. This procedure is sleepy, sluggish, and ineffective because it is carried out by phone or email. This relationship is not effectively digitalized since online communication is regarded as untrustworthy and there is always a chance of fraud. Yet this is now achievable because to the development of blockchain in the energy sector.

2.4. CENTRALIZATION

Decentralization is a well-known application of blockchain in the energy sector. Nowadays, major corporations or centralized bodies are in charge of the energy industry. The government, which oversees energy production and supply, sets the price of energy. As a result, the vendor becomes seriously dependent upon. The energy sector may become customer-centric thanks to blockchain technology. Energy consumption, payment, charge, and production interactions will all be

documented on the blockchain's immutable ledger. Because each entity will be held accountable for their acts, this fosters a feeling of accountability among entities. Moreover, the procedure may be made simpler by employing smart contracts. Several activities, including as the calculation of fees and taxes and the control of energy use, may be carried out according to clear and transparent standards by executing the pre-written code of specified functions and existing in the blockchain ledger in a given state.

2.5. LACK OF TRANSPARENCY

Several businesses claim to have employed cutting-edge technology to produce and consume fossil fuels more cleanly. They think that coal burning, for instance, will become cleaner and more effective. Since they incorrectly think that conventional resources can be used in a sustainable way, other businesses or regular people are unwilling to adopt alternative resources like wind or solar energy. The major difficulty here is to include facts and not simply presumptions. Even if fossil fuel consumption gets cleaner, it will never be as clean as what the climate now demands. Despite the fact that burning fossil fuels has a negligibly little impact on global warming, millions of tons of these fuels are used every year. So, using the hour system could make us persuade the world of the terrible consequences of fossil fuel usage and the importance of renewable energy. Thus, the lack of transparency and the inability to assess its worth are two of the biggest barriers to the adoption of renewable energy. Even if we track individual usage and demonstrate how it affects the climate, an online platform will lose its validity. Many people assume that this is a ruse used by environmental campaigners. This is the point at which the energy sector's blockchain value rises. Create a market powered by blockchain that can track consumption and its effects in real-time. The openness of industry use and individual awareness are the two biggest advantages of having such a market. The energy industry can track each individual action and offer real-time statistics on how these activities influence the environment by using the blockchain. For example, if a person sees that his daily vehicle use reduces the air quality index in his area by 0.01%, he will strive to cut back on his personal use. More importantly, if the public can see and trust the industry's carbon footprint, the industry will be forced to use sustainable energy in order to attract customers.

2.6. CARBON CREDIT TOKENIZATION

The carbon credit, which represents the company's permitted emissions of greenhouse gases, is equal to one metric ton of carbon dioxide. These are the credits that the government is offering as part of the cap and exchange program, which aims to reduce the amount of carbon dioxide produced by various businesses. In other words, carbon credits are used to quantify how much damage an organization causes to the atmosphere. The blockchain-based tokenization of carbon credits can be used to monetize non-current credit and inspire people. The need for more carbon credits will increase as industry consumption is made transparent. These carbon credits are available to the industry as tokens from individuals. In order to sell these credits to the industry, these people will consume less carbon dioxide than is permitted.

2.7. CROWDFUNDING

One of the most important barriers is the need for substantial investment in green energy infrastructure. Even if company owners are eager, they will be unable to acquire investment due to a lack of access to prospective investors. Investors, on the other hand, are unable to locate trustworthy initiatives. The blockchain-based community here links investors and businesses. Investors can directly provide liquidity to businesses and watch the use of these tokens in real time using the token-based method. Furthermore, transferring coins on blockchain-based apps will be a quick, dependable, and low-cost exchange.

3. ADVANTAGES OF SOLVING ENERGY CHALLENGES BASED ON BLOCKCHAIN

The first paragraph under each heading or subheading should be flush left, and subsequent paragraphs should have a five-space indentation. A colon is inserted before an equation is presented, but there is no punctuation following the equation. All equations are numbered and referred to in the text solely by a number enclosed in a round bracket (i.e., (3) reads as "equation 3"). Ensure that any miscellaneous numbering system you use in your paper cannot be confused with a reference [Esiner et al. \(2022\)](#) or an equation (3) designation.

The energy industry has several facets and provides support for businesses operating on many levels. The broader energy industry includes a number of subsectors, including the exploration and extraction of fossil fuels, power generating, and energy distribution. To coordinate activities and manage intricate multi-level supply chains, this intricacy necessitates trustworthy solutions. Participants in the industry must guarantee that local, national, and international regulations are followed because the energy sector is also subject to severe regulation. The increased need to promote sustainable development and clean energy presents another difficulty. Fortunately, the energy business can solve many of its problems by using blockchain technology.

3.1. REDUCE COSTS

The energy industry frequently relies on intricate supply chains and networks with several actors. For instance, there are several steps involved in the production and distribution of oil, including exploration, exploitation, refining, transportation, and marketing. Blockchain technology can assist the various parties involved in these tasks by ensuring frictionless communication, accelerating the procedure, and removing the supply chain's inefficiencies. The organization may experience significant cost reductions as a result of such optimization.

3.2. IMPROVE TRANSPARENCY

The ability of energy blockchain to increase multi-party networks' transparency is another useful characteristic. The data published on the blockchain ledger is simple to verify since every member of a certain blockchain network has a copy of it. Moreover, the blockchain's invariance makes sure that the data already kept in the ledger cannot be altered. Also, this may increase compliance throughout the sector. All of these things are possible without requiring the business to cede control of its private data. This is crucial in a sector where trade secrets are used often.

3.3. DECENTRALIZATION AND PROGRAMMABILITY

Peer-to-peer networks backed by blockchain technology may function without the oversight of centralized authority due to its decentralized nature. Moreover, smart contracts may be used to automate manage transactions between network users. In addition to conveying the idea of how blockchain might help innovation in the energy sector, this signifies the degree of security that can be attained in such systems.

In order to achieve more effective energy consumption, smart grids and meters may be adopted more quickly with the use of the energy blockchain. Also, this technology enables direct power grid connectivity for end users.

3.4. DIGITIZE

The capacity of blockchain technology to digitize tangible goods is another intriguing characteristic. Every asset may be converted to digital form and kept as tokens on the blockchain with the aid of smart contracts. This might alter the way in which energy commodities are traded and provide consumers new opportunities to exchange extra energy and carbon credits.

3.5 WHOLESALE ENERGY DISTRIBUTION

End-users' access to power may alter as a result of blockchain technology. By linking customers directly to the electricity grid, blockchain-based technologies can reduce or even eliminate the need for merchants. Customers may buy power at wholesale rates in this way, significantly lowering their utility expenditures.

3.6. PEER TO PEER ENERGY TRANSACTIONS

In the upcoming years, it is anticipated that there will be a major rise in energy storage capacity, which might lead to further changes in the way electricity is distributed. Families and condominiums that depend on the independent power supply system have the option of selling their extra energy to the grid. By supplying electricity to the peer-to-peer network of multiple power suppliers and purchasers, blockchain can enhance this idea's promotion. With the use of smart contracts, the blockchain-based technology may be used to track energy stockpiles and manage transactions between energy providers and customers. The creation of such platforms may be essential to enabling the mainstream adoption of renewable energy given the ongoing advancements in battery technology.

3.7. ENERGY TOKENIZATION

It is more likely to transition to a new dynamic of supply and demand with the aid of tokenization. " The way customers get, receive, and utilize energy might be drastically altered by digitalizing "extra energy" as a token that can be readily sold or converted back to energy supply. It can implement a practical pay-as-you-go system and encourage the creation of new marketplaces where "energy tokens" can be traded for commodities. By making the issue, distribution, and trading of carbon offset certificates simpler, tokenization can also aid in the tracking and reduction of carbon emissions.

3.8. ELECTRIC VEHICLE

The future electric car ecosystem may be constructed using the ideas mentioned above as a starting point. Networked car networks and charging stations that take part in the sharing economy can be powered by the blockchain in the energy industry. Energy tokens, which may be used at charging stations to purchase energy or swapped by both drivers and autonomous cars, will be used for the transaction in this type of economy.

3.9. REWARD THE USE OF RENEWABLE ENERGY

To make clean renewable energy financially feasible, it is necessary to promote its use. The government has historically used tax breaks and subsidies to encourage company activity in particular industries. Blockchain technology can also offer a means of promoting adoption among customers. The business can design incentive programs to offer energy tokens to consumers who select renewable energy as a reward.

4. CONCLUSION

Renewable energy adoption at the individual level is required to bring it into the mainstream, and energy blockchain use cases must be used to achieve this acceptance. Everyone has the ability to produce their own renewable energy and access a fair market, not only large corporations. Install solar panels at your house as an example. Even though such infrastructure requires a significant upfront investment, the majority of consumers prefer to stick with their current energy sources. But, if there is a method to make money from personal production, it will serve as an example to inspire others to invest in the infrastructure needed for renewable energy. In a truly decentralized society, even the production and consumption of energy are held and regulated by the people, and the use of blockchain in the energy sector is a prominent example of this.

CONFLICT OF INTERESTS

None.

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